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Arbeit, Digitalisierung und Organisation, No. 3

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Gina Glock

Algorithmic Decision-Making in Service Work

An Analysis of Changing Job Autonomy



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Volume 3

Gina Glock

Algorithmic Decision-Making in Service Work

An Analysis of Changing Job Autonomy



Nomos

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I am looking forward to what's ahead.

“My work comes to me in a completely automatic way, in the gestures of an automation. [...] But underneath this my mind never stops working. It lives by itself. Some call it dreaming, and if so, I am dreaming all day long, five days a week. [...] The whole bench dreams like this. It is a gallery of automations locked in dreams.”

From Bryan Slater's *On the line*
in Ronald Fraser's *Work: Twenty personal accounts* (1968, pp. 97–98).
Found in Amelia Horgan's *Lost in work. Escaping capitalism* (2021, p. 49).

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List of abbreviations

ADM	Algorithmic Decision-Making
AI	Artificial Intelligence
ANN	Artificial Neural Networks
BAuA	Federal Institute for Occupational Safety and Health
BIBB	Federal Institute for Vocational Education and Training
DA	Data analytics
DL	Deep learning
ETB	Employment Survey
GDPR	General Data Protection Regulation
HAS	Highly autonomous service
ICT	Information and Communications Technologies
JCI	Job Characteristic Inventory
JDC	Job Demand-Control Model
JD-R	Job Demands-Resources Model
JDS	Job Diagnostic Survey
KIS	Knowledge-intensive services
LAS	Less autonomous service
LEEP	Linked-Employer-Employee-Panel
LKIS	Less knowledge-intensive services
M	Mean
ML	Machine learning
NLP	Natural language processing
PEP	Personnel resource planning
PoC	Point of Care
pp	Percentage points
SD	Standard deviation
SOEP-IS	Socio-Economic Panel Innovation Sample
TBA	Task-based Approach
w/o	Without

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1. Introduction

Despite the forward-looking nature of debating the impact that Artificial Intelligence (AI) has on human labor, this thesis begins with a glance back into the past: In an essay from 1986, the social and occupational psychologist Marie Jahoda first addressed AI. Her analysis reflects tensions in the relationship between AI and humans that still apply today and are transferable to the world of work. Three quotations from this essay are intended to provide an opening explanation of some core ideas and the research focus of this thesis:

ARTIFICIAL INTELLIGENCE (AI) demonstrates the habitual state of every science – uncertainty and controversy – almost to the extreme. Few things are certain in this young and rapidly growing field and controversy within and without the AI community is sharp on major issues. (Jahoda, 1986, p. 333)

AI research is no longer considered young, as the term was first mentioned in a scientific context at the famous Dartmouth Conference in 1956. Regarding the discussion of work and AI within the social sciences, uncertainty and controversy are what remain; controversy, particularly with respect to the discourse on the opportunities and risks of AI for the economy and the working world, in which many public debates hardly go beyond superficial discussions. Expectations of the potential of AI are often high, while the actual risks for society and individuals are difficult to grasp. From workers' perspective, the key questions in dealing with AI must be to what extent (we are clearly beyond *whether*) this changed relation to technology leads to a shift in power towards employers. In what contexts can AI be a driver of inequality? Will AI be utilized to support workers, set the pace, or even take over certain tasks entirely? Are AI systems even capable of fulfilling these diverse expectations?

The crucial turning point was the realisation that computers were capable of more than 'number crunching': they were also competent manipulators of concepts and meaning. (Jahoda, 1986, p. 334)

There is no question that the research successes and applicability of AI in everyday life have seen enormous advances in recent years. The reasons for this include the availability of large amounts of data and lower costs for high computer performance. Today, digital and AI-based

systems are capable of more than simple data processing. In addition to fulfilling work routines in standardized settings, they are no longer just approaching intervention in cognitive and creative activities. They are already performing them. As a result, technical systems are potentially intervening in more areas of employees' work. The new capabilities of AI are the first reason to specifically address their influence on work situations. It is not only routine, easily formalized tasks or cognitive-creative work that is under pressure to change.

AI systems are also increasingly gaining access to the interaction components of work, be it in retail, finance, education, or healthcare – thus, in many work situations in which human skills have long retained sovereignty over work. The intervention in work action must be rethought as far as not only rule-guided, formalizable action but possibly also situation-related, experience-based action can be automated by an AI system. Will the new and rapidly changing capabilities of AI systems be reflected as a means of compressing and intensifying work if they can intervene in even more processes, or will workers establish new ways of retaining their self-determination?

Hopefully major decisions will never rely entirely on expert systems and they will remain tools not become masters. (Jahoda, 1986, p. 333)

Jahoda is only referring to the expert systems that were common at the time, i.e., strongly rule-based concepts, and not the approaches to learning AI that are widespread today. The impression that AI systems have already become the masters of work can already be derived from studying work models in which AI systems completely take over the planning and control, such as platform work or in logistics companies. In these examples, AI systems exert a massive influence on work processes by controlling, specifying, and evaluating them. Workers are sometimes only left with the role of an executing force. The question of AI impacting work is therefore also one of negotiating autonomy at work.

Ultimately, nothing less than the role of humans in work processes – and therefore also questions about the quality of work and the scope for action granted – is up for debate when using AI in the workplace. In particular, the change in job autonomy as a work resource reflects a central means of coping with work requirements and thus influences the well-being, creativity, and productivity of workers. Job autonomy and quality of work are directly linked in this context. Jahoda (1983, p. 141) emphasizes the priority of a “work situation in which the individual has a certain amount of control over the nature and speed of his [or

her] work, in which he [or she] understands the reasons for rules and orders”¹. Hence, it is the self-determined moments at work that make for positive experiences. They even facilitate the acceptance of difficult working conditions.

With little scope for action, work increasingly resembles dehumanized, monotonous work. In this sense, a lack of job autonomy with regard to work content and tasks can be a key driver of alienation (Jahoda, 1983, p. 129). If job autonomy is granted, by contrast, workers run the risk of being exposed to marketization as well as economization processes while no longer being able to escape them when management strategies are exploited accordingly.

Undoubtedly, a central difficulty in describing the relationship between AI and job autonomy is the extent to which work, its execution, and context, are permeated by autonomous and heteronomous moments. Jahoda (1983, pp. 69–70) emphasizes the distinction between voluntary and involuntary actions in working environments. Dependent employees in particular cannot escape heteronomous boundaries within the prevailing economic system (Jahoda, 1983, p. 116). The feeling of self-determined work can therefore only come to fruition within the relationship between autonomy and heteronomy in the workplace. It is crucial that the direct organization of an individual’s work can be co-determined (Jahoda, 1983, p. 117), more so if technical and organizational interventions are undertaken in work processes.

This thesis “Algorithmic Decision-Making in Service Work. An Analysis of Changing Job Autonomy” examines the complex relationship between job autonomy and using novel AI systems. The main question is: What impact does using ADM systems, as a specification of AI systems, have on the job autonomy of employees in the service sector? In this way, this thesis also aims to clarify the conditions under which positive experiences of job autonomy can be created.

The concept of job autonomy used has a direct reference to action. This includes the understanding of job autonomy as autonomy at work, i.e., *the possibility of determining the courses of action in relation to an individual’s own work processes*. This concept of job autonomy is extended by selected dimensions relating to work tasks, methods, objectives, scheduling, working time and place, and interaction.

1 Own translation of “Arbeitssituation, in der der einzelne eine gewisse Kontrolle über Art und Geschwindigkeit seiner Tätigkeit hat, in der er die Gründe für Regeln und Anordnungen versteht” (Jahoda, 1983, p. 141).

Job autonomy is anchored in the sociological research on work as it represents an essential workplace resource and, in this role, can be utilized as an adjusting screw for motivating or stress-reducing developments. The positive influence of autonomy in the workplace has been proven for several motivational factors: organizational commitment (e.g., Park & Searcy, 2012), work engagement (e.g., Spiegelare et al., 2016), creativity (e.g., Sia & Appu, 2015), job satisfaction (e.g., Wheatley, 2017), and performance (e.g., Langfred & Moye, 2004), among others. Job autonomy also has a strengthening effect on well-being in that it can have a mitigating effect on strain (e.g., Bakker & Demerouti, 2007), work pressure (e.g., Carayon, 2006), or delimitation (e.g., Voydanoff, 2004).

In this thesis, job autonomy explicitly includes an interactional component that reflects the dependence on third parties at work. A high proportion and intensity of interaction at work is considered to be the core element of service work, although there is no consensus on the definition of both terms, service and interaction work, due to their wide variety and interpretations. Interaction work plays a particularly key role in the service sector, as working on and with people creates meaningful and motivating resources on the one hand but also demanding work situations on the other. It is true that interaction work has not always been given the appropriate attention and importance. However, Arlie Hochschild's reflections on "The Managed Heart" (1983) were the most significant to break through this view and reframe the understanding regarding the impact of interaction work in work processes (Korczyński, 2013, p. 2).

The inclusion of using AI in the workplace in the topic of job autonomy in the service sector is likewise hampered by definitional ambiguities. This is why some types of data analysis are misused for marketing purposes and falsely labeled as AI. However, as soon as regulatory measures on AI take effect, it is also possible that AI will be *argued out* of technical systems. What is more evident in the current use of language is predominantly the attempt to emphasize the supposedly (super)human capabilities of AI systems (language of anthropomorphism, Wajcman, 2017, pp. 121–122). Put similarly: "The result [of massive media exposure and commentary] has been a sometimes incomprehensible mixture of careful, evidence-based analysis, together with hype, speculation and what might be characterized as outright fear-mongering" (Ford, 2018, p. 2).

In this respect, it is necessary to depart early from the term "AI", not only because no (interdisciplinary) definition of AI has yet been established or because the concept of intelligence has proved to be debatable. This thesis deals with technical systems that are already being used in

the working world. These can be limited to *algorithmic decision-making (ADM)*, i.e., *rule-based or learning technical systems that have an algorithm at their core as a decision-maker*. This conceptual limitation already offers a less complex approach to understanding the influence of novel technical systems on work.

The aim of this thesis is to analyze the impact of ADM systems on job autonomy. The focus lies on the service sector, which partly adapts recent technologies with a certain time lag compared to manufacturing but which seems particularly attractive for such an analysis due to its professional diversity, employment strength, and the wide range of different forms of organization and task profiles. As a prerequisite for the empirical analysis, the concept of job autonomy and related dimensions are analyzed in depth in the context of modern working environments.

The methodical approach taken to address this complex of issues is a multi-method concept consisting of quantitative and qualitative elements. Building on the attempt to quantify job autonomy using a representative survey of workers, two company case studies (outpatient care and banking services) are presented to describe the influence of currently deployed ADM systems on job autonomy. This approach asks strictly about the *subjective experience of job autonomy* in the performance of work. The perceived autonomy at work results from the specific combination of demands and resources and ultimately also the psychological predisposition of the individual (Self-Determination Theory, Ryan & Deci, 2000).

The number of studies that show a connection between job autonomy and digitalization, let alone AI, is still limited. What is visible is that the current discourse on the impact of AI on working environments and conditions is increasingly focused on the change in job autonomy (e.g., Butollo, Jürgens, & Krzywdzinski, 2018; Gensler & Abendroth, 2021; Giering & Kirchner, 2021; Kirchner et al., 2020; S.-C. Meyer et al., 2019; Nies, 2021). Pessimistic voices assume a massive expansion of control mechanisms at the workplace and, in the worst case, assign workers no role or only an assistive one in AI-dominated environments; in the better case, they are equal to AI systems and work together with their new “AI colleague” (e.g., Gröner & Heinecke, 2019). More optimistic voices further support the narrative of emerging freedoms for workers, relieving them from tedious work tasks, releasing potential for productivity and creativity, and helping workers to achieve a new sense of self-determination that translates into less work (e.g., Kirchner et al., 2020).

These excerpts from the AI discourse not only illustrate that extremely conflicting views on the impact of AI in the world of work

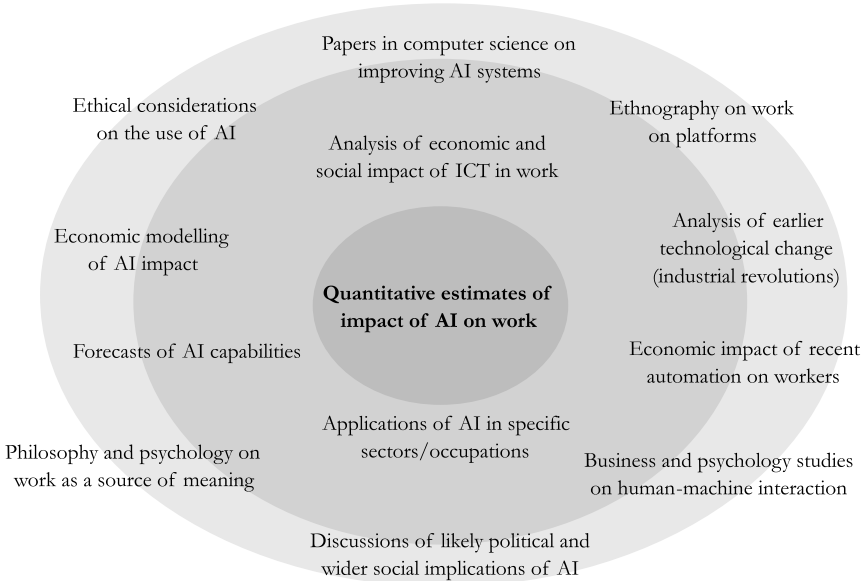
prevail. They also suggest that new polarizations and inequalities are emerging from these areas of tension, in which some workers are gaining in terms of new self-determination and others might (further) lose opportunities for action. This thesis aims to provide an empirically based contribution to clarifying this area of uncertainty.

To systematically examine the relationship between job autonomy and AI, this thesis offers four parts that build on each other: Part I forms the theoretical-conceptual basis, sharpens central terms, and provides an interpretative framework for the corporate utilization of job autonomy. Part II, as a first empirical approach, quantifies job autonomy in the service sector, thus establishing comparability and attempting to isolate the first potential links to AI. Part III is the main empirical contribution within two company case studies, in which current AI systems applied in the service sector are examined for their influence on job autonomy. Part IV concludes the analysis of this thesis, deriving the core impacts of AI on job autonomy for service work and thus opening courses of action for social, economic, and political decision-makers. Chap. 1 initially forms the thematic introduction to this main section and, in particular, sets out the relevance and embedding of job autonomy in organizations and work processes. A detailed formulation of the research objectives and structure is provided in Chap. 2.

Whether and to what extent AI brings about radical changes in relation to work remains to be seen – and is analyzed in this thesis. What is clear is that the transformative nature of AI is not fundamentally “inevitable, necessary or historically unprecedented” (Boyd & Holton, 2018, p.334). Ultimately, the influence of AI on work must also be viewed as a socio-technical project of change (Hirsch-Kreinsen, 2023, p.330) that allows for, indeed absolutely requires, social and political influence. This thesis contributes to this formative process.

1.1. The necessity of a sociological lens on AI

While research on the effects of AI on work, although still limited in quantity, has its roots primarily in computer science, economics, and social sciences, many attempts at considering the interplay of AI and work are limited to a handful of indicators of employment and productivity development or human-machine interaction (Figure 1). In the public discourse, economic issues in particular are present in the discussion of AI (Fischer & Puschmann, 2021, p. 18). A comprehensive, empirically based assessment of the effects of using AI in the workplace is still pending (Deutscher Bundestag, 2020, p.282). In absolute terms, quantitative es-

Figure 1: Dominating research attempts regarding AI and work

Source: Frontier Economics (2018, p. 13).

timates of AI impacting employment (e.g., Bonin et al., 2015; Felten et al., 2019; C. B. Frey & Osborne, 2017), qualification needs (e.g., André et al., 2021; Rammer, 2022; Squicciarini & Nachtigall, 2021; Susskind & Susskind, 2015), or the future economic capabilities of AI applications (e.g., Aghion et al., 2017; Agrawal et al., 2018; Brynjolfsson & McAfee, 2014; Daugherty & Wilson, 2018) have dominated so far. Attempts to transfer knowledge from earlier phases of automation waves are contributing (e.g., Acemoglu & Restrepo, 2018, 2019; Bessen, 2019; Nedelkoska & Quintini, 2018), as are ethical considerations regarding the application of AI systems in society (e.g., Ada Lovelace Institute, 2022; Liao, 2020; Munn, 2023). Comprehensive studies from the social sciences that deal with the concrete effects of using AI on workers and working environments are limited in number and depth.

Some reasons for this research gap are grounded both in the small spread of AI-based systems to date and in the time necessary for reliable studies to be conducted. However, the current scientific discourse on AI appears to be reminiscent of technological determinism in research. The economic and technical perspectives dominate. A sociological voice re-

ceives little public attention – even though it obviously exists. To fill this research gap with even more life from the perspective of the sociology of work is a designated goal of this thesis.

From a historical point of view, waves of technological innovation are often characterized by both visionary and skeptical expectations of its effects on society, business, or specific social formations. In the case of AI, the existing conceptual indeterminacy and ambiguity add difficulties to the precise analysis of AI. The absence of a consensual definition of AI is also due to the fact that “There is basically no consensus on the place, function, and operating mode of natural intelligence”² (Rammert, 1995, p. 9). Some popular AI definitions will be taken up in later chapters. At their core, these will cover ADM systems, i.e., rule-based or learning technical systems that have an algorithm at their core as a decision-maker.

However, whether technology qualifies as intelligent is not the subject of discussion in this thesis.³ Suffice it to say that “Computers are intelligent precisely when we think they are. [...] On the basis of which processes and in which social contexts is intelligence attributed to them?”⁴ (Heintz, 1995, p. 49). Heintz (1995, p. 51) shifts the focus of debating AI from the questions of what machine intelligence is and whether it is comparable to human intelligence to the social embedding of AI applications. R. D. Schwartz (1989, p. 187) adds that sociology can provide new perspectives on AI and assumes that AI applications act in social situations and thus intervene in them.

Since the beginning of research on the concept of AI, the social sciences and humanities, predominantly philosophy and psychology (Heintz, 1995, p. 48), have only been marginally involved in its further development and discussion. If there was any mention of a sociological approach to AI at all, it was in the form of asking how AI relates to society (e.g., acceptance of and expectations towards AI), but not its genesis (Heintz, 1995, p. 48; Woolgar, 1985, p. 558). The status quo seems to have changed only slightly, as Rezaev et al. (2018, p. 368) pointedly state: “What is most striking about sociological literature on AI is how small it is”.

2 Own translation of “Über den Ort, die Funktion und die Operationsweise der ‘natürlichen Intelligenz’ besteht im Grunde keine Einigkeit” (Rammert, 1995, p. 9).

3 Joseph Weizenbaum (1976) already assumed that the type of intelligence that can be transferred to a computer is limited and that a comparison with human intelligence is inappropriate. This takes up the still valid theory that AI systems are only functional and adaptive to a limited extent in closed, predefined situations and domains.

4 Own translation of “Computer sind genau dann intelligent, wenn wir der Meinung sind, sie seien es. [...] Aufgrund welcher Prozesse und in welchen sozialen Kontexten wird ihnen Intelligenz zugeschrieben?” (Heintz, 1995, p. 49).

Overall, sociology's engagement with AI is extremely patchy (Mlynář et al., 2018, pp.130–134). Some contributions also deal with AI as a methodological tool or as an aid for theory development in sociology; exemplary is the contribution of Malsch et al. (1996) to Socionics, who moved into the border area between computer science and sociology, discussing the potentials of collaboration between the two disciplines. However, from a long-term perspective, sociology has played only a minor role in research on AI.

The new dimension of AI abilities, i.e., learning from vast amounts of data and autonomous decision-making, defines the most substantial difference from previous transformations of work environments. For the time being, the question remains open as to what *bounty* (Brynjolfsson & McAfee, 2014, p. 11), i.e., what social and economic benefits, will result from this change (and for whom). Certainly, there is a risk of further polarization of *lousy and lovely* jobs (Goos & Manning, 2007), which also threatens to intensify social inequality.

Hence, the sociology of work naturally has a great interest in the question of the embedding and impact of AI applications in work environments. In fact, the sociology of work *needs* to address the AI issue because it implies a question of both economic distribution and inequality that must be determined in a process of social negotiation. Regarding the possibilities, consequences, and conditions of AI and work, the focus of a sociological discussion of work should not only lie on the consequences of using AI for workers but also on the organizational conditions under which these possible effects might come to fruition.

Thus, questions about the change in work processes are just as central as the embedding of AI in organizational constellations and dealing with uncertainties. It is important to analyze how the use of AI manifests and expresses itself on a task, organizational, and social level. From the perspective of workers, these questions become concrete in the description of changes in the tasks and processes they perform, the work environments and situations in which they operate, the organizational and company structures they are given, and their positioning and status in society.

Job autonomy – as the object of interest in this thesis – can be considered on a wide variety of these levels. The change in job autonomy describes the change in the position of employees in the organizational and technological structure of work environments. It can characterize the relationship and division of tasks between workers and machines, be used as a motivational but also a control instrument by companies, and thus serve as an important indicator for the change in working relationships among entire groups of employees.

Using AI in the workplace is likewise a question of job quality. It is essentially a sociological one, since at the macro level it asks about changes in the conditions of work. Ultimately, altering the relationship between people and technology in the workplace also implies a change in the relationship between work and capital and thus in working conditions, which not only affects people's social position but also their private sphere of life, well-being, health, and contentment.

The intervention of AI in work can thus be understood as a question of social equality and distribution. After all, AI-based systems are embedded in prevailing social, economic, political, and cultural structures (Crawford, 2021, p. 211). For this thesis, the main question is how using AI systems might affect the job autonomy of service workers, which implies questioning the role of employees in the work process. As will be shown later, the use of AI is reflected very differently in work processes depending on the depth of the intervention.

With a view to the macroeconomic perspective and the deepening of social inequality structures, it is striking that a number of renowned economists have been warning of increasing inequality through the use of AI for some time. Acemoglu (2021), for example, describes that the unregulated use of these systems in particular harbors a number of social, economic, and political dangers, which are expressed essentially through increasing income inequality, or rather, the potential lowering of wages. Acemoglu (2021, p. 4) emphasizes the potentially altered power structures and downward tendencies of unregulated AI: "Put differently, AI's harms are harms of unregulated AI". Agrawal et al. (2018, pp. 223–224) go on to state that AI use at the societal level is always expressed as a trade-off problem: intensification of competition between employees and (skill-biased) polarizations in the labor market (productivity vs. distribution) or monopolization tendencies in data and technology (innovation vs. competition). The danger of increasing income inequality (e.g., also Felten et al., 2019) plays a central role in these considerations.

M. Lane and Saint-Martin (2021, p. 27) note that even if AI were to increase productivity, which is not visible at present, it is not synonymous with a fair distribution of these gains. Classic productivity effects on labor demand and wages can be overshadowed by displacement effects and vice versa (e.g., Acemoglu & Restrepo, 2018, pp. 6–8). In general, economists disagree on the direction of the impact of AI on employment and wages due to several overlapping effects (overview in Menzel & Winkler, 2018). M. Lane and Saint-Martin (2021, p. 32) aptly summarize that "the impacts on inequality should not be underestimated as there is no reason to believe that the displacement effects, productivity effects and emergence of new labor-intensive jobs will be distributed

evenly across industries, regions, and socio-demographic groups”. What is agreed, however, is that a broad welfare gain is hardly possible without redistribution (Korinek & Stiglitz, 2017, pp. 38–39).

The scientific and political debate on the potential of AI emphasizes its primarily economic direction of thought (e.g., Büchel et al., 2021). These possibilities translate into growth and productivity opportunities. To what extent working conditions could potentially change in this process remains (as so often) largely unnoticed. Not surprisingly, many workers’ councils consider using AI in a professional context to be untrustworthy (Deutscher Gewerkschaftsbund [DGB] & Hans-Böckler-Stiftung [HBS], 2022, p. 44). This assessment may be influenced by the fact that there is sometimes little knowledge about the functioning of AI systems. However, the doubt about the benefits of these systems for employees is justified as long as the goals of AI use (or the use of other assistance systems) are not always clearly communicated, which in any case only raises questions of co-determination for employees in whose companies it is permitted. In the service sector, in particular, many employees have little or no influence on the way digital technology is used in the workplace (Institut DGB-Index Gute Arbeit [DGB-Index], 2022b, p. 34). In this respect, too, the use of recent technologies is likely to affect job autonomy.

1.2. Avoiding confusion: workers’ autonomy and machine automation

The term “autonomy” derives from the ancient Greek *autós* (self) and *nómos* (law) and translates to self-legislation, or alternatively, self-determination. Applied to the world of work, this thesis understands job autonomy as *autonomy at work*, i.e., *the possibility of determining the courses of action in relation to an individual’s own work processes*. The heteronomous moments lie in the embedding of work in the network of market supply and demand, organizational structures in the company, cooperation and relationships with other workers, the interplay between the private and the professional working world, and much more. Looking back at the historical changes in the organization of work, it is important to note that work today is more autonomous – for example, in terms of flexible work content, time, and place. According to M. Frey (2009, p. 26), autonomy forms the counter-concept to heteronomy, i.e., variations of organization that are characterized by a high degree of planned work and a low degree of subjective influence on the part of the worker. In this context, job autonomy is considered a prerequisite for bringing subjectivity into work.

The idea of establishing a higher degree of job autonomy is fundamentally a counter-draft to Tayloristically influenced ways of working during the *humanization of the world of work* approach in the 1970s and 1980s (Bundeszentrale für politische Bildung [bpb], 2011; Georg & Guhlemann, 2020). Ever since, job autonomy has gained importance in the context of self-determination and self-organization in modern work. Job autonomy, as defined in this thesis, is never viewed as a standalone characteristic of work but as a construct that reflects the relationship and dependencies between workers and their environment.

The situation of ideal job autonomy is difficult to imagine – it is probably non-existent. The term “dependent employment” already implies a form of heteronomy. Even self-employed persons are not free from external constraints but are dependent on the cooperation with third parties, such as clients. In this sense, Sichler (2005, p.106) concludes that autonomy does not describe the possibility of being able to act freely without any external or internal restrictions.

As these reflections indicate, the overall scientific debate on job autonomy is extremely diverse. There is no single mutually agreed-upon definition. Peters (2001, p.20) highlights that the concept of autonomy has different meanings and that when autonomy is mentioned in work, often very different ideas about the term apply. Common research approaches mostly originate from the fields of sociology, economics, psychology, and philosophy. Depending on the field, job autonomy can have different dimensions and meanings. Therefore, the terms used to describe aspects of job autonomy vary depending on perspective and discipline. Following Warr (1994, p. 87), these may include: discretion, decision latitude, independence, job control, self-determination, personal control, absence of close supervision, or participation in decision-making. Although these terms are not to be understood as synonyms, they are all considered to conceptualize aspects of job autonomy to obtain a holistic picture of its dimensions and characteristics (Chap. 4).

In the German-speaking world, variations of the terms *scope of task* (Tätigkeitsspielraum), *scope of action* (Handlungsspielraum), *scope of design* (Gestaltungsspielraum), and *scope of decision-making* (Entscheidungsspielraum), originating from the field of occupational psychology, are often used interchangeably to describe job autonomy. According to Ulich (1988, as cited in Ulich, 2001, p.175), all scopes fall under the umbrella term *scope of task* (also Chap. 4.1). In the following⁵, the term

5 Since the term *scope for action* is more common in English-speaking literature as an alternative description for job autonomy, it is applied in the following to comply with a certain linguistic variation.

“job autonomy” is used whenever appropriate to describe autonomy at work, i.e., the possibility of determining the courses of action in relation to an individual’s own work processes.

While the synonymous use of various terms intended to address job autonomy in sociology, psychology, or economics essentially addresses comparable concepts, this does not apply to computer science and other technology-related domains. In particular, the synonymous use of the term in relation to the scope of action for humans and the functions of machines in socio-technical systems proves problematic for the analysis envisaged in this thesis. More precisely, it is the use of the term autonomy to describe the degree of automation of machines that must be distinguished, because autonomy as a term for self-legislation as described above is by definition to be attributed only to humans.

A description of autonomy from political science adequately presents the special features of human decision-making and allows a transfer to the discussion conducted. According to Müller-Mall (2020, p.30), human autonomy essentially consists of the possibility to think and act in a self-determined way:

This includes the possibility of always deciding anew and differently, to act irrationally or not at all. And it includes being able to orient oneself in one’s decisions and actions to personal standards. At the same time, autonomy understood in this way also provides the condition for being able to take responsibility for one’s own actions.⁶

These considerations highlight the essential difference between humans and machines in terms of autonomy and decision-making at the workplace. Autonomous decision-making can follow an irrational, non-rule-bound principle for workers, while a machine is necessarily bound by its somewhat rule-bound nature. Novel systems of AI are somewhat liberated from this rule-boundness.

The use of the term “autonomy”, however, is not applied to machine capabilities in the following. According to Rammert (2003, p. 6), humans and machines stand in a dichotomous relationship with each other. If autonomy implies self-determination, the concept of autonomy can only

6 Own translation of “Dies schließt die Möglichkeit ein, sich immer wieder neu und anders zu entscheiden, irrational oder auch überhaupt nicht zu handeln. Und es schließt ein, sich in seinen Entscheidungen und Handlungen an eigenen Maßstäben orientieren zu können. Gleichzeitig liefert eine so verstandene Autonomie auch die Bedingung dafür, für sein eigenes Tun Verantwortung übernehmen zu können” (Müller-Mall, 2020, p. 30).

be applied to humans and rarely to machines. The use of the term “autonomous machines” is sufficiently misleading. Autonomous machines signify machines that have achieved a certain degree of automation and give the impression of independent action.

The strengths of AI systems in the work context have so far been within relatively static environments and clearly determined situations in which probability-based decisions can be made or decision recommendations provided. In contrast, the strengths of workers’ action come to the fore, especially in their ability to act autonomously in dynamic situations, which, for example, require a certain capacity for abstraction, flexibility, and intuition. Brödner (2019, p. 89) emphasizes that humans are assumed to have a certain intentionality in their actions with regard to the fulfillment of a certain objective, whereas machines act in a strictly pre-determined manner. Brödner (2019, pp. 90–92) further summarizes the limitations of these machines and systems by pointing out that so-called autonomous systems do not determine their tasks and actions themselves and therefore cannot be described as autonomous. This statement, however, should not be confused with the fact that automated systems are not being granted increasingly greater degrees of freedom (Papsdorf, 2019, p. 51). These new degrees of freedom define the extent to which machines can intervene in human work systems and processes (Chap. 3).

1.3. Framing job autonomy in the organization of work

Back in the 1970s, during the transformational movements of labor, Cummings and Molloy (1977, p. 6) described job autonomy as “the most frequently changed of all organizational variables”. However, “Conceptualizations of autonomy reflect the historical and economic environment of organizations. For instance, in the 1970s most developed economies were predominantly based on manufacturing with employees working on traditional assembly lines” (Gagné & Bhawe, 2011, p. 164). In fact, the analysis of job autonomy has been particularly popular since the 1970s in the context of research on job redesign⁷ which identifies job autonomy as a key driver for motivating employees and enabling

⁷ Early approaches to reorganize cooperation and division of labor include, for example, the quantitative increase of work diversity (e.g., job rotation, job enlargement) or the qualitative expansion of work content (e.g., job enrichment, semi-autonomous work in groups).

performance gains within organizations. Job redesign refers to the attempt to restructure workplaces, which, due to their orientation towards Tayloristic work systems, led to alienation from work (e.g., Sims et al., 1976) and a decrease in the motivation and performance of employees (e.g., Hackman & Oldham, 1975). The three model approaches outlined in the following are intended to exemplify the organizational embedding of job autonomy from this research perspective:

- The Job Diagnostic Survey (JDS), more commonly known as the “Job Characteristics Model” by Hackman and Oldham (1975), emphasizes the importance of autonomy for employee performance, satisfaction at work, and job involvement. Without the presence of job autonomy, no work motivation can arise. Hackman and Oldham (1975, p.162) characterize job autonomy as “The degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out”. The authors name five dimensions of job characteristics that enable so-called critical psychological states of employees (e.g., perceived meaningfulness of work) – one of which is autonomy. Accordingly, autonomy is positively related to the experienced responsibility for outcomes of the work, i.e., “The degree to which the employee feels personally accountable and responsible for the results of the work he or she does” (Hackman & Oldham, 1975, p.162).
- With the Job Characteristic Inventory (JCI), Sims et al. (1976) intend to evaluate how selected characteristics of a job, such as autonomy, influence productivity, motivation, and overall job satisfaction. Their definition of autonomy is derived from Hackman and Lawler (1971, p.265) and describes “The extent to which employees have a major say in scheduling their work, selecting the equipment they will use, and deciding on procedures to be followed” (Sims et al., 1976, p.197). In this model, the time- and method-related elements of job autonomy are emphasized. Additionally, the choice of work equipment is included.
- The conceptualization of job autonomy by Breugh (1985) differs from JDS and JCI in that it makes a distinction between three concrete autonomy dimensions: Breugh’s attempt to measure job autonomy approaches work method autonomy, work scheduling autonomy, and work criteria autonomy. Work method autonomy refers to the scope of personal discretion while choosing work methods. Work scheduling autonomy is defined as the ability to independently sequence tasks. Work criteria autonomy describes the opportunity

to individually choose work performance criteria (Breugh, 1985, p. 556). The distinctive feature of Breugh's approach is that he not only defines three applicable autonomy dimensions but also specifically operationalizes them (also Chap. 7.1).

Reviewing the selected definitions of job autonomy originating in job redesign research from the 1970s and 1980s, it becomes apparent that a limited understanding of job autonomy was predominant. Its justification in typical Tayloristic work systems becomes as clear as its essential limitation to Breugh's (1985) three dimensions of job autonomy. Nevertheless, the above-mentioned dimensions have not lost their significance today. Rather, they must be supplemented by other elements that reflect today's working world.

The 1970s also saw the emergence of research into the tensions between work demands and work resources, that is, the demands that workers must meet and the resources that they have at their disposal to cope with these demands. The following two model approaches show their mutual relationship and thus allow conclusions to be drawn about the embedding of job autonomy in the interplay of demands and resources:

- The Job Demand-Control Model (JDC), also known as the "Job Strain Model" following Karasek (1979), aims to analyze stress factors for employees in order to derive health-promoting measures. Karasek (1979, pp. 287–290) compares job demands with given job decision latitude (i.e., job autonomy) and defines the latter as "the constraint which modulates the release or transformation of 'stress' (potential energy) into the energy of action. [...] Job decision latitude is defined as the working individual's potential control over his tasks and his conduct during the working day". High work demands lead to high stress for employees when the existing job decision latitude is low. If both high demands and high job decision latitude are present, a motivational push occurs (Karasek, 1979, pp. 287–289). Karasek's assumptions implied that high work demands do not necessarily have to be accompanied by high strain, but that the outcomes depend on the extent of job autonomy.
- The JDC is extended by Demerouti et al. (2001) with the Job Demands-Resources Model (JD-R), which relates job demands to job resources, taking into account individual, social, and organizational variables that may have positive or negative effects on employees. Job strains result from an imbalance between demands and resources. According to Demerouti et al. (2001, p. 501), job demands "refer to those physical, social or organizational aspects of the job that require

sustained physical or mental effort and are therefore associated with certain physiological and psychological costs". In contrast, job resources, which include job autonomy, are considered "physical, psychological, social, or organizational aspects of the job that may do any of the following: (a) be functional in achieving work goals; (b) reduce job demands at the associated physiological and psychological costs; (c) stimulate personal growth and development". According to Bakker and Demerouti (2007, pp.312–314), job resources may act as a counterbalance to job demands.

These conceptual embeddings of job autonomy in work organizations assign distinct roles, functions, and dimensions to job autonomy. They all set their own definitions of job autonomy and, in some cases, even named specific dimensions of the concept. Thereby, they form the starting point for the conceptual reformulation of autonomy that meets the demands of work today (Chap. 4).

1.4. Relevance and extent of job autonomy

The effects of changes in job autonomy can be manifold for both workers and companies. Selected frameworks that cover research on the organization of work identify job autonomy as a key enabling factor for positive personal (such as motivation or strain reduction, e.g., Demerouti et al., 2001) or organizational outcomes (such as productivity, e.g., Hackman & Oldham, 1975; Sims et al., 1976). Its ascribed resource quality assigns job autonomy a possible role in reducing work tensions, i.e., an imbalance between work demands and resources.

To illustrate the relevance of job autonomy, it is particularly useful to consider job autonomy as a job resource. Following the logic of the JD-R model, high job resources may have positive effects on personal and organizational outcomes as well as a mitigating effect on strain and its negative consequences. According to a comprehensive literature study by Spector (1986, p.1011), positive relations between job autonomy are found for job satisfaction, commitment, job involvement, performance, and motivation. In contrast, mitigating effects are found for physical symptoms, emotional distress, turnover rate, and absenteeism. Likewise, interdependencies between job autonomy and other job resources such as self-efficacy, learning opportunities, and role breadth have been empirically proven (e.g., Den Hartog & Belschak, 2012, pp.197–199; Morgeson et al., 2005, p.402; Sousa et al., 2012, pp.165–167; Wielenga-Meijer et al., 2012, pp.16–17).

The following paragraphs summarize selected studies that elaborate on the importance of job autonomy in relation to stress, motivation, and personal and organizational outcomes:

Relation to job strain

- According to Karasek (1979) and Demerouti et al. (2001), job resources mitigate the negative effects of job demands. This assumption may also apply to the relationship between job autonomy and job strain. The combination of low job autonomy and high job demands leads to mental strain. Carayon and Zijlstra (1999, pp. 40–43) further differentiate between workers’ control over work tasks and resources, which, if present, also have a mitigating effect on work pressure. Furthermore, based on a low to medium level of autonomy among workers, it is assumed that in the case of an autonomy expansion, the risk of burnout decreases (Gerich, 2019, p. 95).
- With respect to a specific driver of stress for workers, the increasing blurring of the boundaries between private and professional life, i.e., delimitation, it is assumed that job autonomy helps to avoid conflicts between work and private life (e.g., Gerich, 2019, p. 88; Voydanoff, 2004, p. 283). Whether this positive effect of job autonomy on the reconciliation of work and private life comes to fruition depends on the extent of job autonomy. In contrast, higher autonomy may also have the opposite effect of neglecting private needs, for example, by working more or at untypical times to achieve work goals.

Relation to job motivation

- Job resources are generally associated with positive effects on work motivation. This motivation can manifest itself in a variety of ways – for example, through higher commitment to the organization, engagement, or job involvement. It is these aspects that usually have a positive effect on organizational outcomes. Bakker et al. (2003, p. 352) find that job resources are “unique predictors of organizational commitment”. Spiegelaere et al. (2016, pp. 522–524) specify that method-related autonomy has a significant influence on work engagement.
- Creativity is counted as a phenomenon of high motivation since it is assumed that job resources can create free capacity for creative work. Sia and Appu (2015, pp. 779–780) refer to the three autonomy dimensions according to Breugh (1985) and find that all dimensions enable positive effects on creativity at the workplace. Chang et al.

(2012, p.719), however, note that task autonomy can limit the creative performance of employees if no specific, task-related knowledge was previously available on the part of the employees.

Relation to personal and organizational outcomes

- Ryff (1989, p.1071) refers to autonomy as one of six central criteria for the psychological *well-being* of people. High autonomy is understood as the independence and self-determination of a person who can act in a certain way to regulate social pressure situations. Especially within the JD-R model (Bakker & Demerouti, 2007; Demerouti et al., 2001), well-being is treated as a central target dimension that can be positively influenced by job resources. The dichotomy between positive or negative effects of job autonomy and *health*, which is assumed to be closely linked to well-being, is described by the autonomy paradox (see below). Exemplary, Gerich (2019, p.88) describes how flexible working hours do not contribute to a better reconciliation of family and work but can take on self-exploitative tendencies that may lead to a deterioration in health.
- Regarding *job satisfaction*, numerous studies refer to the positive influence of job autonomy. For example, Wheatley (2017, pp.18–19) confirms that control over one's own tasks and the pace of work increase job satisfaction. Lopes et al. (2014, pp.317–320) add that job satisfaction is reduced by increased workloads if they are not accompanied by higher autonomy. Additionally, Nguyen et al. (2003, pp.8–10) approve a significant positive influence of autonomy on five dimensions of job satisfaction (pay, other benefits, prospects for promotion, job security, and the importance or challenge of work for employees).
- Research on job redesign (Hackman & Oldham, 1975; Sims et al., 1976) is followed by empirical evidence that job autonomy can have a positive impact on employee *performance*. These findings are especially related to the redesign of workplaces. Other contributions (e.g., Claessens et al., 2004, pp.944–946; Fuller et al., 2010, p.45; Saragih, 2011, p.211) also refer to the positive influence on performance. Langfred and Moye (2004, pp.939–940) complement the approach of improving performance through task autonomy by exploiting motivational, informational, and structural mechanisms, such as the utilization of information asymmetries or the linking of work tasks and organizational structures.

These exemplary descriptions regarding the relevance of job autonomy initially led to the assumption that a high degree of autonomy *always* has a positive effect on the various possibilities for exerting influence as a job resource. Contrary to this perspective, there are also states of job autonomy that can lead to higher levels of strain. This idea implies that high degrees of freedom can have a negative impact on working conditions after reaching a certain saturation point. However, there are far fewer studies dealing with the negative effects of job autonomy on workers and their constitution than there is evidence that documents the positive effects.

The question of the extent of job autonomy is nonetheless addressed in the following because it provides a first indication of the different organizational roles that job autonomy may take. The focus lies explicitly on the organizational role that job autonomy fulfills while also acknowledging that, from a psychological perspective, individuals have different needs for autonomy.⁸

The concept of autonomy has long been treated in a normative way in relation to the negative consequences of restrictive working conditions in Taylorist work systems (M. Frey, 2009, p. 24). Even today, high autonomy is understood as fundamentally beneficial for workers, while low autonomy is associated with adverse effects. Although there is some verifiable truth in this view, a more nuanced perspective on the extent of job autonomy and possible consequences for employees is advisable.

First and foremost, the so-called Vitamin Model⁹ according to Warr (1994), draws an analogy to the vitamin intake of humans: “The intake

8 Self-determination Theory following Ryan and Deci (2000) declares job autonomy one of three central psychological needs (along with the need for competence and relatedness) that must be met to ensure not only motivation and well-being but also, for example, employee performance (van den Broeck et al., 2016, p. 16). Accordingly, people have individual needs for autonomy (Kubicek et al., 2017, p. 53), which co-determines the individual's perceived job autonomy. In particular, degrees of freedom in terms of working time and location have a positive effect on employees with a high need for autonomy (van Yperen et al., 2014, pp. 2–3). In contrast, workers with a low need for job autonomy may perceive higher demands on their work tasks, conflicting relationships between their private and professional lives, or monitoring tendencies (Gagné et al., 2022, p. 386).

9 The Vitamin Model is of particular importance with regard to selected personal work outcomes such as job satisfaction and health. Gerich (2019, p. 87) states that job autonomy is usually considered a health-promoting work characteristic in occupational health research. Baltes et al. (2002, p. 11) confirm this relationship with regard to job satisfaction: starting from a low to medium level of job autonomy, job satisfaction increases, while it decreases above a certain level.

of vitamins is important for physical health up to, but not beyond, a certain level” (Warr, 1994, p.88). In the transfer to job autonomy, he thus states the thesis that too much job autonomy is harmful for employees. Warr (1994, p.89) justifies this thesis by explaining, “that at those levels an ‘opportunity’ becomes an ‘unavoidable requirement’, coercing rather than permitting action”. Accordingly, excessive job autonomy is no longer expressed in new self-determination and more degrees of freedom but brings constraints such as the frequent assumption of personal responsibility or the accumulation of overtime. Kubicek et al. (2017, p.50) summarize that a high degree of job autonomy is no longer perceived as a *nicety* but as a *necessity* by workers. Accordingly, it is reasonable to assume that high levels of job autonomy also go hand in hand with high levels of other job characteristics that have a negative impact on employees (e.g., time pressure) or low levels of desirable job characteristics (e.g., social support).

The reference to the so-called *autonomy paradox* (Mazmanian et al., 2013), which establishes a connection between high autonomy and the delimitation of private and professional life, has an explanatory effect: The more job autonomy workers are given, the more time they invest in their work to process more content. Correspondingly, companies also intervene in the private lives of their employees. The autonomy paradox is particularly visible regarding the dimensions of job autonomy in terms of working time and place. In this context, Lott (2017, p.19) notes that self-determination with regard to working time can lose its positive effects, so it is important to ensure that high time-related autonomy is not exploited to compensate for high work pressure or large workloads. Similarly, Hünefeld et al. (2019, p.80) report a relationship between high time-related autonomy and the use of over time. In this context, Peters (2011) speaks of *interested self-endangerment* (interessierte Selbstgefährdung), e.g., employees willingly accepting to work longer hours in order to meet their work targets, whether due to a lack of time or personnel. Employers thus draw on employees’ sense of responsibility for their own work.

The conditions under which job autonomy has positive or negative effects on personal outcomes have not yet been clearly established. Many studies show the positive benefits of job autonomy as a work resource. Few point out that, under certain circumstances, high autonomy has the opposite effect. This tendency refers in particular to high levels of autonomy in terms of working time and method. This distinction indicates that for most workers, the granting of medium degrees of autonomy is associated with positive effects on motivation, strain, and other aspects. However, there is a group of workers who have such high levels of au-

tonomy that the potentially positive effects are reversed in the form of self-exploitative tendencies. This insight is discussed in more detail in later chapters, as it contributes considerably to the understanding of how using AI is changing job autonomy in the service sector.

In any case, there is no doubt that not only do different dimensions of job autonomy emerge for workers, but that their extent can have ambivalent consequences depending on the organizational circumstances. The following excursus, therefore, provides an insight into some concrete aspects of work that are closely related to job autonomy. In doing so, the definitional narrowing of the object of investigation in this thesis – the service sector – is likewise pursued.

1.5. Excursus: How are you, service workers?

This brief excursus aims to outline the basic understanding of service work, labor market-related key figures, specific work-related burdens and needs, as well as first tendencies on the current state of job autonomy. In many ways, the analysis of the relationship between job autonomy and AI builds on these preliminary considerations. After all, not all services are the same; the content, requirements, and working conditions are so different that common features need to be identified, such as the high intensity of interaction work that all services have in common or the following distinction between particularly autonomous and less autonomous service branches.

A brief definition of service work

The simplest approach to a definition of service work is to note that it is not production work in the primary (extraction of raw materials) or secondary (manufacturing of goods) sector (Pongratz, 2012, p. 17). The social science perspective usually reveals their difference based on three distinctive features, which serve as a definitional basis (Haller & Wissing, 2020, pp. 9–15):

- A service is intangible at its core and hardly measurable or objectively comparable.
- A service follows the *uno-actu* principle, i.e., production and consumption of the service are hardly separated. The service is consumed during the production process.
- A service involves the service recipients and includes them in the work process. The service is dependent on the service recipient.

While this ideal-typical definition clearly points to an essential feature of service work, which is a high degree of interaction work, it is certainly not applicable to all tasks that are fulfilled in the tertiary sector. The *uno-actu* principle, for example, is not viable for every service. The processes of service production and consumption are separate in the case of security services or cleaning activities, for instance. The degree of involvement of service recipients varies greatly, from passive participants to active cooperation partners (Pongratz, 2012, p. 19). The service character of a task is particularly high when the logic of production and consumption is closely intertwined (Pongratz, 2012, p. 18). Interaction work thus takes on the clearest form of a service. A distinctive feature of service work regarding job autonomy is the dependence on the service recipient.

Initially, interaction work is not limited to the service sector. However, the proportion of interaction work is generally higher in both quantitative and qualitative terms than in the primary or secondary sector, i.e., interaction work is performed more frequently and more intensively due to the close ties to service recipients. It is precisely the dependence on service recipients that makes interaction work so complex and demanding (Böhle & Weihrich, 2020, p. 9).

On average, service workers spend almost three-quarters of their working time on interaction work (manufacturing sector: 43 %, Holler & Dörflinger, 2021, p. 2). The difficulty for service workers arises from not working with inanimate objects but with living beings. Thus, the service process is often characterized by a continuous interplay of action and reaction. The two parties must clarify what the service consists of, ensure that the contractual partners also provide their service, and master possible conflicts (Böhle & Weihrich, 2020, p. 11). Interaction work is therefore hardly plannable, let alone entirely reducible to certain recurring patterns.

Although there is no uniform definition of interaction work (Holler & Dörflinger, 2021, pp. 1–2), the concept of Böhle and Weihrich (2020, pp. 15–19) has become established, which foresees four tasks for service workers: establishing a cooperative relationship with the service recipient (cooperation work), influencing and working with the feelings of the service recipient (sentimental work), coping with one's own feelings (emotional work¹⁰), coping with imponderabilities and non-plannable actions

10 The concept of emotional labor goes back to the American sociologist Arlie Hochschild (1983, p. 7), who ascribes the necessity of “the management of feeling to create a publicly observable facial and bodily display [...] for a wage” for service professions.

(subjectifying action). The concept of interaction work emphasizes the natural subjectivity of both the service recipient and the service worker and presents it as a criterion for the success of the service. Subjectivity is not declared a disruptive factor in the work process but is regarded as a prerequisite (Böhle & Wehrich, 2020, p. 15).

Within the service sector, there is a high degree of homogeneity regarding the frequency of interaction work. In most branches, two-thirds of employees state that they frequently or often work with customers or clients, for example, in finance and insurance (63 %). Only healthcare falls outside these statistics, with just under 90 % working with patients or those in need of care (DGB-Index, 2018b, p. 6). The incidence of interaction work possibly relates to poorer job quality. This applies in particular to the factors of working hours, emotional demands, and work intensity.

Exemplary, working outside of traditional working hours particularly affects branches that provide personal services or that serve basic social needs (DGB-Index, 2022a, pp. 40–43). Evening work is the most widespread. Considering the frequency of night work, it becomes clear which branches are particularly relevant: logistics and healthcare. They do not only suffer from little influence on the quantity of work and scheduling of working time (DGB-Index, 2022a, pp. 24–27), but also frequently work at variance with traditional working hours, which overall suggests particularly intensive work. What is additionally reflected is the low planning security regarding working time (e.g., on-call duty, work on demand).

With regard to emotional demands and intensity, one-fifth or more employees in healthcare and financial services report that they are very often or often confronted with negative, psychologically stressful situations when dealing with the persons concerned (DGB-Index, 2018b, pp. 9–10). However, it is precisely the interaction-typical forms of stress that are still inadequately recorded and to which too little importance has been attached in research and corporate practice to date.

Workers deliberately use their own emotional expressions to elicit a desired reaction from their counterparts. It is assumed that these emotionally demanding activities have a particularly psychologically stressful effect on employees due to the possible discrepancy between the emotions they really feel and the emotions they display (Schöllgen and Schulz, 2016, p. 10).

Employment situation

Around 25 million people are regularly employed in the German service sector (72 % of total, Table 15 | Appendix). Most of them are women (55 %). Almost two-thirds work full-time. In relation to total employment, by far the most women and almost all part-time employees work in services. Most service workers are employed in the wholesale and retail trade (19 %) as well as in healthcare and social work (21 %). The largest part of the service sector is thus made up of jobs that concern the (everyday) care of people. A similar picture emerges for marginally employed persons, who in Germany are almost exclusively concentrated in services.

Women make up the majority of employees in most service branches (Figure 18 | Appendix). These include, for example, healthcare and social work (77 %) and education (72 %). However, this fact does not apply to all branches, such as information and communication (34 %), transport and logistics (24 %). In some cases, close to or over 50 % of employees work part-time (e.g., education, healthcare and social services, accommodation, and food services). It is plausible that the combination of high physical and mental stress leads to part-time work or that there are fewer barriers to entry for part-time employees in these branches.

Regarding the qualification level of workers, the service sector is divided into branches with a great proportion of highly qualified employees and a below-average number of people without formal training, and those where the opposite is the case (Figure 19 | Appendix). Nevertheless, most workers have completed vocational training. Information and communication (48 %), professional, scientific, and technical services (44 %), and education (41 %) show above-average levels of qualification. Trade, transport and logistics, accommodation, and food services, as well as parts of healthcare and social services, employ an above-average number of people without formal training and relatively few with university degrees.

Between 2018 and 2022, employment in the service sector increased (Table 16 | Appendix). These gains are particularly marked in information and communication (20 %), real estate (13 %), professional and scientific services (11 %), and public administration (11 %). However, a closer look at employment growth reveals other structural findings: Part-time employment has grown more strongly than the full-time equivalent. The employment of highly qualified people has increased by more than 20 % on average. In some cases, however, the employment of people without formal training also increased considerably. Overall, both an increasing movement towards academization and a polarization of qualifications are visible.

Around a quarter of all employees in Germany work in the low-wage sector, many of them in services (Bäcker et al., 2020, p.188). The reasons for this are, on the one hand, the weakness of trade unions and the privatization of state-owned companies, but also social policies in terms of low basic income levels and unemployment policies (Bäcker et al., 2020, p.41). Trade, transport and logistics, and food services are clearly prime examples of low-wage branches. High part-time rates additionally precarize these branches. Moreover, work in low-wage branches is characterized by more stressful work situations. According to Dütsch and Bruttel (2021, p. 12), people in those branches are considerably more exposed to strain in terms of working hours. Overall, they work longer hours, overtime, and unpaid work. Their working time arrangements frequently fall outside traditional working hours, i.e., at weekends or in shifts, and they show generally more dependence on fluctuating labor demand, making work less predictable. Women, younger people, and the less qualified are more likely to work in low-wage service branches than their counterparts.

Who is (not) working autonomously?

Autonomous workers are highly qualified, male, and in supervisory positions. They work in business, scientific, or IT services and are less likely to perform interaction work. – Although these remarks are overstated and generalized, they do reflect statistically common characteristics of workers with particularly high degrees of freedom in the workplace. Building a bridge between the positive relationship between job quality aspects and job autonomy helps to establish an impression of the current state of autonomous work. Concepts of job quality¹¹ cover a wide range of autonomy dimensions, even though the term “autonomy” is not often explicitly used: work organizational aspects, work intensities, or working time situations. On the one hand, this wealth of information reinforces the approach of considering job autonomy as an essential element of job quality. On the other hand, it makes clear that the boundaries between job resources and job demands are blurred in that certain job demands also provide information about the degree of autonomy.

To approximate the levels of job autonomy in a very heterogeneous service sector, some selected job characteristics are evaluated to identify

11 In recent years, the attempt at qualitatively describing and empirically measuring job quality has grown in popularity in industrialized countries. The term *job quality* comprises a collection of multidimensional concepts whose definition or operationalization often differs. For an overview of job quality concepts, see Warhurst et al. (2017).

rough trend lines related to job autonomy: In which service branches or forms of interaction are there particularly pronounced or restricted autonomy situations? To what extent are there relations between job autonomy and management function, educational demands, and the sex of workers?

Across all sectors in Germany (Table 1), many workers have little influence on the amount of work they do (63 %), their respective working time (55 %), or the scheduling of work (31 %). Many of them act under constant time pressure (50 %) or are disturbed and interrupted in the process (54 %). For a solid quarter, constant availability, evening and weekend work are a regular part of everyday working life (DGB-Index, 2022a, pp. 40–43). A variety of restrictions and constraints at work are therefore expressed in terms of work content, scheduling, and working time. Alarmingly, employees who frequently perform interaction work, in particular, report quality cutbacks in their work outcomes and regular conflicts with clients.

The analysis by *service branch* shows a broad range of autonomy-limiting factors at work. Well over half of the employees have little or no influence on the amount of work they do, with employees in transport and logistics (79 %) and healthcare (72 %) standing out. The ability to influence the working time situation and the possibility of planning or scheduling work independently are more differentiated. Poles are formed between more restricted branches (trade, logistics, accommodation, food services, education, healthcare, and social services) and rather flexible ones (information and communication, finance and insurance, professional, scientific, and technical services). This polarization continues in a comparable way regarding the possibility of contributing one's own ideas or the necessity of making quality restrictions on their work. Half of the employees tend to work under frequent time pressure, with the healthcare sector (68 %) again standing out.

The autonomy-related difference between workers who have very frequent or rather seldom *client interaction* is essentially reflected in the intensity of work and the organization of working time. The former are interrupted more often, experience intense time pressure, and report having to make quality cutbacks in their work more than average. Conflicts with clients are present in everyday work, and the need to be constantly available is also reflected in more frequent evening and weekend work. However, differences in job autonomy are not as pronounced as expected.

People in *management functions* have higher levels of autonomy in their work than others (also Breugh, 1989, pp. 1046–1047). Unsurprisingly, there is extended scope for action in supervisory positions,

which are organizationally responsible for the performance and output of workers. Management function enables slightly more leeway in organizing work, while higher intensity in the form of time pressure, interruptions, and conflicting work demands counteracts.

The *level of demand for occupational tasks* reveals a highly polarized relationship between qualification and job autonomy. Job autonomy increases considerably with the level of qualification (also Esser & Olsen, 2012, p. 452). The possibility of contributing one's own ideas to work also follows a similar course. Workers with higher qualifications¹² are thus likely to be left to organize themselves, while those with lower qualifications must work in more predefined environments. In contrast, an examination of the intensity of work paints the opposite picture: It is the highly qualified who are particularly often under time pressure, disturbed at work, or confronted with contradictory work requirements.

So far, little attention has been paid to differences in job autonomy in relation to *sex* (Adler, 1993, p. 450; Esser & Olsen, 2012, p. 452). On average, men have higher levels of autonomy than women (Adler, 1993, p. 455). However, this is not only due to gender representation in specific organizational structures. In management or white-collar work, men systematically have higher degrees of autonomy than women (Adler, 1993, pp. 450–455). It is reasonable to assume that existing power structures and the relationship between professional and care work come into play. Women in particular have less influence on the amount of work they do but are less often under time pressure – at least when focused on the selected job quality characteristics.

This overview confirms the need for a differentiated view of job autonomy in services. The contours of two groups of workers are becoming visible: less autonomous services (LAS) and highly autonomous services (HAS). The first group is less likely to autonomously influence their working time, work quantity, and scheduling. It is also those workers who are particularly burdened by their working time situation, in that they must engage frequently at weekends, in the evening, or at night. This group includes trade, logistics, accommodation, and food services, as well as healthcare and social services. The description of LAS applies

12 The German Federal Employment Agency (2021, pp. 27–28) defines four demand levels that describe certain knowledge and skill levels required to perform an occupation. These four requirement levels are: helper and semi-skilled tasks, specialized tasks, complex specialist tasks, and highly complex tasks. They are roughly comparable with the qualification levels: no formal training, vocational training, further training, and higher education degree.

predominantly to person-related tasks and low- to medium-skilled workers who tend to have no management function.

HAS are characterized by constant interruptions at work and contradictory work requirements. The working-time situation of these employees is less demanding. Nevertheless, constant availability is problematic for some. Overall, workers are able to influence their working time and the planning of individual tasks more frequently. However, this freedom makes their work more conflictual. The group of HAS includes those in information and communication, finance and insurance, professional, scientific, and technical services, public administration, and, to some extent, education.

This rough distinction between LAS and HAS is taken up again, particularly in the context of the theoretical embedding of job autonomy in work organizational contexts (Chap. 5).

Table 1: Selected job quality measures, 2019–2022

	Influence on work quantity	Influence on working time	Schedule work independently	Bringing in own ideas	Rushed/ under time pressure	Disturbed/ interrupted	Quality cutbacks	Constant availability	Conflicts with clients
	Answers “Not at all/to a small extent”				Answers “Very often/often”				
Total	63 %	55 %	31 %	31 %	50 %	54 %	23 %	23 %	13 %
Service Sector									
Wholes., retail trade; rep. of vehic.	63 %	53 %	38 %	39 %	49 %	53 %	22 %	22 %	14 %
Transportation, storage	79 %	58 %	48 %	47 %	48 %	36 %	24 %	25 %	14 %
Accommodation, food service	59 %	47 %	51 %	33 %	53 %	39 %	15 %	33 %	17 %
Information, communication	57 %	25 %	19 %	22 %	51 %	58 %	20 %	24 %	11 %
Finance, insurance	67 %	27 %	21 %	25 %	55 %	65 %	19 %	17 %	15 %
Prof., scientific, technical services	56 %	23 %	16 %	26 %	56 %	63 %	20 %	22 %	8 %
Public admin., def., social sec.	68 %	30 %	22 %	36 %	49 %	63 %	23 %	18 %	24 %
Education	62 %	55 %	25 %	13 %	58 %	49 %	38 %	40 %	24 %
Health	72 %	57 %	42 %	32 %	68 %	63 %	34 %	26 %	19 %
Social Service	60 %	53 %	33 %	25 %	47 %	48 %	26 %	28 %	17 %
Client interaction									
Very often/often	63 %	48 %	33 %	29 %	56 %	56 %	25 %	29 %	17 %
Rarely/never	63 %	46 %	31 %	35 %	41 %	48 %	18 %	15 %	12 %
Management function									
With management function	55 %	38 %	20 %	16 %	61 %	70 %	24 %	36 %	17 %
W/o management function	66 %	50 %	37 %	37 %	47 %	47 %	22 %	19 %	12 %

Educational demand	66 %	61 %	45 %	55 %	31 %	26 %	17 %	20 %	7 %
	66 %	55 %	40 %	36 %	48 %	50 %	21 %	20 %	12 %
	63 %	35 %	22 %	25 %	55 %	65 %	24 %	25 %	16 %
	55 %	30 %	16 %	14 %	61 %	62 %	28 %	34 %	17 %
Sex									
Men	61 %	49 %	33 %	29 %	56 %	56 %	25 %	25 %	11 %
Women	65 %	46 %	32 %	34 %	41 %	48 %	18 %	21 %	16 %

Notes: Mean values from 2019 to 2022 for all branches. Relative frequency of employees whose answers to a particular question can be interpreted as restricting autonomy, e.g., having no/only little influence on the amount of work (left side) or being very often/often rushed or working under time pressure (right side).

Source: DGB-Index (2022a), Table 4, 5, 8, 9, 11.

2. Research objective and structure

This thesis is dedicated to the identification of links between using ADM systems, as a more accurate label for current AI applications, and job autonomy in the service sector, as well as the conditions and effects of the existence of these connections. Thereby, this thesis aims at adding significant insight to the current scientific discourse on changing working environments in the German service sector on an empirical basis. The analysis of whether and to what extent various dimensions of job autonomy at the work process level are influenced by using ADM systems is at the core of this objective. The central question of this research is therefore: *What impact does using ADM systems have on the job autonomy of employees in the service sector?* The term “ADM systems” refers to algorithmic decision-making and is the reference primarily applied in this thesis for the generic concept of AI.

While this thesis deals with the influence of ADM systems on workers, the research focus lies not exclusively on possible positive or negative effects on job autonomy but on describing the conditions and environments in which these impacts come to fruition and how to deal with uncertainties that may accompany using these novel technologies. Thus, this thesis seeks to combine and utilize both critical and hopeful stances on ADM and work. However, it understands the potential relationship not as swinging between these two extremes but as the emergence of new uncertainties and complexities of work.

This thesis initially draws on insights from sociology, psychology, and the economics of work. Since this is ultimately a sociological thesis, large parts of the literature and the theoretical framework, as well as the linking of theory, conceptual considerations, and empirics, draw from sociological approaches. Research from psychology is utilized regarding the concept and interpretation of job autonomy, because very early in this work it became apparent that the perception of job autonomy is a deeply subjective one, which must be considered if the effects of ADM on job autonomy are to be grasped with the broadest possible scope of depth. Research from the field of economics is referred to with respect to the intervention depth of ADM systems in work processes, since basic ideas about the effects of ADM on job autonomy are derived from the complementary or substitutive characteristics of technology.

Within such considerations, the service sector often receives only little or partial attention in work and industrial sociology research, especially in the context of integrating technology into work processes. It is only in recent years that a revival of the interplay between digitalization

and service work has been observed in research as part of the transformation of retail and logistics (e.g., Barthel, 2023; Butollo, Engel, et al., 2018; Delfanti, 2021; Gilbert et al., 2021) or the emergence of the platform economy (e.g., Eyert et al., 2020; Gerold et al., 2022; Schreyer & Schrape, 2021). However, it is still astonishing that many (sociological) studies focus only on the manufacturing sector and the transformation of work in industry. Although industry accounts for a considerable share of value creation and employment in Germany, most employees work in the service sector (over 70 %, Table 15), whose working conditions are so heterogeneous that greater knowledge on this topic is desirable. The focus of this thesis is on the research gap in the German¹³ tertiary sector. The empirical analysis of the primary and secondary sectors, as well as self-employed persons¹⁴ is largely omitted. However, the attempt is necessarily made to transfer selected findings, especially from the manufacturing industry, to the service sector.

The heterogeneity of the service sector makes this field of research both exciting and challenging. It brings together a variety of different jobs (object-, person-, or information-related) in a wide range of occupations that encompass a broad spectrum of skill requirements. A high share of interaction work is particularly distinctive, which entails a higher degree of uncertainty and unpredictability of work situations due to the interaction subject (Jungtäubl, 2021, p. 30). As a result, this situation is much more difficult to formalize than, for example, object-related tasks. It requires flexibility and adaptability (Jungtäubl, 2021, p. 30). Therefore, it is essential to explore the extent to which learning ADM applications can also intervene in the complexity of service work and what the consequences are for the job autonomy of employees who already move within the constraints of marketization and subjectification (Senghaas-Knobloch, 2011, p. 30).

Moreover, the service sector's heterogeneity makes purely quantitative research approaches across all sector segments appear superficial

13 The focus on the German service sector is mainly due to accessibility. Due to the growing importance of the service economy in most western industrialized countries, the research results are transferable as the conflicts and challenges are comparable. This applies to the later focus branches of the company case studies (Part III).

14 The self-employed are initially excluded from the analysis because their job autonomy constellation is even more complex than that of dependent employees (e.g., work status, legal conditions, see Pichault and McKeown, 2019). However, selected changes in job autonomy at the work process level are certainly transferable from dependent employees to the self-employed. The alternating use of the terms *workers* or *employees* is thus linguistically acceptable.

and strictly qualitative approaches difficult to apply to the entire sector¹⁵. For this reason, a multi-method approach comprising both semi-quantitative elements and a qualitative approach is applied in this thesis. Therein lies the hope of obtaining as holistic a picture as possible of the autonomy situation of service workers. Within these empirical analyses, job autonomy is consistently addressed from a subject perspective. This is intended to take into account the “role of workers as active appropriators and agents [...] but also their specific action strategies, relevance settings, and work and life orientations”¹⁶ (M. Frey, 2009, p. 15).

Sichler (2006, p. 246) proposes a *radically subjective* conception of job autonomy to meet the requirements of self-organization and self-control in service work. Certainly, it is not always possible to distinguish between objectively given and subjectively perceived job autonomy based on secondary literature and empirics. However, the empirical analyses in this thesis always take the subjective perspective as the basis for interpretation – freely reformulated along the lines of Thomas’ Theorem, it is assumed that autonomous work may only be claimed if it is perceived as such by workers.

Part I of this thesis lays the theoretical foundation for all further analyses and essentially reflects the current state of research on job autonomy and ADM. It serves as a conceptual and theoretical anchor point for embedding the following empirical findings in the scientific discourse: Chap. 3 initially deals with the terms AI and ADM. ADM systems refer to both rule-based and learning systems, i.e., they may belong to currently discussed machine learning systems but can also describe simpler digital systems. Thereby, it becomes clear that “AI tools are point solutions” (Agrawal et al., 2018, p. 130), whose scope of application is mostly limited to very specific fields, but also that the performance of learning systems in decision-making situations depends on the interaction of reliable technology and its organizational embedding (Luong et al., 2020, pp. 41–42). This thesis, therefore, does not attempt to formulate a specific ADM definition but rather a categorized embedding of ADM systems according to their depth of intervention in work processes.

Chap. 4 reformulates existing concepts of job autonomy to reflect the multidimensionality of the term and the complexity of modern ser-

15 The service sector is outlined along the definition of the Statistisches Bundesamt (Destatis) (n.d.), which counts 13 sections to the tertiary sector (WZ 2008, Table 14 | Appendix).

16 Own translation of “Rolle der Arbeitenden als aktiv Aneignende und Handelnde [...] aber auch ihre jeweils spezifischen Handlungsstrategien, Relevanzsetzungen sowie Arbeits- und Lebensorientierungen” (M. Frey, 2009, p. 15).

vice work. Peters (2001, p. 20) makes clear that the concept has different meanings and that when autonomy in work is mentioned, often very different things can be implied. Therefore, finding a common understanding of job autonomy appears to be essential. This refers to the understanding of job autonomy as autonomy at work, i.e., the possibility of determining the courses of action in relation to an individual's own work processes.

The resulting set of seven job autonomy dimensions also forms the basis for the semi-quantitative and qualitative analysis in Part II and Part III. The term "job autonomy" is deliberately chosen to point out that the underlying understanding of autonomy in this thesis is always based on the assumption that within a specific employment relationship there are also specific forms of job autonomy for employees. Job autonomy therefore already implies a certain restriction because it deals with the scope for action within a distinct job.

Chap. 5 concludes Part I with an attempt to theoretically embed the interplay between ADM and job autonomy in existing control logics in companies. The central aim of the chapter is to identify possible interpretations for the occurrence of various expressions of job autonomy and the role that the application of technology plays in this context. A central distinction is made between service branches in which employees are granted little job autonomy and those in which employees have many degrees of freedom in the execution of their work. With both ideas, job autonomy fulfills different organizational purposes within the concepts of direct and indirect control mechanisms. As a first result of this thesis, Part I presents a theoretically sound concept and an entanglement of job autonomy and ADM in companies, which serve as a starting point for further quantitative and qualitative analyses.

Part II takes up these theoretical-conceptual findings, attempts to quantify job autonomy in the service sector, and establishes comparability across branches. A detailed description of the objectives of Part II is given in Chap. 6. The measurement of changes in the subjective degrees of job autonomy provides initial indications of the impact of organizational and technical changes or constraints on employees. Using the BIBB/BAuA-ETB, a representative cross-sectional employment survey, job autonomy is mapped within a *Job Autonomy Index*. This is not limited to findings at the branch level but also considers selected socio-economic characteristics of the respondents as well as ADM aspects of work. Part II thus serves to identify service branches with particularly distinctive characteristics of job autonomy and trajectories of change. The selected branches serve as objects for an in-depth analysis outlining the effects of ADM on job autonomy in Part III.

Part III forms the core of the empirical analyses in this thesis and includes two in-depth company case studies from outpatient care and banking services. A detailed description of the objectives of Part III is given in Chap. 11. The empirical basis for these case studies is formed by problem-centered, semi-structured interviews with service employees who use ADM systems in their daily work routines. In addition, interviews with company and employee representatives, as well as the technology provider or IT managers of the companies, are conducted, which provide an overview of the corporate objectives of technology use, its implementation, and its embedding. Concluding expert interviews from related scientific and public fields, such as labor law or AI standardization, complement the sociological perspective on the case study companies and the handling of ADM.

The interview evaluation is carried out along the seven previously defined job autonomy dimensions and follows a qualitative content analysis according to Mayring (2010), consisting of inductive and deductive elements. A company case consists of a branch profile that reveals general employment trends, strain situations, technology use, the description of the company, the ADM system, and specific deployment situations, as well as a presentation of the changed job autonomy settings from the employees' perspective. The case studies are completed with a discussion of technical hurdles as well as the impact and conditions for creating positive job autonomy experiences. A cross-case analysis and the embedding of the case study results in the theoretical framework conclude the empirical work of this thesis.

The final Part IV combines all theoretical, conceptual, and empirical findings and formulates answers to the initial question about the influence of using ADM systems on the job autonomy of employees in the service sector. It attempts to transfer selected findings from the empirical analyses to the service sector to generate possible courses of action and new implications for political, social, and legal actors. Ultimately, the complex relationship between ADM and job autonomy has hardly been analyzed. This thesis aims at adding meaningful findings to the ongoing scientific debate on the short-term evolution and the long-term revolution of job quality by emphasizing the societal significance of the effects that ADM has on job autonomy.

PART I

Linking ADM, job autonomy & service work: an attempt at conceptual embedding

3. AI in the work process

What are the distinctive technological features behind the widely used term *AI*? What are the peculiarities of looking at AI from the perspective of work organization? How to deal systematically with AI and its influence on work processes? These introductory questions are addressed in Chap. 3. The first step is to sharpen the terminology, moving away from the fuzzy term AI to *algorithmic decision-making* (Chap. 3.1). In addition, an overview of previous approaches to understanding which tasks at work are influenced by ADM allows for insights into the functional spectra of such technical systems that are currently assumed (Chap. 3.2). These considerations lead to the outline of three ADM categories, which illustrate the possible intervention depth of ADM systems in work processes (Chap. 3.3). A final excursion into the actual prevalence and use of ADM systems helps to assess the extent to which ADM-supported work is (or is not) impacting workers today (Chap. 3.4).

3.1. From AI to algorithmic decision-making

While research into AI dates back to the 1950s, the debate about AI tools in the workplace has reached new heights in recent years. More than 60 years ago, computers did not show the performance required to process complex operations. The early 1980s became known as *AI winter* as the development of functional AI systems was still too costly (Agrawal et al., 2018, p. 32). The qualitative and quantitative expansion of available data and computer performance enabled a renaissance of research and the application of AI that has grown considerably since 1990 (Cockburn et al., 2018, pp. 34–37).

Agrawal et al. (2018, p. 9) explain why AI has experienced such an upswing in recent years with the simplest of economic connections: When the price of a good falls, more of it is consumed. And indeed, powerful processors and access to substantial amounts of data have become much more accessible over the past 15 years. However, declining returns on investment in data and machines are already evident today (Agrawal et al., 2018, p. 51). Additionally, this proclaimed renaissance is often limited to research developments (and their scope of financing) and less to the actual diffusion and use of AI systems in economic activities.

Based on the influential essay “Minds, brains, and programs” by the U.S. philosopher John R. Searle (1980), Nilsson (2010, pp. 388–389) names *strong* and *weak* AI as the currently dominating scientific distinc-

tions. Strong AI defines the rather theoretical existence of human-like abilities, including conscious thinking. Regarding weak AI, the technical system can fulfill selected work tasks, but intelligence is only simulated.

Since this thesis intends to focus on AI applications that are already being used in the workplace, the operational definition of AI is based on that of weak AI. Nilsson's (2010, p.13) definition of AI explicitly refers to the ability of those systems to function in their respective environments: "Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment". With this approach, the classification as AI depends on the extent to which one is willing to attribute appropriateness and foresight to a system (Stone et al., 2016, p.12).

However, there is no universal definition of AI, but a plethora of overlapping definitions by private, scientific, or public actors, such as the European Commission (2018, p.1):

Artificial intelligence (AI) refers to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals. AI-based systems can be purely software-based, acting in the virtual world (e.g. voice assistants, image analysis software, search engines, speech and face recognition systems) or AI can be embedded in hardware devices (e.g. advanced robots, autonomous cars, drones or Internet of Things applications).

The German Bundestag (2020, p.51) adds its perspective on AI:

AI systems are intelligent systems designed by humans, consisting of hardware and/or software components, which aim to solve complex problems and tasks in interaction with and for the digital or physical world. To this end, AI systems collect, process, and analyze data and exhibit suitable behavior to solve and fulfill the respective problems and tasks. If the AI interacts physically with its environment through a technical body, e.g., as a robot, this is referred to as embodied AI.¹⁷

17 Own translation of "KI-Systeme sind von Menschen konzipierte, aus Hardware- und/oder Softwarekomponenten bestehende intelligente Systeme, die zum Ziel haben, komplexe Probleme und Aufgaben in Interaktion mit der und für die digitale oder physische Welt zu lösen. Dazu erfassen, verarbeiten und analysieren KI-Systeme Daten und zeigen ein geeignetes Verhalten zur Lösung und Erfüllung der jeweiligen Probleme und Aufgaben. Interagiert die KI durch einen technischen Körper physisch mit ihrer

Although these definitions of AI systems emphasize their dependence on their human creators along with their virtual and physical presence, they are extremely broad and potentially encompass a range of technical applications. These superficial references require further specification.

However, due to the high international dynamics of research and development, the elaboration of a generally applicable definition of AI, on which this work might be based, does not seem appropriate. Rather, it is important to understand how AI tools intervene in work processes, to what depth they do so, and which work tasks are accessed in the process. Translated into a sociological perspective, the discussion of AI addresses the depth of intervention in existing work processes, the change in the division of labor, the organizational mechanisms that support or hinder the intervention of AI, or the changing ways in which people engage with each other and technology. Without going into detail about all possible definitions of AI, the following is a working description that defines the basic boundaries of the technical systems discussed in this thesis: The basis of AI systems are algorithms, whereby an algorithm by itself does not form AI. Following Zweig (2019, p.50), algorithms are based on logical and mathematical procedures that serve as optimized instructions for action.¹⁸ In other words, an algorithm describes an instruction that solves a defined mathematical problem. The formulation of this problem determines which solution possibilities may apply, whereby a certain relationship between input and output is also clearly defined with the problem (Zweig, 2019, p.50).

The term “algorithm” is only valid if the formulated action instruction is so clearly defined that it can be implemented by a machine and completed in finite time (Zweig, 2019, pp.51–52). The output of this process is always to be interpreted according to the respective context and is to be evaluated against the background of the specific data use, modeling, and operationalization (Zweig, 2019, p.80). AI systems consist not only of data, algorithms, and models but also of physical components that can intervene in work systems. Bound to actuators, algorithms transfer and implement actions into the physical world. To answer spe-

Umwelt, z.B. als Roboter, spricht man von verkörperter KI (‘embodied AI’)” (Deutscher Bundestag, 2020, p. 51).

18 The foundation for research on AI was laid by Alan M. Turing (1950) with his influential essay “Computing Machinery and Intelligence”, in which he formulated what is now known as the Turing thesis, namely that any action that follows clear rules can also be mechanized and thus imitated by a machine. The core of Turing’s work was the principle of the algorithm, which by definition does not allow any deviations and thus provides a specific solution path to a defined goal.

cific questions in this way, programming algorithms alone is often not sufficient. It is part of the modeling process, just as the calculated mathematical solution must be interpreted in relation to the question posed (AlgorithmWatch, 2016).

A fundamental distinction is made between *rule-based* and *learning AI systems*. The former (also known as symbolic AI) is based on the formulation of rigid algorithmic rules and expert knowledge, so that overall there is a high level of transparency (i.e., white box models) with regard to the input and output of the systems (Deutscher Bundestag, 2020, pp. 51–52). These systems are still comprehensible to workers, as they are largely based on the formulation of logical rules such as if-then procedures. It is important to note that rule-based systems use predefined rules based on clearly limited amounts of data (expert knowledge).

The latest progress in AI usually refers to Machine Learning (ML), also called subsymbolic AI, as the ability of novel systems to generalize from experience (i.e., data), learn, and continuously improve without executing explicit instructions, i.e., without having been programmed to do so (overview in Alpaydin, 2016, p. 10). In general, three ML methods are distinguished (Castelluccia & Le Métayer, 2019, p.4): Supervised learning is based on labeled data, i.e., a recognition pattern and goal are given and used to classify data, e.g., images. Unsupervised learning does not use previously labeled data. It is a method of pattern and structure recognition in data. Reinforced learning uses feedback mechanisms to improve its function. ML algorithms develop their full potential by analyzing, structuring, and feeding back large amounts of data, continuously improving their performance, and thus finding increasingly better solutions for specified (supervised learning, e.g., finding a specific optimum) or unspecified (unsupervised learning, e.g., pattern recognition) problems.

In recent years, it is particularly Deep Learning (DL) that has established. DL is a subfield of ML that focuses on using Artificial Neural Networks (ANN) to extract complex patterns from data. It has broad applications in areas such as image recognition, natural language processing, and autonomous systems. The necessary pre-structuring of data is largely eliminated, which the system takes over as part of the learning process (Deutscher Bundestag, 2020, pp.51–52). This type of AI model is also known as a *black box model* because its functions are no longer fully comprehensible to humans. There are various approaches for developers to increase explainability. From the user's point of view, however, it is usually difficult to make these systems transparent (Kraus et al., 2021, p. 3).

The transparency-related difficulty lies in dealing with ML algorithms that “jump directly from hypothesis to prediction as if the hypoth-

esis were a fact”¹⁹ (Zweig, 2019, p. 41). However, this is only true if it has been tested. According to Zweig (2019, pp. 196–197), the success of ML depends on the availability of an adequate amount of data for training in both quantitative and qualitative terms, the existence of measurable ground truth, and causal relationships between input and desired output. The output of ML is considered transparent if, among other things, an appropriate quality measure has been selected for testing and sufficient feedback data is available for continuous improvement of the output.

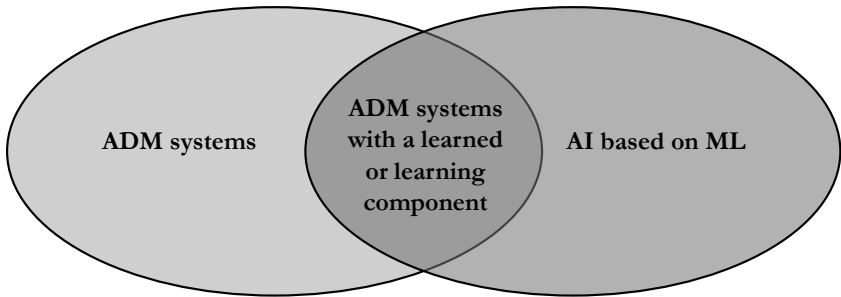
As in earlier hype phases, the use of the term “Artificial Intelligence” (as a synonym for ML) is a source of controversy. In some cases, the term is associated with promises for the future that may or may not be realized; in other cases, using the term merely serves advertising efforts that expect greater success from AI. AlgorithmWatch (2019, pp. 7–8) points to the blurring and overvaluation of the term in public discourse. Pure digitalization efforts and AI are sometimes indistinguishable.

As a result, the term “*algorithmic decision-making* (ADM)” has become established in professional circles, which more clearly indicates the functions performed by the current systems in question: Humans delegate the preparation or implementation of decisions to machines (AlgorithmWatch, 2019, pp. 7–8). AlgorithmWatch (2019, p. 9) further defines those systems as a socio-technical complex consisting of a decision-making model and algorithms that translate this model into computer language, training, and analysis data sets. This is the unique aspect of this definition, the political and economic ecosystem in which ADM systems are embedded. ADM may refer to simple digitalization steps or AI applications as they are currently understood, i.e., learning applications (AlgorithmWatch, 2019, p. 7). According to AlgorithmWatch (2019, p. 3), most ADM systems that make decisions about or for people today are not based on AI but are “usually just more or less complex software applications that calculate, weight, and sort data using sets of rules”²⁰. Common examples of ADM systems cover the improvement of general knowledge (e.g., drug discovery, climate forecasts), digital services (e.g., risk scoring, client targeting, predictive police), and physical systems (e.g., autonomous robots, cars, transport systems) (Castelluccia & Le Métayer, 2019, p. 6).

19 Own translation of “direkt von der Hypothese zur Vorhersage [springen], als wäre die Hypothese ein Fakt” (Zweig, 2019, p. 41).

20 Own translation of “meist nur mehr oder weniger komplexe Softwareanwendungen, die anhand von Regelwerken Daten miteinander verrechnen, gewichten und sortieren” (AlgorithmWatch, 2019, p. 3).

Figure 2: Distinction between ADM systems and AI based on ML



Source: Algorithm Accountability Lab [Prof. Dr. K. A. Zweig].

It is important to understand that ADM systems and ML can overlap, but they do not necessarily represent the same system complexes (Figure 2). Most ADM systems are considered to be expert systems that operate rule-based. However, if a learning or learned component is added, there are overlaps between ADM and ML.

Building on this understanding, Krafft and Zweig (2018, p. 472) formulate the following central definition of ADM systems:

Algorithmic Decision Making Systems (ADM systems) contain an algorithmic component that – based on the input – makes a decision regarding an issue, i.e., calculates a single value. If the algorithm was developed by experts, it is called an expert system. There are also those that derive the rule system independently from data with the help of machine learning.²¹

This clarifies that ADM systems can include rule-based or learning elements (also Castelluccia & Le Métayer, 2019, p. 3). They may contain aspects of ML but do not have to. In addition, the Gesellschaft für Informatik e.V. (2018, p. 17) points out that a decision-making system is called an ADM if the decision-maker is an algorithm.

21 Own translation of “Algorithmische Entscheidungssysteme (Algorithmic Decision Making Systems – ADM-Systeme, die) enthalten eine algorithmische Komponente, die – basierend auf der Eingabe – eine Entscheidung bzgl. eines Sachverhaltes trifft, dh., die einen einzigen Wert berechnet. Wenn der Algorithmus von Experten erarbeitet wurde, spricht man von einem Expertensystem. Daneben gibt es solche, die das Regelsystem mit Hilfe von maschinellem Lernen aus Daten selbstständig ableiten” (Krafft and Zweig, 2018, p. 472).

Based on these approaches to a specification of ADM, the working definition of ADM systems refers to *rule-based or learning technical systems that have an algorithm at their core as a decision-maker*. This understanding of ADM systems applies in particular to the theoretical as well as empirical contributions of this thesis. However, other authors and contents are cited as indicated, whereby the distinctive features of *learning ADM* are highlighted if considered appropriate.

The novelty of these ADM systems, as already indicated, lies less in their pure rule-based approaches and more in their experience-based learning perspective, which allows them to (partly) operate in unknown situations. “The prerequisite for this is that they can draw their own conclusions from structured and unstructured data, adapt their machine actions to the environment, and make decisions about optimal ways to achieve goals related to previously defined parameters”²² (Hirsch-Kreinsen, 2020, p. 141). The importance of delegating decision-making and its support to ADM systems must be emphasized even further as employees are mostly confronted with complex decision-making situations on a daily basis (Ernst et al., 2018, pp. 1–2) and the demand for decision-making skills on the labor market continues to grow (Deming, 2021, p. 31). The automating, augmenting, or assisting character of technology usage is at the heart of sociological and economic debates considering the effects of technology on work. ADM systems are no exception to this logic.

3.2. Differentiating affected tasks

The influence of technological change, especially automation, on tasks and employment is strongly influenced by the Anglo-American perspective of economists. Its transferability to work logics in other countries and general understanding of substitutability and automation are debatable, but some useful insights into the relationship between technology and tasks do emerge: According to the economic perspective, the purpose of technological progress has been the simplification of human labor in terms of muscular exertion, safety, and routine tasks (Autor, 2015, p. 10). Facing financial gains from the investment in automation, companies experienced shrinking benefits from workers whose skills are replaceable by machines.

22 Own translation of “Voraussetzung hierfür ist, dass sie eigenen Schlussfolgerungen aus strukturierten und unstrukturierten Daten ziehen, ihr maschinelles Handeln an die Umgebung anpassen und Entscheidungen über optimale Wege zur Zielerreichung bezogen auf zuvor definierte Parameter treffen können” (Hirsch-Kreinsen, 2020, p. 141).

The broad economic consensus has been that automation particularly affects routine tasks. It draws on the so-called Task-based Approach (TBA) of Autor et al. (2003), which distinguishes between routine and non-routine tasks, i.e., between substitutable and non-substitutable tasks. Based on the TBA, numerous studies have attempted to isolate which tasks are particularly affected by automation and thereby quantify employment effects from using new technologies (e.g., Nedelkoska & Quintini, 2018; Bonin et al., 2015; Dengler & Matthes, 2021).

It is a common perception, with clear origins in the employment developments of the 1980s, 1990s, and early 2000s, that it is those tasks characterized by a routine nature, fulfilling repeating steps in a predefined order, that are influenced by the automating tendencies of technological progress. Determining the first condition for the presence of job polarization²³, the employment share of routine labor, which is predominantly assigned to medium-skilled jobs in this logic, for example, in production, declines. In contrast, non-routine, cognitively demanding occupations experience employment gains due to their complementary relationship with automation (e.g., Autor et al., 2003; Autor, 2015). In total, Autor et al. (2003, pp. 1–6) and Autor (2015, pp. 11–12) define three task profiles: first, routine tasks that can be automated and therefore substituted by a machine. These operations are characterized by structured, repetitive procedures with a need for precision and constant environmental circumstances – typical for middle-skilled employment. Second and third, non-routine abstract and manual tasks that cannot be substituted instantly.

According to this understanding, machines are only able to fulfill tasks that feature a certain arrangement of codifiable steps. The most challenging jobs to be automated are those requiring creativity, common sense, and intuition. So far, these qualities were unique to workers (Autor, 2015, pp. 11–12), or as Polanyi (1966, p. 4) framed it, “We know more than we can tell,” which refers to procedures humans implement tacitly without being able to define their distinct rules. Within this chain of arguments, three engineering bottlenecks are frequently cited as prevent-

23 The term job polarization, first introduced by Goos and Manning (2007), describes the incidence of a rising employment share of both high- and low-skilled occupations at the expense of middle-skilled jobs. As a phenomenon frequently observed in industrialized countries, job polarization is linked to technological progress in terms of automation. However, automation and digitalization do not necessarily result in a long-term increase in unemployment among middle-skilled workers. To date, a plethora of literature has emerged on the subject of technological unemployment – often with a dystopian tone that foresees the end of human labor, see, for example, Ford (2016) and Rifkin (1995).

ing the automation of certain tasks (Papsdorf, 2019, p.108): Firstly, it is the execution of tasks in complex, unstructured environments and the reactions in these situations that are difficult to implement by machines. Second, machines have so far been denied the ability to act innovatively and creatively, i.e., to create something new and generate ideas. Thirdly, machines are not capable of socially intelligent behavior, i.e., of acting appropriately and situationally when interacting with people.

Today's research on ADM systems partly attempts to invalidate this assumption by giving machines the ability to adapt and learn by recognizing patterns and issuing feedback based on big data and higher computer performance (also "Polanyi's Paradox" in Autor, 2014). Recent studies refute previous assumptions that lower- and medium-skilled employees in particular may be affected by substitutional trends in automation and learning ADM.

As M. Lane and Saint-Martin (2021, pp.22–24) summarize studies by Brynjolfsson et al. (2018), Felten et al. (2019), and Webb (2019), the occupations most exposed to AI, including learning ADM, now comprise white collar occupations such as chemical engineers, accountants, or clerks, while physical occupations, e.g., cleaners, fitness trainers, or massage therapists, are less exposed. M. Lane and Saint-Martin (2021, p.22) conclude that high-skilled occupations are among those most affected by ML. These findings are in marked contrast to the previous scientific consensus.

Agrawal et al. (2018, p.28) attribute this change in particular to the novel prediction capabilities of learning systems. Prediction is understood by the authors as a process of filling information gaps (with data). Agrawal et al. (2018, p.81) specifically assume that these prediction machines are already able to produce qualitatively better and faster results than humans in certain situations and that these predictions are an essential component of decision-making in uncertainty. The ability to influence decision-making thus seems to be, as the name suggests, the most critical component of new AI systems, i.e., ADM. However, Agrawal et al. (2018, p.81) do not ignore the fact that prediction is only one part of the decision-making process: "The other components are judgment, action, outcome, and three types of data (input, training, and feedback)". This also suggests an increasing importance of the complementary rather than the substitutive relationship between workers and technology.

M. Lane and Saint-Martin (2021, p.19) agree that AI, also referring to learning ADM, is capable of intervening in some non-routine cognitive tasks and emphasizing the problem-solving, reasoning, and perceptual abilities of these systems but still gives workers clear advantages in the areas of creativity and social intelligence. M. Lane and Saint-Martin (2021, p.35) further assume that the primary impact of those applications will

be visible in the reorganization of tasks. This reorganization may be considered in connection with job autonomy in many respects, but what effect the use of ADM will have in the future remains unclear. Moreover, studies on the specific impact of learning ADM on job autonomy in the service sector are scarce. More indirectly, the growing importance of service tasks is highlighted, emphasizing the social-emotional skills that technical systems have so far been unable to replicate.

In total, M. Lane and Saint-Martin (2021, pp.20–21) accurately summarize the economic discourse specifically around ML: It is too often reduced to an automating technology. The related discussion on the distinction between complementary and substitutive relationships in the division of labor between humans and machines may be useful, but it underestimates the versatility of work.

Especially the valuation of routine and non-routine tasks has been criticized in many other social sciences. According to Pfeiffer and Suphan (2015a, pp.4–7, 2015b, pp.23–24), this approach does not do justice to the complexity of work tasks and their organization. Therefore, it systematically overestimates the potential for substitution. The importance and scope of informal work steps and experiential knowledge as a counterpart to formally recordable and thus substitutable tasks must be emphasized. Since the performance of routine tasks may also have a relieving effect and, moreover, can only become a real routine by means of the accumulation of experience, the objective of eliminating all routine tasks from work processes must be questioned (Huchler, 2019, p. 163).

Pfeiffer and Suphan (2015a, pp.11–12) further criticize the distinction between routine and non-routine tasks for the lack of a deeper examination of the concept of routine. According to the authors, the canonical TBA focuses on routine as a kind of repetitive, monotonous work that is only related to the transferability to machines. Dengler et al. (2014, p. 17) state that the distinction between routine and non-routine, which is predominantly used in the Anglo-American area, does not correspond to the understanding of *routine* in the German-speaking area, namely habitual subconscious actions, but the dissolution of a work process into formalizable and automatable tasks.

This is where the question arises as to what extent new methods of ADM, especially its ML capabilities, can also replace tasks that require experience. An alternative is not to refer to routine and non-routine tasks, but to distinguish between formalizability and non-formalizability (e.g., Huchler, 2019, p. 155). This approach considers the non-formalizability of subjectifying action, i.e., operating in a creative or innovative way, interacting with other people, in unknown environments, or in contradictory situations (Huchler, 2019, pp.163–164). The genesis around

the understanding of routine and non-routine tasks helps to assess the automatability of tasks. Formalizable tasks can be performed in the familiar logic of rule-based ADM systems. A considerable innovation of experience-based learning ADM systems, however, is the potential to include previously less formalizable tasks in the set of automation possibilities.

The predominantly Anglo-American economic discourse and its critics make clear that it must always be asked anew which tasks are to be assessed as automatable and which intuitive, experience-based, or sub-conscious tasks cannot be represented by this concept. This is especially true for the service sector, which is based on interaction work that is, to a large degree, unpredictable.

The automation characteristics of ADM systems are visible. However, Daugherty and Wilson (2018, p.2), among others, also emphasize the *augmentative* characteristics of those systems by stating that “AI systems are not just automating many processes, making them more efficient; they are now enabling people and machines to work collaboratively in novel ways”. Furthermore, Zuboff’s (1988, pp.10–11) conceptualization of digitalized work draws a distinction between the functional characteristics of modern information technology according to the terms “automate” and “informate”. The automating character of these technologies thus traditionally entails a substituting effect in relation to work, while the informing function is to be regarded as the result of a higher quantity and availability of information. The effects of using ADM at the workplace seem to have three parallel features on a task level: automation, augmentation, and assistance of tasks. The approaches presented for differentiating automating systems according to the tasks they may affect are adopted below to categorize ADM systems according to the depth of intervention in work processes.

3.3. Towards a categorization of ADM systems

Focusing on the interference of ADM in the working sphere of humans and its embedding in work processes, the following considerations lead to an approach for categorizing ADM systems that is intended to provide a simple description of their intervention depth in work processes. These categories of ADM systems reflect both gradations according to the degree of decision support, i.e., also the level of automation, and a distinction according to their influence on the work of employees at the task level (automation, augmentation, and assistance of tasks).

The aim of this exercise is to make the actual functions and possibilities tangible beyond the diffuse definitions of AI. The ADM categoriza-

tion follows the differentiation of tasks influenced by ADM (Chap. 3.2) and draws on selected models and concepts of human-computer interaction and automation levels, according to Parasuraman et al. (2000), Sheridan (1991), and Bitkom (2017).

In short, Parasuraman et al. (2000, pp.288–289) distinguish between four different classes of functions in the interplay of both humans and computers:

- Information acquisition automation: The systems can collect and display information. This information can be emphasized or filtered according to the user's preferences.
- Information analysis automation: The systems can process and prepare data and use it to perform analyses or predictions.
- Decision automation: The system can show decision alternatives, filter them according to preference, or make a preselection.
- Action automation: The system can perform actions. Depending on the level of automation, control remains with the user or is transferred entirely to the machine.

The authors thus draw a central distinction between the less invasive function of computer support in terms of work processes such as data collection or analysis and the decision-making support that builds on this in a complementary relationship. The approach cumulates in action automation, in which control²⁴ over a work process can ultimately be handed over to the technical system.

Sheridan (1991) and Bitkom (2017) provide additional approaches towards a categorization of ADM. Sheridan (1991, p.5) describes ten different levels of automation, from the first stage, in which no automa-

24 When workers hand over responsibility for processes entirely to machines and fail to detect faulty systems, the so-called *control problem* is assumed. Zerilli et al. (2019, p.557) argue that especially risky and safety-critical decisions should not be made by ADM systems unless the reliability of the system is proven to be better than that of humans. The reason lies in the failure to detect faulty systems when workers hand over responsibility for processes entirely to machines, either because they trust the machine too much or because they are negligent (Zerilli et al., 2019, p.556). With reference to Bainbridge (1983), Zerilli et al. (2019, pp.560–562) describe four problems that can be regarded as causal for the control problem in human-machine interaction: the capacity problem (cognitive limitations in the comprehensibility of machine decisions), the attentional problem (decreases in attention with passive monitoring of systems), the currency problem (gradual decay of human skill), and the attitudinal problem (assumption and reliance on the error-free functioning of the machine).

tion takes place, to the tenth, in which a fully autonomous machine acts (Table 2). Particularly valuable for the following analysis are the intermediate levels, which describe different forms of provision of action alternatives for humans. From levels five and six, it becomes clear that the responsibility for action is largely transferred from the human to the machine. Though the author generally describes automation and not decision-making.

Table 2: Levels of automation in Sheridan (1991)

Level	Description
1	Computer offers no help, the human must do it all.
2	Computer offers full set of action alternatives, and
3	narrows the selection to a few alternatives, or
4	suggests one, and
5	executes suggestion when human approves, or
6	allows the human a restricted time to veto before automatic execution, or
7	immediately executes automatically, then necessarily informs the human, or
8	informs human after execution only if human asks, or
9	informs human after execution if it, the computer, decides to.
10	Computer decides everything autonomously, ignores human.

Source: Sheridan (1991, p. 5), or more detailed in Sheridan (1992).

An approach with reference to decision-making at the workplace is provided by Bitkom (2017, pp. 21–23). The authors present a model of decision-making automation that describes technical systems according to the degree of intervention in human decision-making processes (Table 3). In addition to the initial stage, in which no automation takes place, a total of five stages of decision support are assumed, whereby, in the transition from stage three to stage four, the active role of the human decision-maker is changed to a passive one. The authors describe that the transitions between the respective levels are fluid, and boundaries can be difficult to identify. Nevertheless, this model provides a valuable starting point for the formulation of a categorization of ADM systems in the work context. Such categories help to systematically analyze the intervention of ADM at the task level of employees.

The following categorization of ADM systems is intended to describe how deeply ADM systems can intervene in employees' work processes, i.e., what kind of support they may provide. In later chapters, this categorization allows for a supplementary description of possible changes in job autonomy and is thus intended to do justice to the different degrees

Table 3: Levels of automation in decision-making in Bitkom (2017)

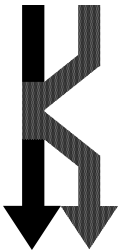
Level	Description
0 Human decides	No automated support
1 Assisted decision-making	Preparation and better processing of information
2 Partial decision-making	Decisions dependent on human preferences; activation incumbent on humans
3 Audited decision-making	Selection and prioritization of decision-making alternatives; activation is incumbent on humans
4 Delegated decision-making	Takeover of control of a predefined situation; human can intervene or leave control to the system
5 Autonomous decision-making	Permanent takeover of complex application situations; manual operation by humans possible

Source: Bitkom (2017, pp.21–23).

of automation that are used in practice. Based on these preliminary considerations and approaches to the automation of functions, processes, and, finally, decision-making, three categories of ADM systems are isolated: assisting-informing ADM, augmenting-complementing ADM, and automating-substituting ADM. As it is an ideal-typical differentiation, it is likely that in practice the functions of ADM systems fall into several or even all categories. The following attempt to categorize ADM is therefore less technical and more organizational in nature, which should facilitate work process analysis of ADM. A rule-based ADM can inform, complement, and automate. A learning ADM can inform, complement, and automate. This perspective on ADM should explicitly focus on the workers and their work processes.

Assisting-Informing ADM

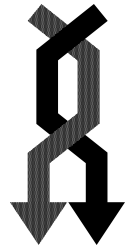
The ADM system assists workers in decision-making and executing work tasks essentially through its informative character. It supports data processing, displays them according to preferences, or provides information on request. This information enables employees to weigh up alternatives independently. These can be software solutions that sort, visualize, and analyze data based on mathematical rules or chat bots that present specific information on demand. The processing of this information is entirely the responsibility of the workers. Decision support depends on the quantity and quality of the available information. The supportive character of assisting-informing ADM systems may also extend to the selection of working methods or tools. In this way, a higher overall infor-



mation density helps in the fulfillment of work tasks, especially if search processes for this information are minimized. Incorrect information or the preparation of this information can lead to an improper choice of method or the false execution of a task. Assisting-informing ADM may be classified as learning ADM by providing feedback (e.g., manual selection of specific information) to the system from which its informative capabilities improve. The question of assisting-informing ADM systems influencing various dimensions of job autonomy probably overlaps in many aspects with the effects of digital tools in the workplace in general.

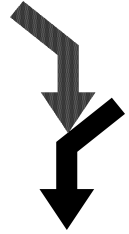
Augmenting-Complementing ADM

The ADM system augments the decision-making process of workers and thus has a complementary effect on the performance of work tasks. A distinction can be made between partial and verified decision-making. In the case of partial decision-making, the decision is made based on predefined action chains that must be actively initiated. Thus, the machine only executes something if the worker confirms the command beforehand. However, the ultimate decision-making power and, thus, responsibility for work results remain with the worker. In the case of verified decisions, the system independently develops decision suggestions from a predefined situation, which can be selected by the employee. The system recognizes patterns in given data frames and uses them as the basis for decision scenarios. The employee makes the final decision. The complementary effect at task level may depend on the degree of formalization of the work process that the system requires. Likewise, depending on the system in question, the path that the system takes to the decision proposal can be (in)transparent and correspondingly (less) comprehensible for the worker. The use of augmenting-complementing ADM systems may have ambivalent consequences for different dimensions of job autonomy as they are strongly dependent on organizational embedding. If the system can modify work processes and take over parts of them, effects on various autonomy dimensions can be expected. They specifically pose risks due to their monitoring and non-transparent tendencies while interacting with workers.



Automating-Substituting ADM

The ADM system automates complete work steps and thus has a substituting effect on work tasks. In this sense, automation is defined as the machine execution of (partial) work processes with little or no human intervention. A distinction can be made between delegated decision-making and completely autonomous decision-making. In the first case, workers give the system control over a predefined situation. Deploying these systems usually requires a high degree of formalization and standardization of work processes. When the adaptability of the system to its environment reaches its limits, workers may again have to prove their adaptability to the system. Failures and imponderables of automating-substituting ADM, be they of a technical or organizational nature, can hardly be excluded. According to this understanding, workers' intervention does not become obsolete. It is less dispensable than necessary in the case of malfunctions and failures, as well as the execution of wrong decisions. The necessity of this situation-related action depends largely on the decision quality of the respective ADM system, which can currently still vary greatly. In systems with high decision quality, the ADM system should generally request the worker's confirmation or inform if the worker explicitly requests its involvement. The difference to purely autonomous decision-making is that even in the case of unexpected situations, adequate decisions can be made by the system, making workers' intervention completely obsolete. In this context, machines can perform the same tasks as them, but in a different way (Huchler, 2019, pp. 161–162). The decisive factor is the fulfillment of the common work objective.



3.4. Excursus: Digitalization, ADM, and AI in figures

The relevance of ADM, both economically and socially, must be assessed in light of the current and future dissemination of these systems. It emerges quickly that the presence of the topic in scientific and public discourse is hardly compatible with the current diffusion of ADM systems. This does not imply that the potential use of modern technologies will not have a considerable, some would say disruptive, impact on work and society. Nevertheless, it remains to be pointed out that ADM systems are often used in specific cases or by specific workers and do not yet affect the broad mass of employees.

The diffusion and potential use of ADM in the German service sector are partly reflected in the degree of digitalization among companies, which serves as a benchmark for the fundamental ability to use ADM systems. Compared to the primary and secondary sectors, selected service branches generally lead the statistics on the degree of digitalization (e.g., Bundesministerium für Wirtschaft und Energie [BMW], 2018, p.21). The widespread assumption that the services sector is lagging far behind in terms of digitalization can only be partially substantiated, as will be shown in the following remarks: The most digitized sectors in Germany primarily include ICT, knowledge-intensive service providers, finance, and insurance. In contrast, transport and logistics and the healthcare sector have the lowest level of digitalization (BMW, 2018, p. 13).

The relative frontrunners in the use of information processing technology for the independent solving of problems with computers, as a proxy for ADM, are in services (BMW, 2020, pp.2–3), namely ICT (18 % of companies), financial services (12 %), and business-related services (e.g., media, consulting, R&D, 11 %). However, these technologies are used less frequently in other services (e.g., security services, cleaning, other business services, 3 %), transport and logistics (2 %), and wholesale (1 %). Overall, only a fraction of other service companies are already using those applications (BMW, 2020, p. 3). The status of learning systems is still in its infancy in Germany. Although companies expect them to play a significant role in the future, only 9 % of them use AI, probably referring to ML, themselves in 2022 (Bitkom, 2022). Overall, studies on the usage rates of AI in German companies differ greatly. They range from a few percent to 25 % of large companies (overview in Giering, 2022, pp. 57–58).

A closer look at individual sectors reveals a clear divide in the services sector in terms of the spread and depth of digitalization and using digital devices (BMW, 2018, pp.21–33): This digital divide is most evident in terms of the proportion of highly digitalized internal business processes and digital services. Transportation, logistics, and healthcare lag far behind other branches. However, the aforementioned differences in the degree of digitalization are much less pronounced when considering the number of companies in which all employees use mobile or stationary devices (BMW, 2018, pp.32–33). Although ICT (65 % and 80 %, respectively), financial and insurance services (66 % and 88 %, respectively), and knowledge-intensive services (46 % and 85 %, respectively) are also in the lead here, the differences are not as severe as, for example, in the degree of digitalization of internal processes. If companies that only partially equip their employees with mobile or stationary devices were included, the sectors considered would converge further. For ex-

ample, around 70 % of healthcare workers use stationary digital devices and 37 % use mobile devices – which puts them in the middle of the pack in purely statistical terms.

These remarks on the degree of digitalization in companies make some points clear: On average, some service branches are ahead of the manufacturing sector when it comes to digitalized work processes or the diffusion of digital devices in the workplace. However, a digital divide within the service sector becomes apparent, which plays out between typical white collar, i.e., knowledge and information-intensive branches that are usually linked to office activities, and personal or object-related services. It is equally clear that the digitalization of processes and the use of digital tools have not yet reached all companies and, therefore, not all employees, regardless of the branch. This fact must be constantly kept in mind when dealing with the current use of ADM applications in the service sector.

What remains is the realization that specifically learning ADM simply does not yet play a role in a large number of companies, which seems quite debatable in view of the presence of the topic in the media and science (Giering, 2022, p. 59). As with digitalization, this argues for an incremental spread of learning systems in companies rather than a disruptive one (Hirsch-Kreinsen, 2018, p. 6). However, it is also possible that the actual use of AI applications, including ADM, is underestimated. Exemplary, Giering et al. (2021, p. 786) find that 20 % of the employed report using ML themselves, but if these systems are only described in terms of their functions, twice as many affirm. Again, fuzzy definitions of AI, ML, and ADM complicate the discussion of the topic.

S.-C. Meyer et al. (2022, p. 319) confirm that almost three quarters of all employees never use AI, whereby the definition refers more to learning ADM systems and adds the aspects of task complexity, occupational field, age, and sex to the perspective on the spread of those applications: Accordingly, the use of those systems generally increases with the complexity of the tasks. Unsurprisingly, IT and scientific service professions show the highest usage rates (although 61 % still never use AI). In person-related services, about one fifth are users (S.-C. Meyer et al., 2022, p. 324). There is a minor difference regarding sex and age (S.-C. Meyer et al., 2022, p. 323).

Supplementary data is provided by the DGB-Index (2022b, p. 16): This survey confirms that most employees, whether in the service sector or outside it, never use independent learning programs in their day-to-day work. However, a split is already apparent between more active industries and more restrained branches. For example, those learning systems are used particularly little in public administration, education,

healthcare, and social services, while information and communication services, finance, trade, and logistics use them more frequently at work.

Likewise, the trade union *ver.di* attempted to quantify the potential impact of using AI, meaning independently learning systems, including ADM, at work for employees in a prospective survey (Zanker et al., 2019, p.24). This initially confirmed the previous hypothesis of a split in using those systems by branch. The service branches with relatively high usage rates include information and transport, as well as financial and insurance service providers. The lowest usage rates were once again reported by trade, healthcare, and social services. The affirmative votes in terms of learning system use are predominantly located in large companies and less in small and medium companies (Zanker et al., 2019, p.25). The primary areas of application are in all areas, from service provision to external communication and internal administrative activities. Interestingly, among the companies using them, learning elements of technical systems are most often deployed in sales. This is also where a high proportion of interactions with clients can be assumed, i.e., AI applications are already influencing core activities in the service sector (Zanker et al., 2019, pp.25–26).

Using ADM systems to provide services initially leaves open how exactly these procedures intervene in work processes. These brief insights into the nature of ADM in the services sector, despite all the conceptual ambiguities with digital systems and AI, confirm the previous assumptions about a digital divide that also translates into an ADM divide. Once again, it is the knowledge-intensive sectors, i.e., those with a particularly substantial number of highly qualified employees, often in data-related activities, whose work and environment are particularly digitized. This means that different starting points in the branches must be considered regarding the possible use of ADM. It is likely that this digital divide will be reproduced regarding the use of ADM systems, as these indicators can be considered catalysts for ADM use. On the one hand, this may suggest that implementation takes longer in less digitized areas, but even more importantly, it implies that employees who already work with little technology support may be overburdened or at least restricted by the possible use of ADM, which can also have a considerable impact on job autonomy.

4. Facets of job autonomy in service work

The intention of Chap. 4 is to formulate a definition of job autonomy on which this thesis is based. The requirements for this concept are demanding, as it is supposed to do justice to the complexity and diversity of modern work constellations but at the same time being as intuitively understandable and operationalizable as possible for the empirical contributions. Following the attempt in the introductory chapters (1.3 and 1.4) to embed job autonomy in the organization of work and to describe its relevance, the importance of reformulating the concept is presented (Chap. 4.1). Seven dimensions of job autonomy are both defined and placed in the context of the research question by consulting selected empirical findings (Chap. 4.2). These seven dimensions of job autonomy should be understood as a proposal and a starting point for further conceptual considerations around the term.

4.1. Call for conceptual renewal

Regardless of the perspective – science, politics, or art – there is a broad disagreement on the conceptualization, evaluation, and measurement of autonomy (overview in Franzen et al., 2014). Considering autonomy in relation to work, research approaches that emerged in the 1970s and 1980s as a reaction to Taylorist work systems, i.e., motivation-reducing and alienation-promoting tendencies in job redesign (Hackman & Oldham, 1975; Sims et al., 1976), do not give the concept of job autonomy much dimensionality. These concepts evolved along Taylorist production work and their transferability to service work or other forms of work (e.g., project work or group work) must at least be questioned (M. Frey, 2009, p. 25). Little attention was paid to job autonomy outside Breugh's (1985) dimensions of method, scheduling, and criteria autonomy. Sovereignty over working hours, task-related degrees of freedom, flexibility with respect to the place of work, or dependencies on third parties are hardly discussed. Job autonomy is often found in today's research attempts as an aggregated concept that lacks conceptual clarity.

The starting point for reformulating the concept of job autonomy is Moldaschl's (2001, p. 136) idea on *autonomy of action* (Handlungsautonomie):

Autonomy of action at work, understood in psychological approaches as scope for action, decision-making or disposition, in the English control de-

bate as ‘job control’ (i.e., control at work), refers to the possibilities of determining own goals and partial goals, deciding independently on ways and means, etc.²⁵

To this end, Ulich (1988, as cited in Ulich, 2001, p. 175) adds the scope of task as a “multidimensional construct consisting of scope for action, scope for design, and scope for decision-making”²⁶. The scope for action refers to all degrees of freedom for action in the execution of work tasks (e.g., scheduling, selection of procedures) (Hacker, 1978, p. 72). Scope for design implies the possibility of self-determination in approaching and structuring tasks, i.e., task variability. Finally, the scope for decision-making encompasses the given decision-making competence in the performance of tasks (Ulich, 2001, p. 175). Ulich names the scope for decision-making as particularly decisive for job autonomy – which also indicates the delicate relationship between ADM and job autonomy.

Building on both concepts, the understanding of job autonomy in this thesis *describes autonomy at work, i.e., the possibility of determining the courses of action in relation to an individual’s own work processes*. These self-determined courses of action encompass various dimensions, as clarified in the next chapter.

The demand for a new concept of job autonomy is generally supported by several authors (e.g., M. Frey, 2009; Moldaschl, 2001). “The concept of autonomy must be redefined in terms of content and operational aspects so that ‘modern’ contradictions become more comprehensible”²⁷ – more than 20 years ago, Moldaschl (2001, p. 161) formulated the call for a redefinition of the concept of job autonomy. In addition, M. Frey (2009, p. 24) questions “the adequacy of the still strong fixation on the paradigmatic field of Taylorized work per se, production work in the

25 Own translation of “Handlungsautonomie in der Arbeit, in psychologischen Ansätzen gefasst als Handlungs-, Entscheidungs- oder Dispositionsspielraum, in der englischen Kontrolldebatte als ‘job control’ (das heißt als Kontrolle *in* der Arbeit), bezieht sich auf Möglichkeiten, eigene Ziele und Teilziele zu bestimmen, selbstständig über Mittel und Wege zu entscheiden etc.” (Moldaschl, 2001, p. 136).

26 Own translation of “mehrdimensionales Konstrukt, das sich aus dem Handlungs-, dem Gestaltungs- und dem Entscheidungsspielraum zusammensetzt” (Ulich, 1988, as cited in Ulich, 2001, p. 175).

27 Own translation of “Der Autonomiebegriff ist inhaltlich und operational so neu zu bestimmen, dass ‘moderne’ Widersprüche fassbarer werden” (Moldaschl, 2001, p. 161).

male-segregated core sectors of industry”²⁸. Both authors assume that the premises of job autonomy, which were developed in the context of industrial work, are not easily transferable to other, more decentralized or interaction-related forms of work, such as the service sector. Lallement (2015, p.235) further argues that in “a society where the service sector employs the vast majority of the working population, autonomy is no longer gained through opposition to hierarchy. [...] It interacts with supervisors, peers, multiple company stakeholders, and, of course, customers”. He thus understands job autonomy as the anchor point for the reorientation of work organization within a service society.

More decentralized forms of work as well as service activities are generally assumed to have greater job autonomy, i.e., more freedom of action and organization (M. Frey, 2009, p.25; Moldaschl, 2001, p.133). This assumption also implies that these forms of work are characterized to a large extent by self-determined work (M. Frey, 2009, p.25). However, as Frey continues, an opposite development seems to be empirically observable in current employment relationships. Many employees are experiencing an increase in the pressure to meet deadlines and higher workloads, which is also reflected in the decay of health (e.g., DGB-Index, 2019, pp.16–18).

On this matter, Moldaschl (2001, p.133) doubts that job autonomy within decentralized organizational forms of work can guarantee more autonomous action without conflict. His work points to the fact that “‘modern’ labor harbors new relations of freedom and coercion”²⁹. The author assumes that job autonomy cannot be absolute but rather describes a specific relationship between demands and opportunities for action (Moldaschl, 2001, p.143).

Particularly new workload constellations are, according to Moldaschl (2001, p.160), closely related to the emergence of *recursively instrumentalized autonomy* (rekursiv instrumentalisierte Autonomie) – the transfer of responsibility for action to employees, which grants them more freedom of action regarding individual aspects of work but also serves restricting moments through performance-based constraints. In this respect, Moldaschl attributes positive effects to Tayloristic work systems in that there are predetermined performance and goal criteria

28 Own translation of “die Angemessenheit der noch immer starken Fixierung auf das paradigmatische Feld Taylorisierter Arbeit schlechthin, der *Produktionsarbeit* in den *männlich segregierten Kernsektoren der Industrie*” (M. Frey, 2009, p.24).

29 Own translation of “‘Moderne’ Arbeit birgt neue Verhältnisse von Freiheit und Zwang” (Moldaschl, 2001, p.133).

that create overall negotiation autonomy. In contrast, decentralized forms of organization rely on performance and work criteria being constantly renegotiated between employees and employers.

This idea finds recognizability in the concept of the *Entreployee* (Arbeitskraftunternehmer) following Voß and Pongratz (1998, pp. 11–18): Under the premises of global capitalism, workers are forced to develop the character traits of entrepreneurs themselves, which imply increased self-control, planning, and monitoring of their work performance. Performance control is transferred from management (directly) to employees (indirectly). Following Moldaschl's (2001, p. 136) example, the thesis of expanding autonomy of action for the employed applies once again. This new scope for action may also be accompanied by new implicit constraints, consisting of the desire to achieve corporate objectives and the associated individual sense of responsibility. The discussion of job autonomy as a means of organizing work is taken up centrally in the following Chap. 5.

However, these collected remarks on the criticism of outdated approaches to job autonomy or concepts that are merely assigned to production work highlight three issues: First, the concept of job autonomy lacks the dimensionality to reflect the modern world of work characterized by services. Second, job autonomy is a concept marked by conflict, which can no longer be regarded merely as the antithesis of restrictive principles of traditional work organization but has opened up into a field of conflict between freedom and coercion at work, revealing both low and high job degrees of autonomy in relation to control mechanisms. Third, job autonomy, even if related to the subjective perspective of employees, cannot be considered detached from the work and actions of others (e.g., colleagues, service recipients), but always moves in a tangle of interests and demands. An essential element of this thesis is therefore to achieve a broader conceptual understanding of job autonomy that is more appropriate to modern work relationships, and conflicts.

4.2. Seven dimensions of job autonomy

The following remarks reformulate existing conceptions of job autonomy, which are intended to do justice to the current characteristics of work. This step is necessary because, on the one hand, research on the transformation of job autonomy (in the wake of digitalization and the use of ADM) is often limited to generalizations of the whole economy or with a focus on production work (e.g., Butollo, Jürgens, & Krzywdzinski, 2018; Giering & Kirchner, 2021; Menz et al., 2019; Nies, 2021), result-

ing in limited translation potential to service work. On the other hand, existing concepts of job autonomy lack dimensionality. They are often limited to task latitude at work, i.e., methodical and time-related factors in the execution of tasks (e.g., Kirchner et al., 2020; S.-C. Meyer et al., 2019).

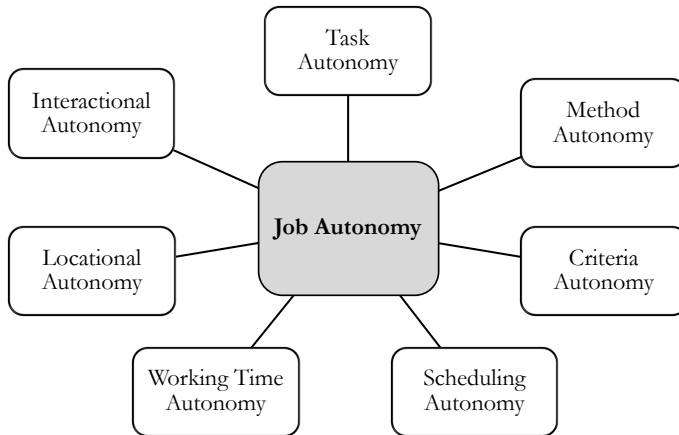
The present reformulation of job autonomy complements these concepts and leads to a more coherent picture of the term. It is intended that the following autonomy dimensions are neither tailored to service work nor to the use of ADM, so that their applicability to other scientific contexts is maintained. It is equally important that the subject perspective of the individual dimensions is preserved. This means that it must always be asked in a practical way whether workers can relate to the concept regarding their specific work task, whether it affects them, and if the individual aspects of a dimension have a corresponding closeness to the work process.

The following seven dimensions of job autonomy (Figure 3) are initially derived from existing research approaches in sociology, economics, business administration, and psychology. Hence, the following remarks also take the form of a research status. The term “autonomy” is less prominent in most studies. Rather, it is a matter of identifying and analyzing factors that can potentially be subsumed under this term. This exercise is designed not only to achieve an overview of the various aspects of job autonomy as well as their empirical relationship with digital work tools and ADM, but also to use these aspects for a later conceptualization of job autonomy in Part II and Part III.

The job autonomy dimensions mentioned refer to the concept of autonomy of action following Moldaschl (2001, p. 136). Thus, they refer to the task level, which functions as the level of analysis for the influence of ADM on job autonomy. The seven dimensions identified include Task Autonomy, Method Autonomy, Criteria Autonomy, Scheduling Autonomy, Working Time Autonomy, Locational Autonomy, and Interactional Autonomy. Although one or more of these dimensions have already been extensively analyzed in previous studies, they have not been considered in the same combination as the following.

The presentation of this reconception of job autonomy starts with a brief definition of the respective dimension, followed by a discussion of selected empirical findings relating to its characteristics. Wherever possible, reference is made to specific empirical findings from the service sector. Since empirical findings on individual aspects of job autonomy and ADM are very incomplete, reference is made to results from the context of digitalization and the more generic term AI.

Figure 3: Dimensions of job autonomy



This research state (marked as *in context*) is intended to show rather broad contours and tendencies in individual dimensions of job autonomy. However, it will once again become apparent that a systematic quantitative and qualitative examination of the relationship between job autonomy and ADM, as aimed at in this thesis, is necessary. Studies on the analysis of possible changes in working conditions in companies that are already working with ADM are scarce – not least because the deployment rate is still very low in many branches. Unsurprisingly, some studies assume that automated language, image or text processing, or the retrieval of expert knowledge, as the most common application for ML, does not have a fundamental impact on working conditions and link the major levers to its embedding in given technical and organizational structures (e.g., Giering & Kirchner, 2021, p. 574).

More differentiated results regarding the effects of AI on job autonomy are often expressed in the form of ambivalent expectations. In a survey by Meinungsmonitor Künstliche Intelligenz (2020, p. 6), one quarter of respondents either expect to have less autonomy at work or are undecided. Almost half do not expect less job autonomy. In contrast, almost 60 % of respondents in Zanker et al. (2019, p. 28) believe that the use of learning systems will reduce their scope for action. This ambivalence possibly reflects a future polarization scenario. Some employees lose job autonomy using ADM, while others gain. In this case, it is important to identify which tasks, occupational groups, or even branches are affected by one or the other.

4.2.1. Task Autonomy

Definition

The majority of research approaches to the concept of Task Autonomy refer to the freedom of workers to choose how a work task is performed (e.g., Battistelli et al., 2013, p.29; Langfred & Moye, 2004, p.934; Wielenga-Meijer et al., 2012, p.6). It is therefore referred to as job autonomy with respect to the method of task execution. In the following, from this partial conceptual blurring is deviated as far as a distinction between Task and Method Autonomy of employees is conducted. This separation follows the assumption of Langfred and Moye (2004, p.935), who stated that a job consists of a number of tasks to which different degrees of autonomy can be attributed.

According to Sichler (2006, p.247), the possibility of shaping work tasks contributes substantially to the understanding of autonomy. Task Autonomy refers to the possibility for workers to select (or reject) work tasks from a set of tasks and thus construct an individual composition of tasks. Workers would therefore also have a say in the quantity of work they do and the task variability through this approach. Task variability comprises the variety of tasks that need to be completed at work, which contrasts with monotonous and repetitive work processes. Likewise, the completeness of a work task is counted as Task Autonomy, which specifies that tasks can be carried out and accompanied from start to finish. Thus, the execution of individual tasks that are detached from the overall work goal or missing information within the work process disagrees with the potential of Task Autonomy. Task Autonomy thus explicitly asks which tasks are completed and in what way the task range can be influenced, not how the tasks are ultimately completed.

Characteristics of Task Autonomy: possibility to choose work tasks from task set; task variability; composition of work quantity; completeness of tasks and information.

In context

Within the context of using digital work tools and ADM, job autonomy, or more precisely, Task Autonomy, is frequently associated with a change in the amount of work and the impact on task variety, although the direction of impact is assessed quite differently. Kohlrausch (2019, p.25), for example, describes how digitalization results in around one-third of employees having to perform more tasks in less time. In addi-

tion to the fundamental trend towards intensification that goes hand in hand with the use of digital means, there is also less influence on the amount of work. In fact, a considerable increase in the amount of work performed by workers is described in all service branches in the wake of digitalization. In some cases, well over half of the workers describe that their workload has increased, for example, in finance and insurance, education, and healthcare. Only a fraction of people believe that their workload actually decreased (Table 17 | Appendix).

Whether these developments are curbed or reversed using ADM remains questionable for the time being. At least S.-C. Meyer et al. (2022, p. 328) suggest that the probability that employees can influence the amount of work increases with learning AI systems, which includes learning ADM. How might this additional amount of work arise in the first place? The ironies of automation (Bainbridge, 1983, pp. 775–776) assume that technical rationalization processes are always associated with unintended additional costs and efforts, such as the maintenance and optimization of technical systems. Unsurprisingly, there is also evidence of a higher probability of completing new tasks when using learning systems (S.-C. Meyer et al., 2022, p. 328).

This is in contrast to Fleming et al. (2019, p. 3), whose studies assume fewer work tasks in combination with ML systems. The authors investigated tasks that are particularly suitable for ML, such as scheduling appointments, and found that occupations that meet this definition have fewer tasks to perform, i.e., their task variability is restricted.

If ADM systems are deployed and work processes are thus formalized to a certain extent so that they can be performed by such systems at all, the task variability of employees is, in essence, restricted. After all, the purpose of the application is usually to take over certain work steps entirely, or at least to support employees in carrying them out. If many tasks from the task range of employees are omitted, the number of repetitive, monotonous work steps can increase. In fact, there is some evidence that work with learning systems is interspersed with a higher probability of repetition, i.e., a higher degree of monotony, especially for personal services (S.-C. Meyer et al., 2022, p. 328, 337). Thus, the danger of increasing monotony comes with highly substitutive technical systems. With increasing monotony, the question of contradictory work requirements also arises, which is rooted in an alternation between underchallenge (monotony) and overchallenge (dealing with ad hoc disturbances) (Hirsch-Kreinsen, 2020, p. 146).

Presumably, all these effects exist in different work scenarios: increased workload and decreased workload, as well as higher task variability and more monotonous work. The direction of effect probably

depends on the intervention depth of the ADM system in work processes and affects professions very differently depending on task content, qualification, and form of organization.

The issue of qualification in particular will remain exciting in the future, since augmenting systems might be capable of enabling less qualified employees to perform certain tasks in the sense of a guidance system, i.e., to expand their range of tasks (Beuschel, 1995, p. 323). However, if the use of recent technologies enables less qualified personnel to carry out certain tasks, this development often harbors the risk of polarization of qualifications.

Whether workers feel restricted in their actions by the changed task conditions ultimately depends on their need for task variety and the degree to which their workload is manageable. Thus, regarding Task Autonomy, whether the substitution of tasks is beneficial to job autonomy depends on whether they really want to be relieved of these tasks or not. It is likely that some workers perceive the relief from certain simple decision-making tasks as relieving, while others will feel deprived of their task variability. Thus, the effects of changing Task Autonomy also depend on the extent to which the use of the system is linked to constraints or is available as an optional support tool.

The holistic nature of the information provided by an ADM result must be considered questionable. It is certainly plausible that these systems could, for example, support the selection of one's own task portfolio by providing the right data in the right quantity. However, Papsdorf (2019, p. 150) poses the risk of a mismatch between the quality and quantity of information in digital systems. If employees are provided with too much or too little usable data, the possible supportive function of the system is quickly reversed, which initially leads to a higher work quantity. The usability of a system in the sense of Task Autonomy therefore depends on its functional quality.

4.2.2. *Method Autonomy*

Definition

There is a broad consensus that Method Autonomy serves as a core dimension of job autonomy. Early approaches to job redesign usually use some form of workers' freedom to choose the procedures and methods within their work (e.g., Breugh, 1985, p. 556; Hackman & Oldham, 1975, p. 162; Sims et al., 1976, p. 197; more recently, Morgeson & Humphrey, 2006, p. 1323). Exemplary, Breugh (1985, p. 556) defines

this dimension as “The degree of discretion/choice individuals have regarding the procedures (methods) they utilize in going about their work”.

More recent research contributions rely on similar definitions of Method Autonomy, such as Spiegelaere et al. (2016, p.517), for which Method Autonomy “refers to the discretion of employees on how to perform the work tasks in terms of procedures and work methods”. In this definition, the selection of methods to perform a work task includes not only the cognitive means to support the execution but also physical aids in the sense of (digital) tools. In the broadest sense, building competencies (Pichault & McKeown, 2019, p.63) and having certain degrees of freedom to approach tasks experimentally (Spiegelaere et al., 2016, p.518) can also be considered part of the Method Autonomy dimension. Method Autonomy therefore essentially questions the extent to which employees can decide for themselves the way in which they complete a work task.

Characteristics of Method Autonomy: selection of procedures, methods, and tools to perform work tasks; possibility to build up competencies.

In context

Specific empirical findings relating Method Autonomy and ADM are rare, presumably also because many studies equate job autonomy with Method Autonomy without formulating it in concrete terms. Fundamentally, Method Autonomy is negatively related to work pressure (Schieman, 2013, pp.277–278), so the promotion of this dimension is fundamentally desirable.

As the demand for decision-making skills increases (Deming, 2021, p. 31), the question arises as to who will make the decisions about processes, methods, and tools in the future. If Method Autonomy is explicitly concerned with the ability to determine how a work task is executed, then ADM systems centrally challenge these decision-making freedoms. Certainly, the use of ADM systems fundamentally offers an alternative course of action to their previous methodical specification. The decisive factor seems to be not necessarily what decision is affected, but who retains or receives control over the decision-making process in the course of delegating tasks to ADM systems (Koeszegi, 2021, p. 69). Depending on the system in question, it is likely that some or even all decision-making processes are transferred to the system in the case of full automation, which would minimize Method Autonomy.

Up until now, workers in the service sector have assumed that digitalization has different effects on the scope of decision-making. Although

most of them do not expect any change, their perceptions of increased or decreased freedom of decision-making in the service sector do diverge. There are some branches in which up to a quarter of employees report increased freedom to make decisions (e.g., trade, information and communications services, or education). But in the financial and insurance sector and the healthcare segment in particular, these figures are offset by considerable decreases in decision-making opportunities for some (Table 17 | Appendix).

In addition, Kirchner et al. (2020, p. 16) show that the effect of using digital tools on Method Autonomy clearly depends on the content of the task. Knowledge workers benefit from the use of digital tools, while more person-related tasks, especially if they have no previous experience with digitality, are more likely to suffer moments of autonomy restriction. In the case of Method Autonomy, the elements of qualification and task content clearly come into play in the relationship between technology use and job autonomy. For example, Logg et al. (2019, pp. 31–32) describe that employees with less competence in a certain area prefer to rely on the decisions of the algorithm. This tends not to be the case for more highly qualified employees. Method Autonomy, however, is even dispensed with under certain circumstances as specific characteristics are attributed to an ADM system. The non-use of competence might be reflected in a reduction of Method Autonomy. In the last consequence, the use of ADM systems could reduce the buildup of competences.

In this context, an essential question arises regarding ADM, namely the transparency of the decision-making processes and results. It is well known that transparency is hardly given in complex systems that use ANN (Kraus et al., 2021, pp. 18–20), for example. Without this understanding of the results, which ultimately deprive employees of control over the work process, they may lack a basis for decision-making. Furthermore, the lack of information or information asymmetries may imply a certain devaluation of work.

If using an ADM system is linked to a certain degree of formalization of processes to make the system usable in the working environment, there is a danger to Method Autonomy. Papsdorf (2019, p. 53) refers to this process as the disciplining of work. It enables system planning and control, as well as transparency and reproducibility (Huchler, 2019, p. 148). If the adaptability and controllability of systems reach their limits, standardization is often relied upon, i.e., the environment is adapted to systems and not vice versa. This standardization can be interpreted at the expense of individual job autonomy, especially in the methodical sense (Huchler, 2019, p. 165).

4.2.3. Criteria Autonomy

Definition

Criteria Autonomy essentially describes to what extent workers can choose and influence the criteria for evaluating their work results and how work performance is assessed. Breugh (1985, p. 556) describes this autonomy dimension as “The degree to which workers have the ability to modify or choose the criteria used for evaluating their performance”. Thus, the dimension revolves not only around whether influence is exerted on the exact work goals, but originally on the evaluation of performance and the ability to assess work achievements. The criteria could therefore be interpreted as a type of evaluation criteria. From the current perspective, these evaluations may, of course, also involve digital or even algorithmic processes.

The idea of Criteria Autonomy is only included in a few studies on overall job autonomy. Besides Breugh (1985), the Maastricht Autonomy Questionnaire (Jonge & Schaufeli, 1998, p. 393) and DeCotils and Koy (1980, p. 173) refer to self-determination in relation to work goals. Nicholson (1984, p. 178) extends this understanding of Criteria Autonomy to include the possibility of choosing work goals and ways of achieving them. Criteria Autonomy thus implicitly includes taking responsibility for work results and assumes that work goals are pursued consciously and intentionally.

Characteristics of Criteria Autonomy: ability to modify or choose the criteria used for evaluating work performance; taking responsibility for work performance; possibility to set work goals and to pursue them consciously and intentionally.

In context

Although the contents of Criteria Autonomy are not often associated with autonomy in terms of definition, it is precisely in light of digital and algorithm-driven means of measuring work performance and setting work objectives that the dimension takes on considerable significance for employees. Particularly present and frequent are considerations of increased monitoring and control tendencies in the course of digitalization and ADM application at work, which imply a diametral understanding of Criteria Autonomy.

A couple of years ago, it was already noted in the service sector that control mechanisms in the workplace are changing drastically (Kratzer &

Dunkel, 2013). It is likely that these trends have increased due to the new possibilities of digitalization and the use of ADM, and that they will intensify even further. This is indicated by Ahlers (2018, p. 8, 14), who analyzes various forms of control mechanisms by industry: Work and performance control as a result of technological progress appear to be particularly high in the already highly digitalized financial and insurance sector. Many work councils surveyed in logistics, accommodation and food services, information and communication, trade, and business-related services report the same trend. The frequency of automatic recording of work steps by a computer program shows similar levels by branch. These mechanisms are less pronounced in public services and education, which in turn are presumably subject to less marketization and rationalization pressure.

In addition, Kohlrausch (2019, p.25) notes that almost half of all workers believe that new technologies enable them to achieve better work results. At the same time, however, more than 40 % report that digitalization is increasing the monitoring and control of their own work performance. Recent surveys confirm these impressions: Depending on the branch in question, well over a third of employees often perceive increased monitoring and control mechanisms as a result of digitalization. This is particularly true for logistics, healthcare, and social services. Hardly anyone perceives a decrease in monitoring and control (Table 17 | Appendix).

According to a survey by MeMo:KI (2020, p.6), 40 % of employees associate the use of AI in the workplace with increased monitoring by their employer. S.-C. Meyer et al. (2022, p.327) also provide alarming evidence that the likelihood of deadline pressure at work increases sharply with constant use of learning systems. The results are particularly striking for person-related (as well as other) services, whose likelihood of suffering from deadline and performance pressure increases by more than 20 % when they work with these systems (S.-C. Meyer et al., 2022, p.337). In this case, ADM use seems extremely negatively related to Criteria Autonomy.

This plethora of monitoring and control tendencies gives reason to believe that control possibilities are inherent in all digital and ADM systems. Whether and how these are exploited must be assessed on a case-by-case basis. Beyond the pure monitoring and control capabilities of ADM systems, Criteria Autonomy may be viewed in the context of algorithmic management. Algorithmic management influences management tasks. Parent-Rocheleau and Parker (2022) provide an overview of the functions that algorithms are already capable of. In connection with performance evaluation, goal setting, or planning tasks, possibilities for (negatively) influencing the autonomy of management personnel

are visible. Langer et al. (2021, pp. 760–761) note that satisfaction with algorithmic results is highest when superiors can still influence them and assess decision chains themselves.

The functions of algorithmic management systems are multifaceted (Gilbert et al., 2021, p. 15): They substitute for management positions, enable remote monitoring of employees, and give them instructions, thereby influencing not only the setting of work objectives but also their execution (Method Autonomy). This refers to systems in which ADM provides at least partial or complete control of work by means of work instructions and in which work objectives are also precisely calculated and specified. Gensler and Abendroth (2021, p. 532) find that workers who receive daily algorithm-based work instructions have significantly less autonomy than their counterparts. The authors explain this result by stating that the influence of algorithmic work control is perceived as effective when it is also frequently used (Gensler & Abendroth, 2021, p. 537).

Presumably, it is not only the mere work objectives that are set that have an adverse effect on the autonomy of workers, but also, as already indicated under Method Autonomy, the delegation of responsibility, this time for the work results. Complementary systems that maintain this sense of responsibility for work results and, at the same time, have a supporting effect could be interpreted as quite conducive to Criteria Autonomy. The extent to which responsibility for work results is handed over to a technical system by employees ultimately depends on the concrete work objectives, or, in the case of service employees, also on the service recipients, from whose judgment and justification workers can hardly escape.

In any case, the use of ADM systems at work, as soon as they intervene in the control and goal-setting of employees, poses a considerable threat to Criteria Autonomy, the complete, technically supported elimination of which is at least theoretically possible. Thus, the question arises: If there is no influence at all on the work objectives and criteria for evaluating one's own work, how is autonomous and independent work supposed to function?

4.2.4. *Scheduling Autonomy*

Definition

Scheduling Autonomy, similar to Method Autonomy, is present in a large number of studies and discussions of job autonomy. Breugh (1985, p. 556) is quoted yet again as he understands Scheduling Autonomy

as follows: “The extent to which workers feel they can control the scheduling/sequencing/timing of their work activities”. More recently, Spiegelaere et al. (2016, p.517) name a similar definition by stating that “work scheduling autonomy refers to the discretion of employees on when to perform which work task”. Thus, the two dimensions of Scheduling Autonomy and Method Autonomy are closely related to each other in that they have the closest relations to work tasks and their execution. In early research approaches (e.g., Hackman & Oldham, 1975; Sims et al., 1976), both dimensions were therefore often considered together or not differentiated at all.

The definition of Scheduling Autonomy in reference to Breugh (1985) and Spiegelaere et al. (2016) is extended by pace of work (e.g., Pichault & McKeown, 2019, p.67) and break determination. They can be considered as supplementing aspects for the analysis of time-related job autonomy in the execution of work tasks by giving further insights into the intensity of the work, referring to the number of work tasks executed in a predefined amount of time.

Additionally, the definition of Scheduling Autonomy is extended to the aspects of handling interruptions and uncertainties at work. These interruptions and uncertainties may have various triggers (e.g., third parties or malfunctions of technologies) as well as considerable influence on employees’ time management. As a counterpart to the independent scheduling of work (Spiegelaere et al., 2016, p.519), this aspect is explicitly included because interruptions at work occur particularly frequently in service branches and in dealings with customers, clients, or patients (DGB-Index, 2021b, pp.88–89). Scheduling Autonomy thus addresses the question of the extent to which work is planned independently and whether this planning is subject to external influence. Scheduling Autonomy thereby covers, in particular, the time-intensifying aspects of work.

Characteristics of Scheduling Autonomy: ability to decide on sequence, prioritization, timing, and speed of task completion; break determination; independent handling of disruptions and uncertainties.

In context

Similar to Method Autonomy, Scheduling Autonomy has the potential to exert a positive effect on employees’ perceived work pressure (Schieman, 2013, pp. 277–278), indicating that the importance of this dimension and the potential influence of ADM systems should not be underestimated.

Empirical findings on the interplay between Scheduling Autonomy and digital technologies, or even ADM, have rarely been conclusive. S.-C.

Meyer et al. (2019, p. 219) show that the introduction of new computer programs slightly increases the probability of planning one's own work independently. However, this connection was not found with the introduction of new manufacturing and process technologies. Furthermore, the authors report that new computer programs are negatively related to repetitive operations, while new manufacturing and process technologies make this development more likely. The authors conclude that differences in the scope for action and monotony emerge depending on the type of technology. Again, this shows the difficulty in trying to transfer knowledge about digitalization and other technical innovations to ADM.

Schaupp (2021, p. 23) aptly describes algorithms as organizational technologies that serve the structuring of work. It is precisely in this structuring sense that ADM systems are able to influence Scheduling Autonomy or to deprive workers of it. Similar to Criteria Autonomy, the core elements of algorithmic work control, in particular when work instructions are available, are of particular importance, not with regard to work goals but to planning capacities. However, systems do not necessarily have to restrict Scheduling Autonomy by issuing work instructions. It is also possible that the person giving the instructions, i.e., the supervisor or management, is replaced and implicitly more is left to one's own organization (Schaupp, 2020, p. 205), whereby the work objectives remain unchanged. Both possibilities can lead to more intensive and less autonomous work.

The clear perception of increased parallel processes at work as a result of digitization also speaks for an increasing intensification and thus less independent planning of work. In all service branches, almost half of the employees describe this development. This is particularly true of branches with an already high level of digitalization, such as information and communications services or finance and insurance (Table 17 | Appendix). The problem with a higher degree of parallelism of tasks instead of sequentially lies in the fact that there is less influence on when tasks are completed.

Regarding the use of learning systems, S.-C. Meyer et al. (2022, p. 327) share this assessment, as they also calculate a higher probability of multitasking at work when these systems are used continuously. This particularly affects person-related services, which are also less likely to be able to influence their work pace (S.-C. Meyer et al., 2022, pp. 337–338). Gerst (2019, pp. 120–121) confirms these expectations and considers them in the context of higher performance requirements. In view of the already intensive person-related services, this potential impact of the ADM system on Scheduling Autonomy must be observed with particular sensitivity.

Interruptions at work are likewise a major obstacle at work in service occupations, especially for those who are frequently in contact with customers, clients, and patients (DGB-Index, 2022a, p. 54). Service occupations show considerably higher probabilities of being interrupted at work, including when dealing with learning systems (S.-C. Meyer et al., 2022, p. 337). These expectations are shared by work councils, who, according to Zanker et al. (2019, p. 28), expect the use of learning systems to result in more difficult conditions for employees: More than half report that the intensity of work and almost as many are convinced that unplannability and disruptions at work will increase.

Interruptions and unpredictabilities, for example, in dealing with service recipients, can arise when system errors occur, the quality of results is insufficient, or the system generally cannot be relied upon. Although system errors potentially affect all autonomy dimensions, they particularly impact Scheduling Autonomy due to the need to react to these unpredictabilities (in terms of time). These occurrences must ultimately be expected in any system, since it is simply unrealistic to take into account all conditions, possibilities of influence, and changes in the planning of work processes in advance (Gerst, 2019, p. 118).

In this context, Weltz (1999) speaks of a *double reality* in companies, i.e., on the one hand, the theory of a planned work process, and, on the other hand, the reality of the usually invisible correction of this planning by workers. Considering ADM systems in relation to Scheduling Autonomy reveals such systems as part of the mechanism and possibly also the initiator, whether intentional or not, of increasingly intensified work situations.

4.2.5. Working Time Autonomy

Definition

In contrast to Scheduling Autonomy, which refers to the time dimension in relation to concrete work tasks, Working Time Autonomy determines “the discretion of employees on when to stop and start working,” according to Spiegelaere et al. (2016, p. 517). In the context of job autonomy, this approach forms a comparatively new level of consideration. Its significance results from the increase in flexible working time regulations. The definition of Spiegelaere et al. (2016) implicitly encompasses the possibility and characteristics of working outside the traditional working hours and variations such as working in the evening, at night, or at weekends, as well as doing overtime.

The hours worked during the day or the week can vary just as much as the number of hours worked during those periods (Stadler, 2019, p. 61). In the broadest sense, the choice of total working hours has an equally specifying effect on this dimension. The autonomy-relevant question is to what extent this working time can be determined by workers themselves and is perceived as burdensome. A key distinguishing component in terms of job autonomy is the perspective from which working time is controlled: by the employee or by the employer (Stadler, 2019, p. 62).

Working Time Autonomy therefore centrally discusses the relationship between flexibility options (autonomous, sovereign organization of working time) and requirements (operational processes, market or industry specifications, employer demands) (Wöhrmann et al., 2016, pp. 7, 54–82). In addition to the beginning and end of working time in terms of days or weeks, Working Time Autonomy may also refer to interruptions in working time routines such as on-call duty. Backhaus (2022, p. 2) discusses this characteristic as working time variability.

These forms of routine interruptions are explicitly included in this dimension because they erode the predictability of working time for employees. In summary, Working Time Autonomy refers to the extent to which workers can influence the extent, position, and plannability of their working hours. Thus, the dimension covers, in particular, the extensifying aspects of work.

Characteristics of Working Time Autonomy: possibility to determine the beginning and end of working time; determination of total working time and overtime; on-call duty.

In context

Findings on digitalization or even ADM in connection with the ability to influence working time are rare and often mixed with local components, namely in the context of remote work. However, aspects of working time in which ADM has a regulating effect on employees are certainly visible but rarely reflected in studies. For example, the working time of suppliers in logistics is controlled by algorithms according to their evaluated performance (e.g., Schreyer & Schrape, 2021, p. 286, 291). Nevertheless, the regulation of working time by ADM remains a largely unknown field, although the essential correlation between health and working time is scientifically undisputed.³⁰

30 Exemplary, Beermann et al. (2019, pp. 3–5) describe the negative relationship between long working hours, health and safety as clearly proven by scientific studies. They are

What is well known, albeit independent of technology, is that workers have certain restrictions on the choice of their working hours. For example, it has been shown that there are people who work part-time involuntarily. Involuntary under- and over-employment situations are quantified at 2.1 million and 1.5 million people, respectively, in Germany (Statistisches Bundesamt [Destatis], 2020). Wöhrmann et al. (2016, pp. 9–11) further show that employees in Germany on average work 43.5 hours per week, presumably more than contractually agreed. Just under half of all employees would like to reduce their working hours. Only 38 % have a great deal of influence over when they start and end their work, as well as when they take a few hours off. While this fact is certainly not due to any particular technology use, but to multiple other organizational factors, it does suggest that there are a large number of workers who have little Working Time Autonomy.

It is likely that Working Time Autonomy is sensitive to changes in the other autonomy dimensions, especially Task and Scheduling Autonomy. In this regard, Hünefeld et al. (2019, pp. 77–78) report that workers who can influence the start and end of their work but who are exposed to high workloads and high work pressure are more likely to try to compensate for the intensity by working overtime. Roth (2019, pp. 40–42) confirms these findings by pointing out that employees work more hours if the amount of work would otherwise be impossible to perform or because it is a work instruction from the company. Incidentally, the same reasons apply to weekend or evening work. Again, within the dimension of Working Time Autonomy, it becomes clear that the pure flexibility of working time has nothing to do with self-determination. It depends on whether it is a matter of self-determination on the part of the employee or of external determination on the part of the company (Krug et al., 2019, p. 7).

Now, how can the influence of digital or algorithm-controlled systems be combined with Working Time Autonomy? At the very least, it is possible that networked systems can free employees from the rigidity of a specific work location (Georg & Guhlemann, 2020, p. 20) and thus possibly also open up time-related freedoms. However, if working times are completely detached from a specific framework, there is an immediate danger of delimited and unbound working time. An increase in the irregularity of working time with ADM systems spreading is quite

associated with accidents at the workplace and reduced performance. In addition, long working hours are often accompanied by other restrictions such as high work intensity or constant availability, see overall in (Wöhrmann et al., 2016; Wöhrmann et al., 2020).

foreseeable. Certainly, ADM-controlled planning functions of working time should be under observation, especially if they influence working time and thus also implicitly transmit elements of unplannability to employees. Hidden influences of ADM systems on Working Time Autonomy might also be assumed if the possible freedoms in this dimension are used to compensate for ADM-induced restrictions in other dimensions, such as the increase in the amount of work.

Another consequence of self-determined working time that should not be underestimated is the balance between professional and private life. Although a self-determined working time situation may assist in coping with private challenges (Lott, 2020, p. 38), the potential for dissolution of boundaries also exists in the case of completely self-determined working time (Lott, 2020, p. 43). Lott and Ahlers (2021, p. 5) speak in particular of the danger of entrenched traditional gender roles, in which women tend to devote themselves to care work. This development is favored when flexible working hours meet high work pressure and unplannable working hours (Lott, 2017, p. 23).

4.2.6. *Locational Autonomy*

Definition

A relatively new dimension of job autonomy is Locational Autonomy. In this sense, it shall not imply that the possibility for employees to freely choose their place of work has only recently become established. Rather, the discussion of work locations considers the increased importance of this option for certain groups of workers. Locational Autonomy is linked to the extent to which employees can determine the place where they carry out their work. Reference is often made to home-based work.³¹ Spiegelaere et al. (2016, p. 517) fit in with their definition that “locational autonomy refers to the discretion of employees on where to perform the work tasks”. This definition may also include considerations on the specific extent of work outside the regular workplace, i.e., frequency and duration.

31 Prospectively, other forms of mobile work need to be considered as well. After all, around a quarter of all employees consider mobility to be an essential part of their work, which takes place at frequently changing work locations. These forms of mobility can include long-distance traveling to work, employees with telecommuting agreements, the need for overnight stays away from home, and business trips (Wöhrmann et al., 2020, p. 5).

Locational Autonomy essentially refers to the spatial sovereignty of employees, who, due to novel ICT, choose their place of work according to their needs and in consultation with their employer. This location may also refer to the digital workplace (Bundesministerium für Familie, Senioren, Frauen und Jugend [BMFSFJ], 2021, p. 91).

However, Locational Autonomy does not solely represent the local component in the sense of working outside the usual workplace (*macro-locality*). Equally relevant is autonomy regarding the location within the regular workplace (*micro-locality*). This refers to the freedom to choose the location for carrying out individual tasks at the regular workplace, for example, the change of rooms in the office or on the shopfloor. In summary, Locational Autonomy essentially addresses the extent to which employees can influence the place in which they perform their work.

Characteristics of Locational Autonomy: possibility to determine the place where work tasks are executed within (micro-locality) or outside (macro-locality) the usual workplace.

In context

Location-flexible work is probably the aspect of a transforming working world that has changed the most in the recent past. However, there is a deep rift between service branches. Typical white collar services with a high proportion of information-related tasks generally permit working from home more frequently (Brenke, 2016, p. 99). In contrast, the content of work does not permit working from home for a comparatively high proportion of employees in trade or consumer-related services. Yet, the focus of Locational Autonomy lies not on the quantity of remote work but on the extent to which they can choose their place of work in a self-determined manner.

Working from home is considered particularly relevant, as it is generally assumed to have a positive impact on employees' sense of autonomy as well as being beneficial for work-life balance (e.g., Beermann et al., 2019, p. 8; Gajendran & Harrison, 2007). However, there are also voices that report considerable overtime, conflicts with said work-life balance, and, ultimately, productivity issues in home-based work (e.g., Gibbs et al., 2021, pp. 12–16).

Considering this background, studies on the connection between ADM systems and Locational Autonomy are not highly informative. This finding should not be confused with the fact that digital technologies are, of course, a key enabler of many location-independent activities (e.g., DGB-Index, 2022b, p. 26). But what role does the self-determination of

employees play when work can be performed away from the usual workplace? First of all, it is well known that many employees would like to work from home. Of those employees whose jobs generally allow them to work from home, almost two-thirds would like to be able to work from home across all sectors (Brenke, 2016, p. 99).

However, there are also employees who clearly reject working from home. According to Grunau et al. (2019, p. 1), around two-thirds of employees who do not work from home also reject it in principle. In addition to the obvious argument that the professional occupation does not permit work from home, the reasons for rejecting it in the pre-COVID-19 period were mainly in the professional field (Grunau et al., 2019, pp. 6–8): There is a culture of presence that is appreciated by superiors, collaboration with colleagues is considered more difficult, or the basic technical requirements are not met. In the private sphere, many employees state that they want to separate their professional and private lives spatially. Although home office users often report that this experience is positive, they also state that the two are becoming increasingly intermingled.

It becomes apparent that it is primarily individual preferences and organizational requirements that determine employees' Locational Autonomy. Can ADM systems also influence and, if necessary, support employees' self-determination regarding the place of work? According to Georg and Guhleman (2020, p. 20), networked systems are at least capable of detaching employees' work from a specific work location. This would appear to be a supportive function in the sense that the technical option is provided in certain situations. However, it is difficult to make generalizations about the interaction between ADM systems and the macro-locality of employees.

There are certainly systems that coordinate the work location, especially in the sense of micro-locality, as a kind of control system. One might think of logistics, for example, but also of route planning in the care sector or in food services. However, it is also possible that ADM could provide support in making information available in the right place. It is possible that using ADM systems will have less of an impact on the degree of freedom in the choice of mobile work options (macro-locality) and more of an influence on the Locational Autonomy of service employees at their usual place of work or within their usual radius of activity (micro-locality).

Interestingly, spillover effects on other autonomy dimensions from Locational Autonomy must not be underestimated. It is evident, for example, that employees who work on the move not only have greater Locational Autonomy (or Working Time Autonomy), but also greater autonomy regarding the content and approach of work tasks. For exam-

ple, more mobile employees can determine the sequence of their work themselves (77 %), make many decisions themselves (80 %), and plan and schedule their work themselves (75 %) than in-house employees (66 %, 61 %, and 60 %, respectively) (Waltersbacher et al., 2019, p. 94). They are more often able to plan work independently and have greater influence over working hours. However, these new freedoms are also accompanied by more paid and unpaid work or the expectation of being available outside traditional working hours (DGB-Index, 2021a, pp. 2–6). Locational Autonomy is, therefore, inherently characterized by ambiguity.

4.2.7. Interactional Autonomy

Definition

Interactional Autonomy marks a comparatively more complex and newer job autonomy dimension. The idea of Interactional Autonomy is intended to represent the influence of interactions with third parties (e.g., colleagues, superiors, service recipients) on job the autonomy of workers. Interactional Autonomy explicitly asks where there are dependencies on other people inside or outside the organization and to what extent these dependencies influence the sense of autonomy in the execution of work.

Earlier concepts relating to the scope for action were criticized for neglecting the social context of work action (Vieth, 1995, p. 119). Alioth (1980, pp. 19–20) therefore supplemented the scope of interaction with the concept of job autonomy at an early stage. However, this addition hardly appears to have gained acceptance because interactions are hardly found in today's considerations of job autonomy. Theoretical considerations on this subject are difficult to identify. As far as intra-organizational dependencies are concerned, the relationship between the team and the individual is often the subject of debate: Haberstroh and Wolf (2005, pp. 20–23) initially state that several team characteristics influence individual autonomy: team size, uncertainty and difficulty of the team task, professional competence of the team members, and the urgency and importance of the team task. Further research approaches point to partly contradictory relationships between individual autonomy and team autonomy. Jønsson and Jeppesen (2013, p. 78) write that team autonomy is positively related to individual autonomy.

In contrast, Langfred (2000, p. 581) notes that job autonomy is in conflict at the individual and team level when the organization tries to give more autonomy to both the individual and the team. However, in

a later study Langfred (2005, p. 524), concluded that “the optimal combination of individual and team autonomy depends on the level of task interdependence in a team”. Van Mierlo et al. (2006, p. 294) add that especially social support as a moderating variable can mediate between team and individual autonomy in a positive sense. Even if the effect direction is not entirely clear, it is reasonable to assume that the integration into an organization, or more precisely, a team, and the cooperation of this team are components that influence job autonomy.

Regarding the collaboration with extra-organizational actors, the concept of interaction work according to Böhle and Wehrich (2020) comes to the fore (also Chap. 1.5). Given scope for action is considered a central prerequisite for interaction work, especially its situational and informal elements (Böhle & Wehrich, 2020, pp. 18–19; Tisch et al., 2020, p. 49). The distinctive feature of interaction work is that work is carried out on a living subject whose subjectivity is often indispensable for the success of the service (Böhle & Wehrich, 2020, p. 15). Here, a conflict line emerges regarding job autonomy: In the performance of interaction work, there is a relationship of dependency between service worker and recipient, whereby the core idea behind Interactional Autonomy is to examine to what extent this relation can be determined by workers themselves.

Interactional Autonomy asks about the dependence of workers on other people, be they colleagues, superiors, or service recipients. Of particular importance is the extent to which employees themselves can influence the degree of dependency, i.e., the degree of cooperation.

Characteristics of Interactional Autonomy: dependency on third parties; relation to team autonomy; possibility to determine extent of collaboration with third parties.

In context

While there is more empirical evidence on other job autonomy dimensions, only isolated findings exist on Interactional Autonomy. When studies do cover interaction work and its conditions, they often relate to conflicts and the resulting stresses and strains for workers (e.g., Holler & Dörflinger, 2022; DGB-Index, 2018b). The possible degrees of freedom in the performance of interaction work are rarely considered – even more seldom in conjunction with the use of technology. The subsequent empirical analyses in Part II and III are thus also intended to develop and explicate this dimension. Therefore, the discussion of Interactional Autonomy also has an exploratory character.

Perhaps research on the relationship between job autonomy and ADM in interaction situations is still so limited because there is currently a broad consensus that these systems are less able to influence the emotional-cooperative skills of employees' interaction work. Tolan et al. (2021, p.209) confirm that AI systems currently influence the abilities of searching, perceiving, and processing information rather than interaction-related abilities. Other authors (e.g., Felten et al., 2019; Webb, 2019) consider the field of action regarding novel systems to be in different areas as well. However, especially in view of the rapid development of large language models, the relevance of this argument must at least be questioned.

Regarding spatiality and digital work, some exciting insights have been gained in recent years about the changing relationship between teamwork and digital environments. For example, with the perception of more mobile work, collaboration and team activities are becoming more difficult due to less spatial proximity. Gibbs et al. (2021, p.21) describe this development as higher costs for communication and coordination. Thus, if ADM systems were to influence the location of employees' work in this way, it is possible that the cost of collaboration may increase. Presumably, job autonomy would also suffer. However, the way and place in which employees want to collaborate with others depends on the previous working atmosphere (Mergener & Trübner, 2022, p.477).

In the case of technically induced greater spatial independence of employees, it is likewise conceivable that the individual worker can act more independently of team structures or other third parties due to a higher and qualitatively better provision of information by the ADM system. In cases of doubt, information no longer must be requested from other parties but can be accessed as needed and according to the situation. This would allow concentration on the cooperative elements of work that are necessary in the sense of productive collaboration, and possibly unnecessary interruptions of the work of others could be avoided.

The fact that a high degree of mobile work can have a negative impact on the relationship between colleagues is also shown by Gajendran and Harrison (2007, p.1537). The authors argue that in this case, employees have fewer interactions with colleagues and therefore receive less support. Supervisors also need to be approached more actively to receive support. A positive relationship with one's supervisor, especially when the supervisor intervenes supportively in employees' work, has been shown to have a positive impact on job autonomy and even reduce turnover intentions (Dysvik & Kuvaas, 2013, p.15). The role of the supervisor is thereby reminiscent of previous considerations regarding the influence of algorithmic management on job autonomy. In the context of

algorithmic management of work, Gilbert et al. (2021, p. 41) even assume an alienation of employees from work and team, in which they are left to their own self-management. Communication would thus become less important. However, regarding Interactional Autonomy, the direction of the effect remains ambivalent and depends on whether workers are left to organize themselves or receive specific work instructions.

The extra-organizational component of Interactional Autonomy, i.e., assessing changed interaction work with service recipients through ADM use, is carried out in particular within the following empirical work in Part III. Fundamentally, it is evident that the standardizing and formalizing tendencies of technology use in the workplace impede the peculiarities and necessities of interactional work (Böhle & Wehrich, 2020, p. 20; Hielscher, 2014, pp. 9–14; Hielscher et al., 2015, pp. 7–8). In this constellation, interaction work may adapt to the rigidity of technical conditions and present workers with new challenges. The example of care work shows that in the application of new technologies, they not only face the obstacle of familiarizing themselves with the technology but also of actively integrating it into the care process and in their interactions with patients (Hielscher, 2020, p. 41). They are therefore faced with a new work challenge in two senses.

Interaction work faces a formalization problem (Jungtäubl, 2021) – at least if the quality of the interaction is not to suffer. It is important to emphasize that although formalization is rather considered to restrict job autonomy, it does not necessarily have to go hand in hand with poorer working conditions. Jungtäubl (2021, p. 36) describes that formalization can also serve the organization of processes, quality assurance, or the creation of measurability, which may well lead to a reduction in work requirements, especially with regard to the challenge of interaction work. This argument is supported by empirical evidence that workers who perform a lot of interaction work have less job autonomy on average and are exposed to higher emotional demands (DGB-Index, 2018b, p. 18). For a number of employees, there seems to be a negative relationship between interactional work and self-determination at work. As far as the impact of ADM systems on Interactional Autonomy is concerned, it is reasonable to assume that the direction of effect depends on the consequences of using the system on the quantity, quality, or individualization of interactional services. Perhaps there is no serious connection between ADM and Interactional Autonomy at all because workers are still able to do better interaction work and thus retain sovereignty over this field of work.

5. Job autonomy as ambivalent element of control

The consequences of job autonomy for workers, i.e., the proven connections between job autonomy and other workplace-related factors, have already been discussed (Chap. 1.4 and 4): As a motivational or stress-reducing work resource, granting job autonomy may help to shape personnel or corporate aspects such as job satisfaction, health, or productivity in a positive way. The absence of job autonomy may have corresponding diametric effects. However, it has also been argued that there is a saturation point regarding job autonomy, i.e., that once a certain extent is reached, the positive consequences of granting degrees of freedom can diminish or even be reversed. Thus, the analysis of empirical studies on the extent of job autonomy has already pointed to its ambivalence.

While these ambivalent consequences of different job autonomy levels have been discussed so far, the reasons for and attempts to explain varying job autonomy remain unexplained. The previous considerations have indicated what is dealt with in greater depth in this chapter: There are workers who have to cope with work demands with little job autonomy, and there are those who have greater scope for action but who are also subject to strong constraints with regard to their work results. Vieth (1995, p.94) describes both states of job autonomy as a result of *execution control* in the first case and of *outcome control* in the second case. In both cases, job autonomy serves an organizational purpose. The differences are supported by numerous theoretical approaches. At the core of these considerations is usually the corporate need to exercise control³² to solve the *transformation problem of labor* and to make the complexity of organizations controllable.

However, control is not (exclusively) antagonistic to job autonomy. Job autonomy finds application in distinct roles in the control logics of companies. The way in which technology intervenes in the utilization and exploitation of job autonomy is not completely mapped by theoretical approaches. Especially regarding new types of learning ADM, known approaches have so far hardly been sufficient to cover the implications for job autonomy and organizational embedding.

32 In the English-speaking debate, the term *control* is much broader than in German. Nies (2021, p.480) states that in English-speaking discourse, control refers to all forms of performance management, irrespective of whether direct monitoring of behavior is involved. M. Frey (2009, p.44) distinguishes between workers' control and management control in the German-speaking debate. Chap. 5 generally refers to a broad understanding of management control.

Essentially, two schools of thought on the interplay between digitalization, ADM, and job autonomy are dominant so far (Kirchner et al., 2020, pp. 3–5): Digital Taylorism supports the theory of a systematic decline in job autonomy and the revival of Tayloristic principles, especially by exploiting the monitoring capacities of digital and ADM tools. The opposite pole refers to increasing self-determination, i.e., more job autonomy using modern technology, which frees workers from monotonous and burdensome tasks.

Both approaches assume different organizational paradigms of work: Considerations on the spread of digital Taylorism emphasize the classical mechanisms of technology as a controlling, productivity-increasing element in the work process, which systematically restricts job autonomy. Comprehensive control mechanisms through digital tools enable almost complete traceability of individual work steps, which erases the last bits of the possibility to shape work processes (Staab & Nachtwey, 2016, p. 28).

Supporters of the liberating nature of digitality and ADM, granting individual workers more job autonomy, expect better conditions inside and outside of the workplace, not only in terms of content but also detached from the constraints of non-digital times regarding working hours and location. The possibilities offered by using digital means create new spaces for creativity and collaboration (e.g., Kirchner et al., 2020, pp. 4–5). In both cases, technology in the work process is fundamentally associated with the objectives of reducing the amount of human labor, gaining control over remaining human labor, and improving efficiency (Pfeiffer, 2018, p. 321).

Beyond these often polarizing views on new, sometimes disruptive technologies, the central question is what significance and function job autonomy assumes in different organizational patterns, what role is envisaged for workers in these respective constellations, and what influence using rule-based and learning technologies has on the utilization and exploitation of job autonomy. Hence, the objective of the following remarks is to *generate interpretations for the occurrence of different forms of job autonomy and their changes*. Low levels of job autonomy are no more synonymous with negative consequences for employees than high levels, which are invariably described as particularly good conditions at the workplace. Rather, it is the organizational utilization of job autonomy that determines its appearance and consequences.

These reflections must be elaborated and made applicable to the empirical analyses in Part II and Part III. A certain degree of abstraction is essential since the development of theory on the influence of learning ADM on work has not yet been completed and concluding findings are

rare, more so regarding the service sector. The interplay of (learning) technological systems and interaction work, for example, is seldom included in sociological studies.

Thus, Chap. 5 first provides an overview of existing concepts for utilizing job autonomy in companies, especially those related to direct (Chap. 5.1) and indirect (Chap. 5.2) control logics. The application of technology does not always play a leading role in these concepts, which is why more recent theoretical developments, such as the proclamation of a new Digital Taylorism, are discussed subsequently to assess the current state of research on the integration of digital tools and ADM in the work process (Chap. 5.3). It is important to emphasize that these technologies can take the form of classic rule-based systems as well as newer ML-based learning systems. Where evidence is available, separate reference is made to the possibilities of learning systems. However, it also becomes clear that basic control instances in companies can be performed by both types. These approaches are contextualized in light of the role specific corporate strategies play in the integration of technologies in companies (Chap. 5.4). Chap. 5.5 concludes by summarizing the theoretical framework on which the following empirical considerations are based and stating some expectations regarding the relation between job autonomy and ADM.

5.1. Rationalization at its core: minimizing job autonomy and direct control

The treatment of job autonomy in the logic of classical Taylorism has hardly lost any of its significance, even from today's perspective, at least for certain branches and occupations. Especially with regard to rule-based technological systems that provide largely transparent processes for management, the analogy with Frederick W. Taylor's (1911) principles is obvious since the minimization of job autonomy and maximization of control is at the core of the Taylorist idea. Taylor described the fundamentals of an organizational paradigm that seeks precise control of work processes. Rationalization and control are simultaneous objectives and prerequisites of this organizational approach. Individual steps of the work process are precisely defined to optimize their sequence. In this sense, it is hardly surprising that automation was implemented so well in Tayloristic work systems. Ideally, rule-based, mechanized work steps are performed just as well by machines.

The ideal-typical characteristics of classic Taylorism open a constant field of tension between job autonomy and company productivity de-

mands. The features of Taylorist work systems lie not only in the clear separation of simple and complex tasks but also in the division of the planning and execution of work processes. The Taylorist form of work organization systematically deprives workers of the possibility to independently organize work steps, for example, determining the methodical procedure for completing a work task or deciding on the sequence and speed of completion. The realization of performance goals is thus achieved by minimizing job autonomy. The technicization of work processes plays a decisive role – after all, the use of technology is the pacesetter of daily work. In the past, this applied to mechanical automation just as it does today to digital and learning systems, which, for example, specify the structure and scheduling of work processes in the form of algorithmic management systems.

Harry Braverman's (1974) *Labor Process Theory* (LPT) is still regarded as the central source of criticism for Taylorist work and ascribes job autonomy a fundamental role in its rationalization logic. According to LPT (overview in Thompson, 2010), the technicization process of work is regarded as an intensification and optimization of management control, dequalification, and degradation of workers under the imperative of maximizing the utilization of labor power. The collective term for the aforementioned control mechanisms is *direct control* (Friedman, 1977a, 1977b). Direct forms of control are relatively clearly identifiable by workers. For the most part, they are aimed at restricting job autonomy and decision-making (Gerst, 2002, p.105). In this constellation, using ADM systems would be considered a control instrument as it fundamentally impacts job autonomy.

The need for control in the workplace is due to the incompleteness of employment contracts, which generally do not spell out the practical implementation of work processes and the disposal of labor, i.e., the transformation problem of labor. In this context, M. Frey (2009, p. 35) names job autonomy as the central descriptor of the possibilities of control in the workplace: "From a control-theoretical perspective, the relationship between autonomy and heteronomy in work addresses *the* central problem of the capitalist labor process: the transformation of indeterminate labor capacity into determinate labor performance"³³.

Specifically, the area of uncertainty in the work process must be minimized. According to Gerst (2019, p. 111), the aim on the company side

33 Own translation of "Aus kontrolltheoretischer Perspektive wird mit dem Verhältnis von Autonomie und Heteronomie in der Arbeit *das* zentrale Problem des kapitalistischen Arbeitsprozesses angesprochen: die Transformation des unbestimmten Arbeitsvermögens in bestimmte Arbeitsleistung" (M. Frey, 2009, p. 35).

is to integrate the performance of workers regardless of their personal interests, as well as to make technology choices that best bring out their control potential to dominate workers. Thus, at the core of LPT is also the minimization of opportunistic employee behavior. In the Taylorist principle, the goal of minimizing subjectivity in work prevails. Ideally, the *disruptive factor* of human labor must be minimized as far as possible, i.e., removed from work processes.

In the Taylorist organization of work, it was originally assumed that wage incentives sufficed for guaranteeing obedience to company requirements (Senghaas-Knobloch, 2008, p. 71). In this logic, even working conditions that reduce job autonomy to a minimum would be accepted – after all, workload is compensated by a corresponding wage. Implicit in this assumption of Taylorism is that workers contribute their labor power to work processes without any attachment to subjectivity (Senghaas-Knobloch, 2008, p. 72).

Today's research consensus, however, states that even under such autonomy-restricting conditions, workers attempt to incorporate subjectivity into their work. Senghaas-Knobloch (2008, p. 71) writes that the "limits of normalizability become clear in the face of subjectivity and sociality,"³⁴ meaning that employees inevitably bring subjectivity into every work situation – also independent of the application of technology, if normalization in this sense (i.e., formalization) is seen as a prerequisite for using technical systems. Accordingly, subjectivity relates primarily to certain coping strategies with which one reacts to given work requirements, considering personal demands on one's own work. The control problem of labor could thus never be completely solved by Taylorism.

Viewing subjectivity as a disruptive factor, as in Taylorism, even contradicts the premises of successful service work. Service work thrives on the contribution of a subjective part within the framework of interaction work. In this sense, subjectivity and service work are interwoven. If organizational or technical possibilities are exploited to further reduce the subjective share of work, the core of service work is eroded, and the appropriation of work becomes more difficult, if not impossible. The consequences of such an intervention are potentially not only new burdens but also a massive cut in the motivating factors that constitute service work. What is up for discussion with ADM systems is whether their learning properties result in new possibilities for accessing or preventing subjective engagement at work.

34 Own translation of "Grenzen der Normierbarkeit werden angesichts von Subjektivität und Sozialität deutlich" (Senghaas-Knobloch, 2008, p. 71).

Despite the considerable explanatory power of Braverman's LPT, it is precisely the neglect of the subjective part of work that has triggered several waves of criticism. In addition to the disregard for resources of the subject in the work process, critics argue that there is too strong a focus on Taylorism as the only explanatory concept of given corporate strategies. The core criticisms are those of Friedman (1977a), Edwards (1979) and Burawoy (1979).³⁵

Even Thompson (2010, p. 13), as one of the leading scholars of the British branch of the LPT, admits that while the LPT can accurately describe how the control imperative is enforced in Taylorism to minimize indeterminacy, the concept, building on several waves of criticism and suggestions for improvement, has failed to provide a comprehensive theory-building around the modern transformation of the work process.

In fact, a large number of studies dating back to the 1970s, a supposed peak phase of Taylorism, point to an alternative interpretation of job autonomy. Concepts such as *responsible autonomy* (Verantwortliche Autonomie, Friedman, 1977a, 1977b), *controlled autonomy* (Kontrollierte Autonomie, Vieth, 1995; Wotschack, 1987) or *externally organized self-organization* (Fremdorganisierte Selbstorganisation, Pongratz & Voß, 1997) refer to a change in the organizational utilization of job autonomy, especially in office work at that time and in contrast to production work that was originally considered to be Tayloristic. In this context, it becomes clear that while digital and rule-based technologies create greater transparency in work processes, the control logic observed does not fit with the latter (Vieth, 1995, pp. 92–93).

The ideas of classical Taylorism are currently being revisited and expanded in the phenomenon of Digital Taylorism (Chap. 5.3). What initially remains is the realization that low levels of job autonomy point to the translation of the transformation problem of labor through direct control mechanisms and rationalization efforts in the sense of ideal-typical Taylorism. The critique of Taylor's ideas puts job autonomy in focus but also reveals that the logics of job autonomy utilization have changed or never followed Taylorist principles, especially in the service sector.

35 Likewise, the contributions by Knights and Willmott (1990) and Thompson (2010) are insightful on the course of the LPT debate.

5.2. Exploiting the subject: granting job autonomy and indirect control

Initially, Moldaschl (2001, p. 137) not only refers to outdated notions of job autonomy (Chap. 4.1) but also argues for the inclusion of *marketization* and *subjectification* tendencies in modern work environments, which often grant workers job autonomy in their self-organization but simultaneously deprive them of these freedoms by constantly renegotiating the indeterminacies and constraints of work. M. Frey (2009, p. 20) confirms that job autonomy moves and develops in an increasingly tense field between marketization and subjectification. As will be shown, the utilization of job autonomy under conditions of increasing marketization and subjectification is almost contrary to the principles of Taylorism, while the goal of exercising control remains the same. In this process, the use of technology at work does not take on the role of a direct control instance but is often used as a support tool in the primary instance.

Menz et al. (2019, p. 183) summarize marketization as an approach to the reorganization of work as a “double movement: on the one hand, the opening of the company to the market [...], and on the other hand, the incorporation of market and competition mechanisms into the company”³⁶. It is precisely the latter, namely the *internalization of the market*, that drives workers into what is in part a limitless market and outcome orientation (Menz et al., 2019, p. 183). Marketization refers not only to the opening up of the company but also of the individual employee to the mechanisms of the market with all its risks and uncertainties, which have an unfiltered effect on employees through company management (Peters, 2001, pp. 31–34).

Kratzer and Dunkel (2013, p. 47) describe this conflicting interest of workers in the course of marketization as an “organizational dilemma: the attainability of unattainable goals cannot be controlled”³⁷ – at least not directly. As an instrument of rationalization, *indirect control mechanisms* (Peters, 2011) aim to internalize economic objectives as one’s own individual work goals and attempt to increase the productivity of employees by granting them targeted scope for action in the performance

36 Own translation of “doppelte Bewegung: einerseits die Öffnung des Unternehmens in den Markt [...], andererseits die Hereinnahme von Markt- und Konkurrenzmechanismen in das Unternehmen” (Menz et al., 2019, p. 183).

37 Own translation of “organisatorisches Dilemma: Die Erreichbarkeit unerreichbarer ziele lässt sich eben nicht steuern oder organisieren” (Kratzer and Dunkel, 2013, p. 47).

of work tasks (Menz et al., 2019, p. 183). Concrete examples of indirect control mechanisms can only be sketched since they are interwoven into work organizations and hardly ever occur in physical form (examples in Kratzer & Dunkel, 2013, p. 49). These certainly include performance-related income, comprehensive control and indicator orientation, client orientations, or individual target agreements.

In contrast to direct control logics, which aim at minimizing job autonomy, indirect control mechanisms specifically exploit the granting of job autonomy. In this framework, digital technologies are still considered control instruments that eliminate the decentralization of processes and have a performance-documenting effect on workers. In relation to technology usage, Menz et al. (2019, p. 183) also refer to findings from the 1990s, which describe that information systems are essentially exploited to manage organizational complexities. In this sense, learning ADM is much better suited to dealing with these complexities in a predictive and anticipatory manner.

Indirect control mechanisms massively fall back on the subjective share in the work process in the form of self-control. However, self-control in no way equates to self-determination because job autonomy is transferred in a very targeted fashion and sometimes only partially (Mronga, 2013, p. 102). Marketization implies that the boundaries between organizational and individual work objectives begin to blur, as subjectivity is no longer regarded as a disruptive factor (in the Taylorist sense) but as a driver of labor power. Kleemann (2012, p. 7) describes this process of *subjectification of work* as the “targeted corporate utilization of human subjectivity for the work process, based on new (‘post-Tayloristic’) corporate strategies for the utilization of living labor”³⁸.

As many service workers are exposed to growing market pressure (Kratzer & Dunkel, 2013, p. 41), their subjective mechanisms for coping with the demands and needs of service recipients are increasingly under tension (Senghaas-Knobloch, 2011, p. 30). This highlights the contradictory nature of the marketization and subjectification of work in the service sector. The role of ADM systems in this relationship remains unclear at first. However, there is a risk that learning systems, which are already being used by management to cope with organizational complexities, will increasingly reach a level of maturity that allows access to the subjective part of work.

38 Own translation of “gezielte betriebsseitige Vernutzung von menschlicher Subjektivität für den Arbeitsprozess, die auf neuen (‘post-tayloristischen’) betrieblichen Strategien der Vernutzung lebendiger Arbeit beruht” (Kleemann, 2012, p. 7).

According to Senghaas-Knobloch (2008, p. 79), these subjective efforts are always necessary to cope with work demands. The formalizing and standardizing requirements of using technology contradict subjectifying work actions, which are particularly difficult to plan due to situational, experience-driven, and sense-guided behavior. When considering coping mechanisms for using technology, it is necessary to either identify the technical and organizational conditions that prevent the insertion of subjectivity into work processes (Senghaas-Knobloch, 2008, p. 74) or to recognize the subjective characteristics that protect workers from the intervention of technological control mechanisms. The latter, of course, refers to the aforementioned labor capacity and experiential knowledge of workers (Pfeiffer, 2004), which contrasts with the assumed simplicity of formalization and automation of tasks.

The ideal form of corporate exploitation of subjectivity in the course of marketization is offered by Voß and Pongratz (1998) to the *Entremployee*: The *Entremployee* no longer acts as a simple seller of labor, but as a contractor who brings labor power into the company in a self-controlled, self-economized, and operationalized manner. This self-control may refer to various job autonomy dimensions in relation to a concrete work task (method, time, location, etc.). The marketization of labor capacity, exploiting high levels of job autonomy, ultimately accesses all the individual resources of workers. The authors place the *Entremployee*³⁹ in close connection with the growing economic importance of the service sector, in which not only new forms of work often take hold but which are based on corporate flexibilization⁴⁰ to a considerable extent. The logic

39 *Entremployees* not only often work as service providers but are more likely to be female, see overview in M. Frey (2004). Voß (2007, p. 107) emphasizes that the *Entremployee* is a gender-neutral ideal type, but the author has nevertheless had to accept clear criticism of the supposedly male form of the concept (e.g., Jurczyk, 2002, p. 105) which, in particular, does not do justice to the responsibility of reproductive work (Winker and Carstensen, 2007, p. 282). M. Frey (2004, p. 68) further assumes that women are better able to meet the demands of marketization than men because they have experienced the dissolution of boundaries, i.e., balancing different spheres of life.

40 According to Büssing and Glaser (1998, p. 587), flexibilization may take four forms: numerical flexibility (number of employees), functional flexibility (improved and broader qualification of employees), financial flexibility (performance-based remuneration system), and temporal flexibility. The disposition of working time plays a key role as it allows for the demand-oriented use of labor and is thus expressed as a condition of job autonomy (Büssing and Glaser, 1998, p. 586). The impact of flexibilization in the sense of job autonomy depends to a large extent on whether employees are faced with flexibility opportunities or requirements (overview in Wöhrmann et al., 2016, pp. 54–82).

of the Employee is essentially explained by access to the subjective momentum that employees use at work. Granting job autonomy takes on the function of an enabler of this access. Finally, the motivation to work is also transformed into an individualized search for meaning, which centrally presupposes a form of self-disciplining (Voß, 1998, p.480).

In this context, it is important to note that using technology does not necessarily involve intervening in the subjectivation of work. However, subjectifying intervention in the work process is often necessary to ensure the integration of technical tools into the work process. This form of subjectification is described by Voß and Weiß (2005, p.141) as *compensatory subjectification*, which refers to the compensatory intervention of subjects in the work process as more technology is used.

In the overall picture and as a consequence of increasing marketization, the *delimitation* of boundaries and subjectification must be thought of closely together and even be described as a complementary relationship (Voß & Weiß, 2005, p.143). The blurring of boundaries and subjectification are no less than symptoms accompanying specific corporate strategies that attempt to access the resource of subjectivity. Compensatory subjectivization therefore assumes that intervention by workers in technical processes is necessary, regardless of whether it is rule-based or learning-based.

Furthermore, M. Frey (2004, p.63) considers delimitation to be a central consequence of marketization and subjectification, namely with regard to the boundaries between professional and private life, the extreme outcome and performance orientation of work, the spatial dissolution of regular work environments, and the boundaries between management and employees. The latter refers to the internalization of corporate principles and practices on the part of employees. The exploitation of legal gray areas and blurring of boundaries is another area of concern. According to M. Frey (2004, p.63), the common feature of all these forms is the “partial dissolution of an institutional constitution of work”⁴¹.

Delimitation essentially breaks up existing organizational logics to make them more flexible. As the concept encompasses all social levels, delimitation attacks and deliberately dissolves established social structures (Voß, 1998, p.474). According to Voß (1998, p.480), those social structures may include:

41 Own translation of “partielle Auflösung einer institutionellen Verfasstheit von Arbeit” (M. Frey, 2004, p.63).

- Time: flexibilization of working hours, duration, and distribution
- Space: decoupling of work from the place of work
- Tools/technology: Self-organization in the choice and use of technical aids
- Work content/qualification: Self-organization in the execution of work, self-responsible maintenance of work ability
- Social organization: self-organization of horizontal and vertical cooperation
- Sense/motivation: individual motivation and goal/sense setting.

As a final note, experiencing the dissolution of boundaries is of course not limited to employees who face particularly strong marketization and subjectification trends but also affects those under more restrictive conditions, such as Taylorist work systems. Regarding learning ADM, it appears likely that their use contributes to further delimitation from the workplace institution in terms of time and place, as well as influencing the further internalization of self-control.

5.3. Digital Taylorism: Just old wine in new bottles?

When it comes to the embedding of digital technologies and learning ADM in existing organizational relations, Crawford (2021, p.58) states that “rather than representing a radical shift from established forms of work, the encroachment of AI into the workplace should properly be understood as a return to older practices of industrial labor exploitation”. The reference to the rationalization logic of Taylorism seems reasonable. Many other authors establish this connection to already-known organizational phenomena as well.

What is called Digital Taylorism (e.g., Brown, 2011, p.65; The Economist, 2015; Kirchner et al., 2020, p.3; Staab & Nachtwey, 2016, p.27) today still refers to the separation of tasks, prescribed work steps, their division to the smallest level, and the control of workers – with rule-based and learning means. New to Digital Taylorism in the service sector is the extent of restructuring established business models (e.g., e-commerce division in retail), the extensive possibilities of technical process control, and new forms of peer-to-peer control (Staab & Nachtwey, 2016, pp.27–29). As a result, work intensification and devaluation tendencies occur, which insist on increased pressure to perform with little job autonomy. Staab and Nachtwey (2016, p.28) emphasize the networking idea behind digital technologies, which, as the authors describe, are similar to an assembly line and clearly show the contours of the Taylorist

idea. According to Brown (2011, p. 72), the special quality of Digital Taylorism also lies in its digital interconnectedness and global nature. Accordingly, monitoring and control options are available regardless of location (Brown, 2011, p. 74).

However, classical Taylorism had little, if any, access to the service sector. That appears to be changing. In the light of low union and social partnership coverage as well as many precarious employment conditions in services (Haipeter, 2020, p. 48), this development is all the more worrisome. Under the umbrella term of Digital Capitalism, Nachtwey and Staab (2015, p. 76) explain Digital Taylorism as the techno-digitally supported rationalization wave that now also affects the service sector and pushes workers back into the supposedly overcome labor struggles of the 1970s and 1980s. The control imperative and capital valorization again take center stage. In the system of Digital Capitalism, as Nachtwey and Staab (2015, p. 78) continue, the company as an institution and social space is increasingly dissolving – very much in line with the definition of delimitation according to M. Frey (2004, p. 63). The trend toward delimitation extends to dimensions of labor law, for example, in that a small core of fixed employees is confronted with many who are flexibly employed. Digital Taylorism assumes that companies rely on classical control mechanisms to minimize uncertainty and subjectivity (Menz et al., 2019, p. 188). The unsolvable control gap of Taylorism is being reworked by means of digital technologies, especially ML-based systems.

Schaupp (2020, p. 202) summarizes the characteristics of Digital Taylorism as follows: In Digital Taylorism, *digital* systems provide work instructions and lead to familiar simplification and segmentation of work (Nachtwey & Staab, 2015, p. 76), while the work actions of employees are recorded *digitally* and are recorded down to the smallest detail (Brown, 2011, pp. 72–74). In contrast to classic Taylorism, however, this makes the entirety of work processes more opaque in terms of the black box character, not only for workers but *also for management*, whose tasks are also subject to partial automation (Nyckel et al., 2017, p. 238). It is precisely this black box property that is characteristic of learning ADM. Management feedback is replaced by permanent digital feedback from the technical system, which calls for self-optimization and self-monitoring by employees (Nyckel et al., 2017, pp. 230–236). In this process, companies become more self-organized, but workers also disconnect more from the organization, which ultimately goes hand in hand with the dissociation from the formerly stable institution of the company (Nachtwey & Staab, 2015, p. 78).

However, as this summary by Schaupp (2020) indicates, the supporters of Digital Taylorism have already been confronted with critical voices

that either do not consider the concept sufficient for describing current developments or even discover inconsistencies with Taylorist ideas: With reference to the industrial sector, Nies (2021, p. 482) describes that highly flexible production systems, lower plannability and quantities, as well as the flexible use of labor, can hardly be reconciled with the requirements of formalization, as some digital tools require. The theory of Digital Taylorism has not yet found an answer to this problem. As with the ironies of automation, Taylorism reaches the limits of controllability.

In addition, there are well-known *limits to the formalizability* of human labor. Butollo, Engel, et al. (2018, p. 144) ask whether Digital Taylorism fails because of the same obstacles as classic Taylorism, and thus focus in particular on the involvement of workers in the work process with all their skills and experience. Butollo, Engel, et al. (2018, p. 146) further pose the question of the validity of Digital Taylorism, namely to what extent digital work processes continue to depend on the subjectivity of workers and how disruptions and impasses can be dealt with. Digital Taylorism, including the possible use of learning ADM systems and thus the minimization of subjectifying work, is in contradiction to compensatory subjectification (Voß & Weiß, 2005, p. 141) and the importance of labor capacity and experiential knowledge (Pfeiffer, 2004).

Menz et al. (2019, p. 197) agree and recognize not the corporate ideal of Taylorism in current developments but, rather, the creation of even more transparency with ongoing marketization. Nor does it focus on curtailing job autonomy. Taylorism, however, pursues different strategies rather than new forms of control. It is the answer to the problem of transforming work by other means. Ideally, Digital Taylorism is accompanied by formalization and standardization to utilize digital technologies and create transparency in work processes: “Digitalization is the dream of controlling the entire value creation process while at the same time being able to respond flexibly to the market”⁴² (Menz et al., 2019, p. 196). This means that the visibility of the work process has been massively increased, while the goal of using technology remains the operational exploitation principle (Menz et al., 2019, p. 197). However, these observations seem to relate less to learning systems due to their lack of transparency.

Possibly, the proclamation of Digital Taylorism only refers to the *service factories* (Nachtwey & Staab, 2015, p. 76) of the BigTech and

42 Own translation of “Die Digitalisierung ist der Traum von einer Durchsteuerung des gesamten Wertschöpfungsprozesses, die gleichzeitig flexibel auf den Markt reagieren kann” (Menz et al., 2019, p. 196).

platform companies. Nies (2021, p.481) confirms that the goals of Digital Taylorism are similar to those of classical Taylorism, and that digital means are used to minimize job autonomy through transparency, real-time control, and quantifiability. However, the most radical forms of this control regime have so far been observed primarily in logistics and the platform economy.

Henceforth, for Schaupp (2020), the theoretical approach of Digital Taylorism does not go far enough to explain current technological developments at the workplace and therefore brings *Cybernetic Control Theory* (Beer, 1963; Wiener, 1948, as cited in Schaupp, 2020) into play as a further explanation. Nyckel et al. (2017, p.229) also interpret the new popularity of algorithmic control systems as returning to established ideas of cybernetic control, which combines the principle of self-control with feedback mechanisms. Schaupp (2020, p.204) explains that, following Beer (1963, p.61), management cybernetics describes systems of controlled self-organization that are characterized by complex demands on control abilities. These dynamic organizations are hardly transparent, which is why Beer (1963, p.22) points to the black box character of these systems.

This also shows why management functions are becoming obsolete in management cybernetics (also Nyckel et al., 2017). The organization is supposed to regulate itself at the lowest possible hierarchical level (Schaupp, 2020, pp.205–206). What Beer (1963, p.146, as cited in Schaupp, 2020) lacked at that time for success in his conception of controlled self-organization was the *central nervous system*, which directs the desired feedback mechanisms. At this point, at the latest, the parallels to modern ML-based management systems become clear. The presence of cybernetic control elements is supported in particular by the intransparency of algorithmic process control for both employees and management (Nyckel et al., 2017, p.238).

The peculiarities of cybernetic control clearly suggest that the control gap of Taylorism at work is further closed. Cybernetic process control mechanisms no longer only aim to directly control employees – as assumed in the sense of traditional LPT – but are also intended to minimize the planning leeway of middle management (Nyckel et al., 2017, p.230). Learning feedback systems, which are supposed to coordinate specific actions via a direct coupling to control goals, play a supporting role in these control systems (Nyckel et al., 2017, p.232). This means that these algorithmic control systems intervene in the execution of individual process steps, adjust them to the control goals in real time if necessary, and give feedback directly to employees. This questions the necessity of the planning and coordinating tasks of middle management (Nyckel et al., 2017, p.233).

Overall, the cybernetic control system is more dynamic than Digital Taylorism, especially regarding time regimes. Permanent and holistic monitoring and transparency of work are linked to automated management and feedback mechanisms that leave workers to take responsibility for their own work. In this sense, only a few employees overall have the impression that digital technology is forcing predetermined work behavior to a greater extent than was previously the case (Schaupp, 2020, p. 206). In comparison to Taylorism, technical (learning algorithms) and organizational (feedback instead of management) innovations are more strongly intertwined (Schaupp, 2020, p. 207).

5.4. Corporate strategies as drivers between technology and job autonomy

Criticism of the restriction to Digital Taylorism as an explanatory model for the technical and organizational change currently being observed points not only to conceptual weaknesses but also to the fact that the principles apply only selectively to specific branches. Several authors, meanwhile, question the narrow corporate target corridor associated with the use of technology from the company's point of view: overcoming the transformation problem of labor through rationalization. Gautié et al. (2020, p. 777) write in this regard that the use of digital technologies is not the cause of a possible revitalization of Taylorism but enables it. The cause is a change in corporate strategies. The goal behind using a particular technology, it is argued, follows a particular corporate strategy, which can be understood in diverse ways in relation to job autonomy.

As described earlier, control mechanisms have distinct influences on job autonomy (Nies, 2021, p. 479). Nies (2021, p. 480) names three fundamental functions of control mechanisms: first, to deal with the transformation problem of labor. Second, management control must always be considered an instrument of power that is intended to keep opportune employees in check. Third, control (whether directly or indirectly) aims at orienting performance to market requirements.

In particular, this strengthens the argument that no technology by design is intended solely for rationalization in the sense of labor power (including minimization of job autonomy), but rather that the actual effect of using technology is determined by its organizational embedding in the company, which in turn follows a specific corporate strategy. Menz et al. (2019, p. 190) aptly point out that, in the context of the current digitalization movement, the use of technology as a control instrument is no longer primarily designed for rationalization (as in classic Taylorism)

but for process optimization. Menz et al. (2019, p.191) suggest that if workers do not perceive this digital transparency as an increase in supervision and a restriction of job autonomy, it is because the goal of technology use is not rationalization but the optimized attempt to meet performance targets.

Nies (2021, p.478) likewise criticizes the one-sided reference in the discussion of Digital Taylorism to control in the execution of work and the minimization of subjective influence by employees and expands the perspective to include the systematic corporate utilization of job autonomy. However, Nies does not limit herself to rationalization as the sole objective of technology deployment. Accordingly, the implementation of technology is not necessarily aimed directly at the control interests of companies and, in this sense, does not have a distinct impact on job autonomy. Rather, the focus shifts to the entirety of possible corporate strategies for dealing with digitalization.

Based on the so-called *Corporate Approach* (Betriebsansatz, Altmann, 1978, pp.153–167), Nies (2021, p.486) describes four corporate strategies, referring to Altmann et al. (1982, p.19), each of which describes different ways for companies to realize capital utilization. With this idea, “not the manifestation of digital technology, but the identification of the corporate interests of utilization behind it”⁴³ (Nies, 2021, p.487) moves into the focus of analysis:

- The *labor power-related strategy* (Nies, 2021, pp.489–490), also known as *labor power rationalization*, is most compatible with the principles of Digital Taylorism in that it attempts to deal with the transformation problem of labor while maximizing control logics and minimizing job autonomy. Under this strategy, however, there may equally be an expansion of job autonomy under the marketization mechanisms. The focus lies on utilizing labor power.
- The *strategies of process rationalization* or *systemic rationalization strategies* (Nies, 2021, p.490) describe logics in which technical systems are not designed for control but for the optimization of processes, which has a concrete effect on the organization of work and thus on job autonomy. However, their direction of effect is not predefined and must be determined based on specific examples. While this strategy follows rationalization principles, the various mechanisms for utilizing labor power are secondary.

43 Own translation of “nicht die Erscheinungsform digitaler Technik, sondern die Identifizierung der dahinterstehenden betrieblichen Nutzungsinteressen” (Nies, 2021, p.487).

- With *market and business strategies*, Nies (2021, p.491) refers to purposeful technology use for improving market positions. This strategy relates, for example, to the tracking of products for end customers and, in this sense, has less to do with the control ideas of companies.
- The fourth strategy is more of a non-strategy because technology use follows *innovation and discourse-driven digitalization* (Nies, 2021, p.492). This involves reacting to competitors and external effects, not necessarily a specific objective associated with the technology.

These corporate strategies may refer to both rule-based and learning ADM. Nies (2021, p.492) concludes that the influence of technology on job autonomy does not necessarily result from the prevailing control mechanisms. If, as in most cases, there is a connection between job autonomy and control, then the specific direction of the impact on job autonomy and the interest in exploiting this changed autonomy depends on the specific corporate strategy behind using a technology.

While Nies (2021) and Menz et al. (2019) deal with the use of digital tools, which can include both rule-based and learning ADM in this general sense, Huchler (2023, p.366), as one of the few authors who does not limit himself to the monitoring and control properties of technical systems, adds another perspective on the functions of technology in the work process. In particular, Huchler emphasizes the assisting character of subsymbolic, i.e., learning, systems. The author adds to the direct or indirect control properties of these systems and introduces the controlling effect of the technical systems as *control by design* as a kind of latent control instrument. Huchler (2023, p.367) refers to control by means of work equipment, which in turn has an indirect influence on work, for example, on job autonomy. This idea might correspond to the strategies of process rationalization.

Huchler (2023, p.368) specifically points out the similarity between subsymbolic systems and indirect control. Accordingly, technical systems with learning elements enable the complexity of work to be kept open for a long time, in contrast to purely rule-based systems. The need to master work processes is thus suspended since only functions and goals are given to the system and not precise calculation steps (Huchler, 2023, p.369). This is where the black box properties of learning systems come into play, which are comparable to indirect control in that they aim at a specific controllable result and not the path to it. The linearity of these systems can be suspended thereby.

However, according to Huchler (2023, p.369), the logic of indirect control, especially the focus on flexibility and adaptability, is transferred

to technical systems rather than to employees. Accordingly, learning systems trigger a “new phase of technology-centered handling of complexity and uncertainty in work processes”⁴⁴ (Huchler, 2023, p. 369), which not only represents a further step in the direction of automation. It also demands higher levels of compensation and supplementation (Huchler, 2022, p. 164) from employees in order to integrate the systems into the socio-technical system. According to Huchler’s assumptions, some parallels to cybernetic control theory may be drawn.

In summary, as valuable as these approaches to determining the specific corporate strategy for assessing the impact of technology use on job autonomy are, the extent to which these considerations can also be applied to the service sector remains an open question. For a long time, the paradigm of Baumol’s cost disease (Baumol, 1967) predominantly excluded the rationalization possibilities of service work. Accordingly, service work can hardly be rationalized without lowering the quality of the service because wages always rise, and thus total costs also rise. For this reason, it is particularly desirable from a corporate perspective to increasingly anchor rationalization principles, to the disadvantage of service quality, in the service sector: personnel costs are high and capital intensity is too low (Ahlers et al., 2018, p. 10).

However, it is fairly obvious that the ideas of Baumol’s cost disease, which attributed special resilience to rationalization in the service sector, have long since lost their validity. On the one hand, the technicization of service tasks has long since taken over those branches, whose contents are particularly susceptible to automation efforts. After all, what is being witnessed is a sometimes disruptive change in the organization of work on the basis of technical innovations – for example, in retail and logistics, whose online segment is keeping the entire industry under constant pressure to change (Staab & Nachtwey, 2016, p. 25).

This contrasts with service tasks that are supposedly still difficult to automate, i.e., especially person-related services. However, rationalization mechanisms are clearly visible in these branches as well, even if they are less technology-supported in some areas. In this context, Baumol’s cost disease must be eliminated by visible cuts in service quality (Table 1). Although the diffusion of recent technologies in the service sector varies considerably, it is reasonable to assume that the rationalization principles and strong marketization tendencies that have been proven for the industrial sector also apply to the service sector. The best example of

44 Own translation of “neue Phase des technikzentrierten Umgangs mit Komplexität und Ungewissheit in Arbeitsprozessen” (Huchler, 2023, p. 369).

this is the healthcare sector, whose supposedly high social importance as a public good has been eroded to the core by excessive economization (overall in Dowling, 2021).

5.5. Expectations of ADM in service work and missing pieces

The initial challenge for Chap. 5 was to identify interpretative guidelines for the occurrence of various forms of job autonomy, relate these to technology use, in particular the features of rule-based and learning ADM, and apply existing theoretical approaches to the empirical analyses envisioned. For this purpose, a central distinction is drawn between less autonomous services (LAS) and highly autonomous services (HAS) as ideal types. Both expressions of job autonomy are assumed to employ different control logics and utilizations of technology, which will be illustrated in the following (Table 4). They are united in the achievement of corporate objectives of profit maximization, capital utilization, resource efficiency, and market orientation. Job autonomy fulfills different organizational roles to achieve these objectives.

Ideal-typical LAS describe branches in which rationalization efforts are expressed in a low degree of job autonomy. Prime examples are trade, logistics, accommodation and food services, or healthcare and social services. These services tend to perform person- and object-related tasks and account for the largest share of employment in the service sector. At the same time, these branches are particularly relevant to society, as they are often involved in the day-to-day care of people – be it the provision of goods or the care of people. Accordingly, many workers in LAS perform interaction work to a high degree and intensity.

The theoretical links originate in classic Taylorism, the wave of criticism in the context of LPT, and the development of Digital Taylorism. Behind these approaches lies a direct control logic, which is aimed at controlling the execution of work. Not only is job autonomy to be minimized to ensure process control and prevent opportune worker behavior. The disruptive factor of subjective involvement in work is also targeted. Control gaps are to be closed as far as possible, thus minimizing uncertainties. What, in its original form, was assigned to industry is in many areas also leading to the industrialization of services – which carries a certain terminological inconsistency.

Table 4: Overview on theoretical embedding of job autonomy and ADM systems

Less autonomous services	Highly autonomous services
Prime examples	
Trade, logistics, accommodation, food services, healthcare, social services	Information, communication, finance, insurance, scientific and technical services
Person and object-related tasks	Data and knowledge-related tasks
Theoretical link	
Classic Taylorism, LPT, Digital Taylorism	Marketization, Subjectification, Cybernetic Control
Control logics	
Direct control / execution control	Indirect control / outcome control
<ul style="list-style-type: none"> → Minimizing job autonomy → Minimizing subjectivity → Minimizing uncertainty/risks 	<ul style="list-style-type: none"> → Utilization of selectively granted job autonomy → Utilization of subjectivity → Individualization of uncertainty/risk
↓	↓
Industrialization of services (dequalification, devaluation, alienation)	Internalization of market (self-control, self-optimization, self-responsibility)
Presumed job autonomy characteristics	
<ul style="list-style-type: none"> - Task Autonomy (-) - Method Autonomy (-) - Criteria Autonomy (-) - Scheduling Autonomy (-) - Working Time Autonomy (-) - Locational Autonomy (-) - Interactional Autonomy (?) 	<ul style="list-style-type: none"> - Task Autonomy (+) - Method Autonomy (+) - Criteria Autonomy (-) - Scheduling Autonomy (+) - Working Time Autonomy (+) - Locational Autonomy (+) - Interactional Autonomy (?)
Corporate strategies	
1) Labor power rationalization 2) Process rationalization and optimization	
Role of digital technology and ADM	
1) Intensification, automation, control 2) Effective processes, reorganization 1 & 2) Creating transparency in work processes (content, time, location)	
↑↓	
Conflict with non-transparency of learning ADM systems (black box)	
Direct algorithm-driven work	Indirect algorithm-driven work
<ul style="list-style-type: none"> → Pacesetter → Real time control → Quantifiability 	<ul style="list-style-type: none"> → ADM as central nervous system → Control by design → Automated feedback/management

Condition: formalization, standardization	
↑	
Limits of formalization, standardization	
<ul style="list-style-type: none"> - Conflict with flexibility demands of the market - Necessity of compensatory subjectification 	<ul style="list-style-type: none"> - Conflict with utilization of job autonomy/ subjectivity - Necessity of compensatory subjectification
↓	↓
Effects on job autonomy	
1) Job autonomy losses (-) 2) unclear (?)	1) Job autonomy gains (+) 2) unclear (?)
Relation to concepts of action in service work	
<ul style="list-style-type: none"> - Automation of objectifying actions - Minimization of subjectifying action 	<ul style="list-style-type: none"> - Intensification/support of objectifying actions - Erosion of subjectifying action
Experiences of delimitation	
<ul style="list-style-type: none"> - Limitation within the company - Delimitation from the company 	<ul style="list-style-type: none"> - Delimitation of organizational/individual objectives - Delimitation of working time/location

The fact that LAS cannot exert much influence on the working time and location-related aspects of their work (Working Time, Locational Autonomy) appears obvious in view of their personal and object-related nature. Given the characteristics of Taylorism, the existence of direct control also suggests that job autonomy is kept as low as possible regarding the selection, execution, and scheduling of tasks (Task, Method, Scheduling Autonomy). This principle also leaves little scope for influencing work objectives and their evaluation (Criteria Autonomy).

A questionable aspect is the degree of Interactional Autonomy, i.e., the dependence on third parties and freedom in shaping cooperation. This form of job autonomy has received little attention since considerations about the organization of work and the utilization of labor have traditionally emerged from the industrial sector. The question arises as to what extent LAS can escape, at least in part, from the prevailing logics of control in the context of interactive work.

The ideal-typical HAS, in contrast, describe branches in which the principles of rationalization and process optimization are expressed in the granting of job autonomy. Prime examples include, in particular, information and communications, finance and insurance, and scientific and technical services. These service branches tend to engage in data- and knowledge-related tasks. The above-mentioned branches are characterized by a relatively high proportion of well-paid jobs and highly qualified employees. At the intersections with customers, clients, and patients, there may still be large interaction shares.

The theoretical explanations for the characteristics of HAS are essentially rooted in discussions of marketization and the associated subjectification of work (and the ideal form of the *Entreployee*). In the interplay with learning ADM, cybernetic control in particular provides a contrast to Digital Taylorism. Behind these theoretical links lies an indirect control logic that aims to control results rather than execution. The control gap of Taylorism should be closed by means of the targeted granting of job autonomy and the exploitation of subjectivity, which is no longer regarded as a disruptive factor but as an enabler. Thus, in the course of marketization processes, workers in HAS find themselves exposed to the opening of their own work to the market. The direct controlling authority of the company recedes into the background. Thus, market requirements directly affect service workers, who react to this internalization of the market with self-control and self-optimization while investing a large part of their subjectivity.

These developments are particularly ensured by granting job autonomy in the selection and way of performing tasks (Task, Method Autonomy). Working Time and Locational Autonomy complement the flexible and situational adaptation to market requirements. Nevertheless, the possibilities for action in HAS are still framed by limits. Similar to LAS, it remains to be discussed to what extent the group can determine its own work objectives and their evaluation (Criteria Autonomy). Likewise, the degree of freedom in the area of Scheduling Autonomy is at least questionable, but from a different perspective than with LAS. It is logical that workers in HAS can plan and prioritize their tasks independently, but it is evident that the time intensity of work is high and that interruptions in work processes occur frequently. In any case, the time-intensifying factor in the context of marketization should not be underestimated. Finally, the degree of Interactional Autonomy must also be considered in this context. It is possible that this is also not highly pronounced, especially because of the specific organizational forms of HAS (e.g., project work, decentralization), which lead to a dependence on third parties. It is the task of Part II, i.e., the attempt to quantify job autonomy dimensions, to systematically record the characteristics by branch.

Digital technologies and ADM serve a variety of organizational functions for both groups: as a control device, as a process-optimizing element, as a support tool, or as a combination of these. It depends on the operational goals of technology use. If these operational objectives essentially lie on a continuum between reducing human labor, gaining control over it, and improving effectiveness (Pfeiffer, 2018, p. 321), then ADM systems cannot be excluded from this logic.

Nies's (2021, pp.489–491) emphasis on the corporate strategy behind technology use is taken up in relation to different rationalization principles: labor power rationalization and process rationalization which, as described above, might have different effects on job autonomy. They may therefore be related to both LAS and HAS. Within the framework of the corporate strategy of labor power rationalization, the objective is to intensify labor power utilization through technology or to automate it completely. Control mechanisms play a key role under this target dictate. The strategy of process rationalization, by contrast, strives for more effective processes and value flows through the utilization of technology. Operational reorganization, rather than control, plays a role under this approach. Again, it can be assumed that in practice there is no clear distinction between the two concepts in companies, but that the nuances of both approaches are discernible.

With reference to the classification of ADM systems (Chap. 3.3), it is assumed that automating-substituting ADM systems are more likely to fall under the principle of labor power rationalization, while assisting-informing and augmenting-complementing functions are closer to process rationalization since they may involve a higher degree of organizational change. In this sense, the distinction between corporate strategies should be regarded as ideal-typical because Friedman (1977a) already described that corporate control strategies move between the extremes of direct control and responsible autonomy (overview in Marrs, 2018). However, this view assists in the systematic consideration and interpretation of different logics for exploiting job autonomy.

What is novel about digital and rule-based ADM systems (in relation to both operational strategies) is that their utilization creates a new level of transparency in work processes in terms of content, location, or time. This transparency of detailed work steps has the potential to cause a massive increase in inequality towards management, to the disadvantage of workers. However, this assumption contradicts the opacity of (especially learning) ADM systems for management and workers. This lack of transparency argues for an overall evolution toward less execution control and more result control, regardless of the corporate strategy or utilization of job autonomy.

Within this frame of conflict, the control principle of *direct algorithm-controlled* work is visible for the group of LAS, in that learning ADM systems are still used as pacesetters for individual work steps but also monitor them in real time and enable quantification. A new wealth of monitoring data is thus generated, which in turn is used to precisely control work. For HAS, meanwhile, there are trends toward *indirectly algorithm-driven* work, where middle management in particular is elim-

inated and control mechanisms are built into the learning systems. Employees are encouraged to exercise self-control via automated feedback mechanisms.

As advanced as some sophisticated ADM systems may be, their deployment is usually conditional on the formalization of work steps and the standardization of work environments. Standardization must not be read exclusively as alienating and monotonous for employees. In terms of occupational safety, standardization, such as the automated specification of precise work steps, can also be regarded as desirable. However, ADM systems still have their limits in terms of formalization and standardization. Regarding the service sector, these technical necessities contrast in particular with the subjective parts of the work, which do not take place in a standardized way but are carried out to a large extent by subjective work actions, i.e., reacting according to the situation and experience.

Since subjectivity should be kept to a minimum in LAS, standardization tends to conflict with a flexible response to market requirements. However, it is also well known that employees in these branches always find ways to bring subjectivity into their work, meaning that compensatory subjectivation must at least be assumed. For HAS, formalization and standardization are in clear conflict with the utilization of job autonomy and subjectivity, which are at the core of the control model. It is also assumed that for both groups, limits to automation remain, perhaps not even due to a lack of technical capability but rather because employees manage to close off some tasks (e.g., interaction work) from access by technology.

Overall, the effects of using rule-based and learning ADM systems on job autonomy assumed on the basis of previous theoretical approaches must always be viewed in light of the underlying corporate strategy. In the isolated view of labor power rationalization, a polarization is likely, which will manifest in LAS as decreases in job autonomy because the strong control mechanisms increasingly make it difficult to identify new scope for action and possibilities for appropriation. It may be that employees are left with only compensatory tasks to empower the technical systems, rather than the other way around. HAS, by contrast, could expect further gains in job autonomy under the dictates of labor power rationalization. These gains could be leveraged for further self-optimization and the identification of subjective opportunities to contribute to the work.

Regarding the strategy of process rationalization and optimization, however, the effect on job autonomy for both groups remains largely open and dependent on the specific technology and its controlling, optimizing, or supporting potential. The necessary reorganization of pro-

cesses may have unexpected consequences for employees. The possible influence on the interaction part of work is considered to be particularly relevant.

Considering the extended influence of using ADM systems, it may be assumed that effects on both objectifying and subjectifying work actions can be observed. Previous findings indicate that, in the case of LAS, objectifying actions are further automated. Due to the new level of control mechanisms and learning capacities of these systems, the erosion of the remaining possibilities for subjectifying work actions is to be discussed. Little job autonomy and the attempt to eliminate subjectivity from work processes are likely to solidify as a field of conflict with service activities. For the group of HAS, further intensification tendencies are possible, but they also support potentials regarding objectifying work actions. It remains apparent from the previous logic that subjectifying work actions must be further exploited to trigger self-optimization processes among employees.

The experience of delimitation that workers have in the process of using ADM systems is already partially visible. For LAS, it is likely that the minimization of job autonomy will continue to lead to limitations within companies. In addition, delimitations from the institutional unit of the company continue to be realistic. For HAS, delimitations have so far been found to exist in terms of the fulfillment of both personal and corporate objectives, as well as in terms of working time and place of work. Although not desirable, a further intensification of these delimitations is quite conceivable.

Many of these expectations regarding the interplay between job autonomy and ADM need to be examined in the empirical parts that follow. However, it remains to be noted that previous theoretical approaches to achieving transparency in the current utilization of technology in companies reveal two gaps: First, the effects of learning ADM systems and their partial lack of transparency must be embedded in the various control logics because they contradict known attempts to close control gaps in the work process. Is a new phase of technological determinism imminent, as Huchler (2023, p. 369) assumes, and if so, what are the consequences for service workers?

Secondly, the specific characteristics of service work, especially interaction work, and its demands for employees remain, as already mentioned several times, hardly illuminated regarding the use of ADM systems. Subjectifying action as part of interaction work might be the decisive driver of change regarding the use of learning ADM systems. Up until now, it has always been the objectifying work action that was subject to the influence of technology and automation. Does the use of learning

ADM systems result in a change in the subjective share of work? If so, the consequences could be serious, because for many service employees, interaction work is the last instance of creating meaning and motivation at work.

The theory development on both issues is not yet complete. The empirical examination of the interplay between job autonomy and ADM systems also attempts to contribute to this. In this context, the analysis of the empirical data must consider which previous theoretical insights can actually be recognized and which contradictions may arise. The final question is to what extent the utilization of ADM systems contributes to the reinforcement of existing polarizations and inequality developments, i.e., rationalization-led operational structures and market orientation. These questions will have to be returned to at a later point.

PART II

Who catches the eye?

Quantifying job autonomy in service work

6. Objective

Measuring job autonomy as part of employment quality has come to the fore in recent research attempts (overview in Warhurst et al., 2017). Though analyzing the job autonomy of workers has been explored in economics, social science, or psychology long before (e.g., Breugh, 1985; Hackman & Oldham, 1975; Sims et al., 1976). The aim of this section is to model and quantify the previously defined autonomy dimensions to determine the status quo of the job autonomy available to workers, to establish comparability across different branches based on a uniform scale, and to identify changes in job autonomy over the past years. The underlying assumption is that ADM systems have increasingly found their way into the world of work. Although no causalities between using ADM systems and changes in job autonomy are established, the aim is to identify branches in which job autonomy is particularly strong (or weak) and which individual dimensions of job autonomy have changed.

The BIBB/BAuA-Employment Survey (BIBB/BAuA-ETB)⁴⁵ is particularly suitable as a data basis for this analysis as it provides extensive data on German working environments from the point of view of workers. The central objective of the analysis is to quantify job autonomy for the German service sector, the branches falling under it, and selected characteristics of their employees (e.g., educational attainment or sex). For this purpose, an overall value for job autonomy, the *Autonomy Index*, and a breakdown of the previously defined seven autonomy dimensions are presented. Furthermore, the corresponding data sets of the BIBB/BAuA-ETB from 2018 and 2012 are compared to identify changes in job autonomy. These findings may provide indications of the penetration of ADM systems into the world of work.

45 As a representative cross-sectional survey, the BIBB/BAuA-ETB is conducted every six years. The targeted audience is employed persons aged 15 and older who work at least 10 hours a week in a paid job. The survey is supervised by the Federal Institute for Vocational Education and Training (BIBB) and the Federal Institute for Occupational Safety and Health (BAuA). The current wave dates from 2018 and includes 20.012 respondents. The corresponding dataset from 2012 includes a total of 20.036 employed people. Both datasets are harmonized. The data analysis is based on the questionnaires of the surveys, see Hall and Siefer (2011, 2017), and the associated method reports, see Gensicke and Tschersich (2018), Gensicke et al. (2012), Rohrbach-Schmidt and Hall (2013, 2020). For the present analysis, the Scientific Use Files of the 2018 and 2012 surveys were acquired.

Since the BIBB/BAuA-ETB does not contain any explicit items to map the use of ADM tools, an approximation of this content is attempted by means of combining selected skill- and task-related items following Pfeiffer (2020, p.473) (e.g., knowledge of mathematics and statistics, extent of computer usage). Although these work demands are not equivalent to the actual use of ADM systems, they do illustrate workers' potential capacities for handling them.

Part II is mainly intended to establish comparability within the service sector and, thereby, provide a comprehensible basis for the selection of branches for the qualitative, in-depth analysis. Thus, this section is an intermediate step in this thesis, which also considers gaps in previous research regarding the expression of selected autonomy dimensions, socio-economic characteristics of workers, or job-related attributes. This overall process concludes with the identification of service branches that are particularly striking examples of job autonomy cases, i.e., that show peculiarly high or low levels, and those mostly affected by changes in the degree of job autonomy between 2012 and 2018. Two of the selected branches serve as objects for an in-depth analysis of ADM systems influencing job autonomy in the qualitative Part III.

Part II is thus structured as follows: A description of the method applied (Chap. 7) is followed by the analysis chapter, which examines the calculated autonomy scales according to branches and task types (Chap. 8.1), selected socio-economic characteristics of the respondents or their organizations (Chap. 8.2), as well as other aspects connected with the use of ADM (Chap. 8.3). This cross-sectional analysis of the 2018 survey year is followed by a qualitative longitudinal comparison with the 2012 data (Chap. 8.4). The consideration of the limitations in the analysis conducted is essential for a reliable evaluation of the results (Chap. 9). Concluding remarks (Chap. 10) close Part II, summarize it, reflect on previous findings, and lead into the next section.

7. Method: constructing the Autonomy Index

There are four preliminary considerations for measuring the quality of work (Lepperhoff, 2011, pp.32–33), some of which are applied to the following analysis of job autonomy. These conceptual preliminaries include: (1) how work is defined in the present case; (2) which functions of work or dimensions are included in the analysis and to what extent they are hierarchically ranked; (3) to what extent existing inequalities in quality concepts are reproduced and how these principles are taken into account in the analysis and interpretation of the data; and (4) to what extent the complexity of work and work quality are taken into account in terms of both objective-structural and subjective perceptions of workers. These requirements for a measurement concept for work quality serve as a point of orientation for the analysis of job autonomy in the following:

- 1) The definition of work includes the paid work of dependent employees (blue-collar and white-collar workers, civil servants) in the German service sector (Chap. 7.3).
- 2) The analysis draws on the theoretical definition of seven autonomy dimensions: Task, Method, Criteria, Scheduling, Working Time, Locational and Interactional Autonomy (Chap. 4.1). Weighted equally, no hierarchical ranking is assumed between the dimensions.
- 3) Socio-economic differences among the respondents are partly considered by including educational attainment, sex, working hours, or duration of employment.
- 4) The Autonomy Index includes both objective and subjective aspects of work, depending on the dimension considered. The BIBB/BAuA-ETB mainly reflects the subjective impressions of the employees. For a lack of appropriate measures, some items deviate from this approach (specifically Working Time and Locational Autonomy).

In addition to these quality requirements, the construction of autonomy scales and the summarizing Autonomy Index are initially based on a critical examination of previous attempts to operationalize job autonomy, with a particular focus on the use of the BIBB/BAuA-ETB (Chap. 7.1). It emerges quickly that the existing concepts need to be considerably expanded to do justice to a multidimensional concept of job autonomy, which is the foundation of this thesis (Chap. 7.2). The calculation of the autonomy scales is followed by a brief description of the sample and the variables used for further analysis (Chap. 7.3). The extensive Appendix I Part II breaks down individual construction and analysis steps to achieve the highest possible reproducibility and transparency of the results.

7.1. A question of operationalization

The central question in the analysis of job autonomy based on the BIBB/BAuA-ETB is the operationalization of the concept, i.e., the selection of items that are to fill job autonomy with substance and meaning. In this regard, it is remarkable that current operationalization and measurement approaches to job autonomy hardly differ from early concepts, e.g., job redesign research in the 1970s and 1980s. Rather, earlier approaches to determining job autonomy show more multidimensional concepts. In particular, reference to the job redesign frameworks for analyzing motivational potential (Hackman & Oldham, 1975; Sims et al., 1976) and the conceptual approach of Breaugh (1985) is useful (Chap. 1.3 and 4.2): Reconsidering the Hackman and Oldham (1975, p.162) definition of autonomy in the JDS (“The degree to which the job provides substantial freedom, independence, and discretion to the employee in scheduling the work and in determining the procedures to be used in carrying it out”), the authors use three items to operationalize job autonomy (Hackman & Oldham, 1974, pp.72–79):

- *How much autonomy is there in the job? That is, to what extent does the job permit a person to decide on his or her own how to go about doing the work?*
- *The job gives a person considerable opportunity for independence and freedom in how he or she does the work.*
- *The job denies a person any chance to use his or her personal initiative or discretion in carrying out the work.*

Building on the work of Hackman and Oldham (1975) and using a similar definition of job autonomy (“The extent to which employees have a major say in scheduling their work, selecting the equipment they will use and deciding on procedures to be followed”, Sims et al., 1976, p.197), Sims et al. (1976, pp.200–208) formulate another operationalization attempt within the JCI:

- *How much are you left on your own to do your own work?*
- *To what extent are you able to do your job independently of others?*
- *The freedom to do pretty much what I want on my job.*
- *The opportunity for independent thought and action.*
- *To what extent do you receive information from your superior on your job performance?*
- *To what extent are you able to act independently of your supervisor in performing your job function?*
- *The control I have over the pace of my work.*

Finally, Breugh's (1985) operationalization closes this first canon of past analytical approaches to job autonomy. As already prominently listed in the seven dimensions of job autonomy, the author considers three dimensions of autonomy, each based on three items (Breugh, 1985, p. 570):

Work Method Autonomy

- *I am allowed to decide how to go about getting my job done (the methods to use).*
- *I am able to choose the way to go about my job (the procedures to utilize).*
- *I am free to choose the method(s) to use in carrying out my work.*

Work Scheduling Autonomy

- *I have control over the scheduling of my work.*
- *I have some control over the sequencing of my work activities (when I do what).*
- *My job is such that I can decide when to do particular work activities.*

Work Criteria Autonomy

- *My job allows me to modify the normal way we are evaluated so that I can emphasize some aspects of my job and play down others.*
- *I am able to modify what my job objectives are (what I am supposed to accomplish).*
- *I have some control over what I am supposed to accomplish (what my supervisor sees as my job objectives).*

The approaches to operationalizing autonomy according to Hackman and Oldham (1975), Sims et al. (1976), and Breugh (1985) have in common that they define job autonomy by means of methodical degrees of freedom and components of time allocation while executing tasks. In addition, Hackman and Oldham (1975) and Sims et al. (1976) include independence from other people at work in their approaches. Furthermore, the subjective part in the execution of work is emphasized (e.g., personal initiative or judgment in Hackman & Oldham, 1975) as well as the availability of information (e.g., receiving information from superiors in Sims et al., 1976). Breugh (1985) stands out with his definition of Criteria Autonomy, which is one of the few approaches that includes the influence over work goals and the evaluation of performance as part of job autonomy. What is missing from these approaches, however, are job autonomy aspects that explicitly deal with time and place of work – these gaps are presumably due to their lesser relevance at the time.

Other studies that also operationalize job autonomy but do not use the BIBB/BAUA-ETB have already been discussed in the research status

of Part I and are therefore not dealt with again in detail. An example of this is S.-C. Meyer et al. (2022, p. 328), who address learning systems and their connection with selected criteria of quality of work. Using the DiWaBE survey (Digitalization and Employment in Transition), they define job autonomy as a concept that includes independent work scheduling, determining the pace of work, freedom of decision-making, working oneself into new tasks, and influencing the amount of work or the frequency of monotonous work processes (S.-C. Meyer et al., 2022, p. 321). Gensler and Abendroth (2021, p. 526), on the contrary, are guided by Breugh's (1985) definition of job autonomy and, using the LEEP dataset (Linked-Employer-Employee-Panel) for an operationalization of job autonomy, refer to the items of autonomous determination of when a task is completed, methodical degrees of freedom, and the possibility of defining work goals themselves. In addition, Giering and Kirchner (2021, p. 562), using the SOEP-IS data set (Socio-Economic Panel Innovation Sample), take up similar operationalization elements: the possibility of deciding independently how work is to be carried out, the pace at which it is to be done, and the extent to which the sequence of tasks can be determined.

This selection of studies clearly shows that even in the current research context, there is hardly any agreement on the definition and operationalization of job autonomy. Although overlaps in terms of content are recognizable, they do not go beyond the standard understanding of quantitative approaches to job autonomy. This may be due in part to the construction of the respective data sets, but there is also a lack of critical engagement with the limited formulation of job autonomy. As will become clear, this criticism can be applied to a number of studies that use the BIBB/BAuA-ETB to deal with job autonomy. This list is intended as an excerpt of the study landscape with reference to quantitative approaches to digitalization and does not claim to be exhaustive.

Drawing on the more complex operationalization approaches of job redesign research in the 1970s and 1980s, today's understanding of job autonomy in attempts based on the BIBB/BAuA-ETB has become more limited. The studies in the following overview mostly use the 2018 dataset (Table 5). The operationalization of job autonomy is not always an explicit goal but a component of the respective research approach. In addition to the very narrow definitions of job autonomy within these studies, all other items used to answer the given research question are listed. According to the definition of job autonomy in this thesis, these items also include a wide range of autonomy-related aspects: organizational possibilities (influence on work quantity, working time, planning), work intensity (perception of pressure, contradictory demands, interruptions, lack of information, quality cuts), working time situation (work

outside traditional working hours), as well as some individual criteria (bringing in ideas, support from colleagues, timely information). The following overview of items used not only provides an insight into the different approaches to the concept of job autonomy and the content depth of the BIBB/BAuA-ETB but also marks an important orientation towards operationalizing the Autonomy Index.

It becomes clear that recent studies attribute little dimensionality to the concept and are concentrated on elements of the methodical and scheduling dimensions: Kirchner et al. (2020, p. 8) operationalize job autonomy via the frequency with which the execution of work is prescribed down to the last detail and the extent to which one's own work can be planned and scheduled. S.-C. Meyer et al. (2019, p. 215) even restrict themselves to the latter item when depicting job autonomy. In addition, a series of studies by the BAuA determine the characteristics of selected job resources by task type. They subdivide according to the task types of leadership and management (Ribbat et al., 2021, pp. 10–11), person-related (Schlicht et al., 2021, p. 11), object-related (Terhoeven, 2021, p. 7), and information-related (Tegtmeier, 2021, p. 8), and refer to task-specific resources and job autonomy. The authors define job autonomy as the ability to plan and schedule one's own work, to choose break times, and to influence workload.

Accordingly, there is a consensus among the studies examined as to how job autonomy should be operationalized. Components of flexibility in terms of working time or location, or of interaction work, are not included. Similarly, there is no focus on aspects that describe the objectives of work or task diversity. For the construction of an Autonomy Index based on the job autonomy dimensions already defined, the operationalization of job autonomy is considerably expanded. Though the studies listed help identify further suitable items: The resources include support from colleagues and superiors, which is generally considered to promote job autonomy. The same applies to the items listed under interaction demands. Factors relating to working time and place of work are used as guidelines for constructing Working Time and Locational Autonomy. Selected items of the categories intensity/demand and learning/problem solving demand are transferable to the dimensions Task, Method, and Criteria Autonomy. The reasoning of why these items are included in the construction of the Autonomy Index follows in the next chapter.

Table 5: Recent operationalization attempts of job autonomy using BIBB/BAuA-ETB

	Description	Item	Kirchner et al. 2020	Meyer et al. 2019	Ribbat et al. 2021	Schlicht et al. 2021	Terhoeven 2021	Tegmeier 2021
Job Autonomy	Prescribed how to perform work down to the last detail*	F411_02	x				x	
	Planning and scheduling work independently*	F700_02	x	x	x	x	x	x
	Deciding when to take a break*	F700_06			x	x	x	x
	Influencing amount of work*	F700_03			x	x	x	x
Resource	Feeling that task is important	F700_07			x	x	x	x
	Perception of being part of a collective	F700_10			x	x	x	x
	Support from colleagues*	F700_12			x	x	x	x
	Support from superiors*	F700_13			x	x	x	x
	Appreciation by superiors	F700_14			x	x	x	x
Time/ location	Excessive working time	AZ, F206			x	x	x	x
	Taking family and private interests into account*	F208			x	x	x	x
	Work outside 7am-7pm*	F209			x	x	x	x
	Weekend work*	F220, F223			x	x	x	x
	Work at home*	F228, F229			x	x	x	x
Intensity/ demand	Working under intense deadline or performance pressure*	F411_01			x	x	x	x
	Repeating work processes down to the last detail*	F411_03			x	x	x	x
	Experiencing disruptions or interruptions*	F411_06			x	x	x	x
	Prescribed number of pieces, certain min. output, or time*	F411_07			x	x	x	x
	Tracking of different types of work or processes*	F411_09			x	x	x	x
	Reaching the limits of performance*	F411_12			x	x	x	x
	Very fast work required	F411_13			x	x	x	x

Learning/problem solving demand	Responding to and solving problems	F327_01	x	x	x	x
	Making difficult decisions independently	F327_02	x	x	x	x
	Identifying and closing knowledge gaps*	F327_03	x	x	x	x
	Thinking about and familiarizing with new tasks*	F411_04	x	x	x	x
	Improving existing processes or trying something new*	F411_05				x
	Unlearned skills required	F411_08	x	x	x	x
Interaction demand	Not receiving all the necessary information	F700_09	x	x	x	x
	Organizing, planning, and preparing work processes of others	F310	x			
	Taking responsibility for other people*	F327_04	x	x	x	x
	Convincing others and negotiating compromises*	F327_05	x	x	x	x
	Communicating with other people professionally	F327_06	x	x	x	x

Notes: Own translation, collection, and item assignment. *Items used for the construction of the Autonomy Index.

Source: Collected items from Kirchner et al. (2020), S.-C. Meyer et al. (2019), Ribbat et al. (2021), Schlicht et al. (2021), Terhoeven (2021), Tegtmeier (2021).

7.2. Item selection

In the theoretical part of this thesis, a total of seven dimensions of job autonomy are identified. These dimensions are described in detail (Chap. 4.2) and serve as a starting point for modeling dimensions that are as congruent as possible using the BIBB/BAuA-ETB 2018 and 2012. A brief description of the defined dimensions of job autonomy may provide a reminder:

- Task Autonomy: possibility to choose work tasks from task set; task variability; composition of work quantity; completeness of tasks and information.
- Method Autonomy: selection of procedures, methods, and tools to perform work tasks; possibility to build up competencies.
- Criteria Autonomy: ability to modify or choose the criteria used for evaluating work performance; taking responsibility for work performance; possibility to set work goals and to pursue them consciously and intentionally.
- Scheduling Autonomy: ability to decide on sequence, prioritization, timing, and speed of task completion; break determination; independent handling of disruptions and uncertainties.

- Working Time Autonomy: possibility to determine beginning and end of working time; determination of total working time and overtime; on-call duty.
- Locational Autonomy: possibility to determine the place where work tasks are executed within (micro-locality) or outside (macro-locality) the usual workplace.
- Interactional Autonomy: dependency on third parties; relation to team autonomy; possibility to determine extent of collaboration with third parties.

In the following compilation of the Autonomy Index, particular importance is given to a broad definition and thus to the best possible representation of the defined dimensions of job autonomy. In this way, the requirements of a modern concept of job autonomy, which goes beyond purely methodical and scheduling characteristics, are considered. Table 6 provides an overview of the respective number of items assigned to a dimension, the content of the assigned questions, and the effect of the selected question on the dimension.

For example, the answer *frequently* to the first question *How often does it happen in your work that one and the same work process is repeated down to the last detail?* has a negative effect on the calculation of the index value of the dimension Task Autonomy. The underlying question is always whether job autonomy is strengthened. If an item promotes job autonomy (+), answering the question with *frequently* or similar has a positive effect on the calculation of the Autonomy Index. If an item is rated as autonomy-reducing (–), answering the question with *frequently* or similar reduces the overall Autonomy Index.

Table 6: Construction of Autonomy Index with selected BIBB/BAuA-ETB 2018 items

Autonomy Dimension	No.	Question	Effect
Task Autonomy	1	How often does it happen in your work that one and the same work process is repeated down to the last detail?	–
	2	How often does it happen in your work that you improve on existing procedures or try something new?	+
	3	How often does it happen that you have influence over the amount of work assigned to you?	+
	4	How often does it happen that you are not informed in time about important decisions, changes, or plans for the future?	–
	5	Do you perform your tasks mainly according to instructions or mainly independently?	–
Method Autonomy	1	How often does it happen in your work that you have to identify and close your own knowledge gaps?	+
	2	In your work, how often do you find yourself being told how to perform the work down to the last detail?	–
	3	How often in your work do you find yourself faced with new tasks that you first have to think about and familiarize yourself with?	+
Criteria Autonomy	1	How common is it in your work that you are prescribed an exact number of pieces, a certain minimum output, or the time to complete a certain job?	–
	2	How often does your work require you to push yourself to the limit?	–
	3	How often does your job involve working under intense deadline, or performance pressure?	–
Scheduling Autonomy	1	How often do you experience disruptions or interruptions in your work, e.g., due to colleagues, bad material, machine malfunctions, or telephone calls?	–
	2	How often does your work require you to keep track of different types of work or processes at the same time?	–
	3	How often does it happen that you can plan and schedule your own work?	+
	4	How often does it happen that you can decide for yourself when to take a break?	+
Working Time Autonomy	1*	How often do you manage to take your family and private interests into account when planning your working hours?	+
	2	Are your working hours normally between 7 am. and 7 pm.?	+
	3*	Have you arranged the following in your job? (on-call duty, work on demand, etc.) – none of the above	+
	4*	Do you usually work on Saturdays, at least once a month?	–
	5*	Do you usually work on Sundays, at least once a month?	–

Autonomy Dimension	No.	Question	Effect
Locational Autonomy	1*	Do you work for your company – even if only occasionally – from home?	+
	2*	How often does this occur? If your company gave you the option of working at home at times, would you accept this offer?	+
Interactional Autonomy	1	How often does your job require you to take responsibility for others?	–
	2	How often does your work involve convincing others and negotiating compromises?	–
	3	How often do you get help and support for your work from colleagues when you need it?	+
	4	And how often do you get help and support for your work from your direct supervisor when you need it?	+

Notes: Own translation, collection, and item assignment. *Marked questions indicate deviations in the definition of a dimension in 2018 from the equivalent in 2012. These differences are due to changed items in the 2018 dataset. A detailed listing of the items used in both datasets and the composition of the individual dimensions are prepared in Table 18 and Table 19 | Appendix.

Task Autonomy

If individual work processes are repeated down to the last detail for employees (item 1), it is assumed that there is little autonomy due to the low task variability. Accordingly, the item is included negatively in the calculation. In contrast, higher Task Autonomy is expected if existing processes can be improved or new things at work can be tried out independently (2). The possibility to influence one’s own workload (3) not only has the potential to increase task variability but may also enable employees to select tasks from a set and thus contribute to the holistic nature of work tasks. If workers are not informed about important decisions (4), their ability to act may be limited, and the holism of tasks may be restricted. Finally, working predominantly under instructions (5) also falls under this dimension because it influences the task content and task variability of employees.

Method Autonomy

The need to recognize and close one’s own knowledge gaps (1) is interpreted as promoting job autonomy, as it contributes to the development of competence and thus enables the use of new methods, procedures, or tools for carrying out work. On the contrary, if individual instructions are given as to how a task is to be carried out in detail (2), a reduction in

job autonomy is assumed in the methodical sense as the decision-making competence of performing tasks is minimized. If, however, it is necessary to constantly work on and think about new tasks (3), it is associated not only with the development of competence but also with the possibility of working on these new tasks with a free choice of methods.

Criteria Autonomy

This dimension is linked to setting one's own work goals and taking responsibility for them. Accordingly, the specification of exact quantities, results, or time targets (1) reduces job autonomy, according to this understanding. In contrast, frequently being forced to the limits of performance (2) has a more indirect effect on reducing job autonomy. What is intended is that the limits of performance capacity are more likely to be reached when work goals are determined by supervisors, i.e., cannot be set by oneself. Working under pressure to meet deadlines (3) is likewise evaluated in this context. This item assumes that work pressure and deadlines, whether directly or indirectly imposed, have the effect of reducing job autonomy.

Scheduling Autonomy

If this dimension is about being able to freely organize working time and work content, then being interrupted in one's work, whether for example by colleagues or by technical malfunction (1), is at odds with this form of job autonomy. Similarly, the need to monitor several work processes simultaneously (2), in the sense of intensified work, is regarded as reducing job autonomy. The formulation of the question makes it a compulsion and not a degree of freedom ("required to"). The possibility of planning and scheduling one's own work independently (3) has a clearly beneficial effect on dimensions. The same applies to the scheduling of breaks, which is decided by the employees themselves (4).

Working Time Autonomy

This dimension can only be mapped indirectly with the given items. The strongest item is the question of how often private interests can be considered when planning work (1). The remaining items reflect the extent to which deviations from traditional working hours in the form of evening and night work (2), work on call (3), or weekend work (4, 5) are present. All of them are linked to unhealthy, intense, and burdensome work. Work on call reflects the unplannability of work schedules as an element of heteronomous work. Saturday and Sunday work are included separately in the

analysis, as Saturday, in contrast to Sunday, is considered a regular working day under the Working Time Act, despite its weekend status. Thus, structural peculiarities regarding Working Time Autonomy are captured. It has been proven that these forms of temporally atypical work have a stressful effect on employees, so a negative effect on job autonomy is assumed.

Locational Autonomy

This dimension can only be mapped in relation to the possibility and frequency of working from home (1). Both items are associated with an autonomy-promoting effect on employees. The more frequently employees work from home, the more positive the effect on job autonomy. In addition, and due to a lack of other data, the potential possibility and perception of employees working from home (2) are included in the calculation of the Autonomy Index. With this dimension, however, it must be clearly pointed out that interpretations must be made with the greatest caution.

Interactional Autonomy

This dimension describes the dependency on other people at work, be they service recipients, colleagues, or superiors. Since the need to take responsibility for others (1) interferes with one's own work sphere, it is rated as reducing job autonomy. Finally, there tends to be little influence that can be exerted on the behavior or work performance of other people. Convincing others and negotiating compromises (2) also fits into this logic as an interactional demand. There is a dependence on third parties that cannot be influenced entirely by the employees themselves. In contrast, support at work from colleagues (3) or superiors (4) is regarded as conducive to job autonomy. A decisive role is played by the fact that these persons, in their supportive role, may help with work demand, be it with the gathering of information or in the actual performance of work tasks.

7.3. Calculation, sample, and variable description

In addition to the targeted selection of suitable items for the content mapping of job autonomy, the calculation of the values for the overall index and autonomy dimensions, as well as the sample and variables, is described below.

The Autonomy Index and the individual dimensions are presented on a scale from 0 to 100. To achieve this, adjustments are necessary

regarding the direction as well as the length of the response spectrum of the selected items. The correction of the direction refers to a recoding of the response spectrum of all items that would enter the index negatively, according to the above explanations. Example: The first item in the dimension Task Autonomy is *How often does it happen in your work that one and the same work process is repeated down to the last detail?*. The answer spectrum includes the possibilities frequently (F411_03=1), sometimes (=2), rarely (=3), never (=4), and not stated (=9). The recoding is frequently (=0), sometimes (=1), rarely (=3), never (=4), and not stated (=missing value). This item thus contributes positively to the Autonomy Index, provided that a work process is repeated as rarely as possible, down to the last detail. The breakdown of the recoding can be presented in Table 18 and Table 19 | Appendix.

The problem of different *lengths* of the response spectra (e.g., four vs. five response scales) is overcome by means of z-transformation, i.e., the data are standardized to establish comparability (also z-standardization). The conversion of these z-scores into the cumulative standard normal distribution leads to the representation of the data spectrum from 0 to 1. To increase reader friendliness, the values are multiplied by 100, i.e., transformed linearly.

The calculation of the index values for dimensions and the total index follows the logic of classical sum indices, i.e., the average index score across all selected items for a dimension forms the dimension score:

$$\text{Autonomy Dimension} = \frac{100}{n} \sum_{i=1}^n \text{Item score}_i$$

n – No. of items in dimension

All items are *weighted equally* in the calculation of the index value of a dimension. In order to obtain findings that are as representative as possible, the *product of design weight and drop-out weight* is taken into account (Gensicke & Tschersich, 2018, pp. 34–43; Rohrbach-Schmidt & Hall, 2013, p. 18, 2020, pp. 26–27). The purpose is to consider the selection probabilities of households and respondents caused by the sample design (design weight) as well as the selective failures due to refusals (drop-out weight) in the calculations. In particular, socio-economic characteristics are taken into account in the weighting approach (e.g., employment, occupational status, federal state, education, gender, marital status). Orientation is provided by the distribution of the population, according to Mikrozensus 2017 and 2011. Finally, the Autonomy Index is calculated as a simple average of the individual dimensions:

$$\text{Autonomy Index} = \frac{1}{m} \sum_{j=1}^m \text{Autonomy Dimension}_j$$

m – No. of dimensions

The test for reliability and internal consistency of the Autonomy Index, including all 26 items, is satisfactory with a Cronbach's alpha of 0.69.

This procedure is repeated for the 2012 wave of the BIBB/BAuA-ETB. However, there is a particularity in the comparison of the 2012 and 2018 observation years: Although both surveys are largely harmonized, there are some differences in the wording of individual items or their range of responses. However, these differences have only a minor impact on the comparison of the index values of 2012 and 2018. A problem arises from the inclusion of added items in the 2018 questionnaire or their absence in the 2012 survey. This applies primarily to items dealing with the locality or mobility of employees, i.e., the dimension of Locational Autonomy. The items assigned from the 2018 dataset are completely missing from the previous dataset, so the Locational Autonomy dimension is not calculated for 2012. As a result, an Autonomy Index that differs from the method presented is provided within Chap. 8.4. Instead of the originally defined seven autonomy dimensions, this index contains only the six calculated comparative values. Thus, a distinction is made between the two values *Autonomy Index* and *Autonomy Index w/o Locational Autonomy*.

The following sample and variable descriptions are preceded by several steps of data cleaning. In an initial step, the data is reduced by all respondents who are not in dependent employment, i.e., blue-collar workers, white-collar workers, or civil servants. Thus, self-employed persons⁴⁶ were excluded from the analysis. Likewise, all respondents not working in the service sector are excluded from the analysis. According to the Federal Statistical Office (Destatis, n.d.), the service sector comprises sections G to S according to WZ 2008 (Table 14 | Appendix). Following the data reduction, the datasets used for analysis include a total of 11.738 and 10.896 observations for the years 2018 and 2012, respectively (Table 20 | Appendix).

46 The employment status is mapped in the data set via the variable *position in occupation* (Stib). The following characteristics are excluded from the analysis: self-employed persons (Selbstständige/r), freelance workers (Freiberuflich tätig), freelancers (Freier Mitarbeiter/Freie Mitarbeiterin), contributing family members (Mithelfende/r Familienangehörige/r), and missing answers.

In line with the representative character of the BIBB/BAuA-ETB, the respondents are distributed predominantly among the sectors of human health and social service (Q), education (P), public service (O), and wholesale and retail trade (G) in 2018. This distribution differs only slightly from that in the 2012 survey year. Nevertheless, the case numbers for relatively low-employment branches are quite small. This applies to the real estate (L) and arts, entertainment, and recreation (R) sectors. When interpreting the results at a later stage, it is therefore necessary to focus on the branches that present higher case numbers.

For a more in-depth analysis of job autonomy, generated variables are used to explain the socio-economic and ADM-related characteristics of the respondents. The selected variables are available for both years under review. Table 21 | Appendix gives a brief overview of the selected generated variables, the source variable, the number of observations by year, and the share of each expression. Detailed breakdowns of the generated variables *task type*, *ADM knowledge*, and *changes in work environment* are listed in Table 22, Table 23, and Table 24 | Appendix.

Accordingly, a wide variety of task types are distributed across the respondents, also reflecting the great task-side heterogeneity of the service sector. Several task types could be assigned to one respondent. Accordingly, 30 % of respondents perform management tasks in the form of personnel responsibility. Information-related and people-related tasks are likewise frequent task types. Purely object-related tasks are performed less often.

Furthermore, the present sample mainly comprises people with vocational training or a university degree. In the period under review from 2012 to 2018, the increase in the proportion of workers with a university degree (+11 pp), the decrease in the proportion of employees without a vocational qualification (-2 pp), and those with a vocational qualification (-9 pp) indicate a certain trend toward academization. Gender ratios have remained relatively stable. Just under two-thirds of those represented in the sample are women. The respondents work in roughly equal numbers at large, medium, and small companies⁴⁷. Only a small proportion are employed by micro-enterprises. Most of the employees surveyed work 31 to 40 hours a week. Another 30 % work part-time (10 to 20 hours or 21 to 30 hours). Around one-third of the sample is made up of employees who work particularly long hours, i.e., more than 40 hours a week. More

47 Classification of enterprise sizes according to Eurostat (2016): micro-enterprises (less than 10 employees), small enterprises (10 to 49), medium-sized enterprises (50 to 249), large enterprises (more than 250).

than half of the respondents have been employed by the same employer for more than 10 years. A further 19 % have worked for the same employer for up to 10 years in 2018. This relationship is very welcome in that process-related changes in the company may be perceived over a longer period of time.

Of those respondents who already have ADM knowledge, as an indicator of the potential for dealing with ADM applications, it is predominantly basic knowledge that is indicated. Knowledge-intensive services (KIS)⁴⁸, although the ratio has fallen compared with 2012 (-12 pp), account for most respondents, at around three-quarters. In addition, most respondents work in environments that have changed little over the past two years. Around 16 % of respondents work in environments that have undergone considerable changes in many areas in the recent past. This may also be where the users and developers of ADM applications are likely to be. Almost half of all respondents frequently must make difficult decisions, which may be perceived as evidence of particularly intensive and responsibility-loaded work.

For the generated variables *task type*, *ADM knowledge*, and *changes in work environment*, definitional explanations are provided below: The idea of distinguishing between different *task types* originates from research conducted by the BAuA. A distinction is made between leadership and management (Ribbat et al., 2021), information-related (Tegtmeier, 2021), object-related (Terhoeven, 2021), and person-related (Schlicht et al., 2021) tasks to describe the digital transformation of these areas. The definition of the task types used is superficially based on the reports mentioned above but differs from the originals (Table 22 | Appendix): (1) Management describes persons who exercise supervising responsibility. (2) An information-related task describes activities such as handling data and computers, searching for and collecting information, and planning processes or research activities. (3) An object-related task describes the handling of objects in everyday work. This can include the handling/supervision of machines, the transport of goods, or cleaning activities. (4) A person-related task places a person at the center of the activity. A person is the recipient of a service, as in teaching, caring, or hosting. A

48 Knowledge intensity is assigned based on the demand profile of a job and measures whether a job is filled by an above-average proportion of highly qualified employees. The definition includes not only university graduates but also all employees who have completed further training in the form of a technical, master craftsman, or specialized school education. Knowledge-intensive occupations provide information, in particular, on the extent to which the use and provision of scientific and technological knowledge is part of a job (Hall, 2007).

job may, of course, consist of several of these tasks. Accordingly, some respondents are also assigned several task types. The differentiation according to task type ultimately serves the purpose of simplification.

Since the BIBB/BAuA-ETB does not include items related to the specific use of ADM in work environments, the goal of introducing the variable *ADM knowledge* is to approximate the use of ADM systems at work. It is assumed that it is fundamentally possible to use ADM if selected skills and tasks are used at work. These essentially include information gathering, working with computers, knowledge of mathematics and statistics, and the usage of computer application programs. Advanced ADM knowledge is additionally assumed if the computer use goes beyond pure application (Table 23 | Appendix). The approach goes back to Pfeiffer (2020, p. 467), who does not ask which tasks can be replaced by machines, since this depends on much more than pure technical feasibility, but approaches the topic of what potential workers bring to the table for shaping AI and ML in companies – a concept that appears largely applicable to ADM.

Pfeiffer (2020, p. 472) maps these potentials in terms of competencies that are necessary for utilizing these systems and draws on the following selection of items from the BIBB/BAuA-ETB: frequent collection, research, and documentation of information; professional knowledge of mathematics, specialist arithmetic and statistics; professional knowledge of PC application programs; application or use of IT systems that goes beyond pure application. The latter variable determines the extent to which *basic* (application only) or *advanced* knowledge (beyond application) is assumed.

The variable *changes in work environment* describes changes in the direct work environment within two years before the survey. These may include the introduction of new computers, machines, or services, but also organizational changes and new products (Table 24 | Appendix). The assumption is that the use of ADM systems can translate into all these forms of change. *High changes in work environment*, in this sense, describe changes at (almost) all these levels. *Low* is more likely to be interpreted as a marginal change in the immediate working environment. This variable thus serves as an approximation of the degree of change in the immediate work environment that may be associated with technological innovation, e.g., the use of ADM systems.

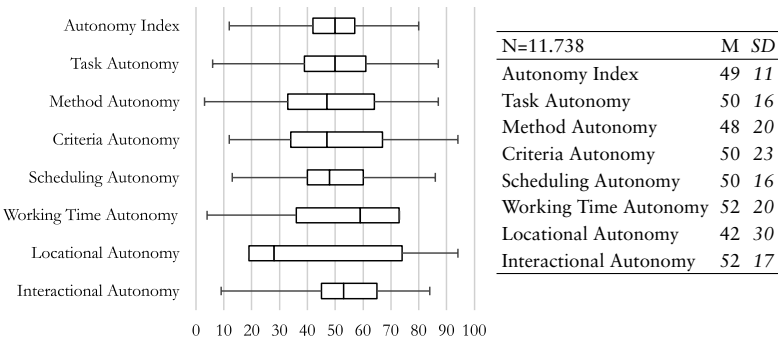
8. Results: Autonomy Index

The analysis of the Autonomy Index begins with a first overview of the sum index for the entire service sector and, at the same time, serves as an interpretation aid and reading example for the following analyses: Figure 4 initially shows the box plot results for the Autonomy Index on a scale of 0 to 100. Boxplots generally provide information about the distribution and statistical variability of data. The end of the lower whisker shows the minimum value of the underlying sample (N=11.738). Correspondingly, the upper whisker shows the maximum value. Within the box are the middle 50 % of the data. The boundaries of the box show the upper and lower quartiles. The median is usually displayed within the box as a continuous line, separating the entire chart into the lower and upper 50 % of the data.

The supplementary data table lists the mean (M) and the standard deviation (SD). Unless otherwise explained, the following considerations refer primarily to the mean value. However, it is worth taking a closer look at the median and the further distribution to statistically assess the quality of this mean value. For example, the mean value of the overall index is 49. However, the median of 50 and the position of the box indicate that there are some outliers in the lower field. Detailed summary statistics are provided in Table 25 | Appendix.

The average index value of 49 fundamentally suggests that employees are well below the maximum value and experience restrictions in their work at many levels. Even in this highly aggregated presentation, differences between individual dimensions become clear. Method and Locational Autonomy in particular are below average, indicating that many employees experience constraints in the way they perform their tasks and are also tied to a specific place of performance. Working Time Autonomy is the most pronounced dimension. This result reflects the fact that only in certain branches is it necessary to work at weekends, on call, or in shifts – again, this would apply more to low-wage branches or particularly person-related services. Interactional Autonomy makes a positive first impression. Seemingly many employees in the service sector have support at work and can work relatively independently of compromises with others.

Figure 4: Autonomy Index (Total, service sector), 2018



Source: BIBB/BAuA-ETB 2018. Own calculations.

However, the heterogeneity of the service sector at this level allows only superficial interpretations. In addition, the conceptual difficulties of Working Time and Locational Autonomy become clear: In the first case, the top 50 % of workers have stable and similar freedoms regarding working time. The bottom 50 %, by contrast, are spread over a wide range of seemingly quite different degrees of Working Time Autonomy. The opposite is the case for Locational Autonomy. This clear separation of the data situations will apply throughout the analysis.

A differentiated analysis of these aggregated autonomy dimensions is the aim of the following chapters. The question being clarified is for which employees, in which branches, and which tasks, particularly striking autonomy characteristics are apparent. For further interpretation, two method-related aspects are important: On the one hand, not the distance to the maximum value of 100 (or minimum value of 0) of the Autonomy Index should be used as an interpretation reference, but possible deviations from the mean value of the dimension. This shows more clearly, for example, which branches, or socio-economic factors are to be considered in connection with different degrees of autonomy. On the other hand, the composition of the index values for individual dimensions allows for an interpretation of the results within dimensions rather than between dimensions, for example, which branches deviate particularly clearly from the mean value within the dimension Task Autonomy.

Ultimately, the aim of this analysis is to uncover relative proportions or disproportions in the expression of job autonomy according to selected characteristics of employees, associated companies, working conditions, and branches. This approach does not show causal relationships. Based on the theoretical considerations, the following also applies here:

Low levels of autonomy must be questioned just as much as high levels, because even work environments that are conducive to job autonomy can create intensive and stressful work situations.

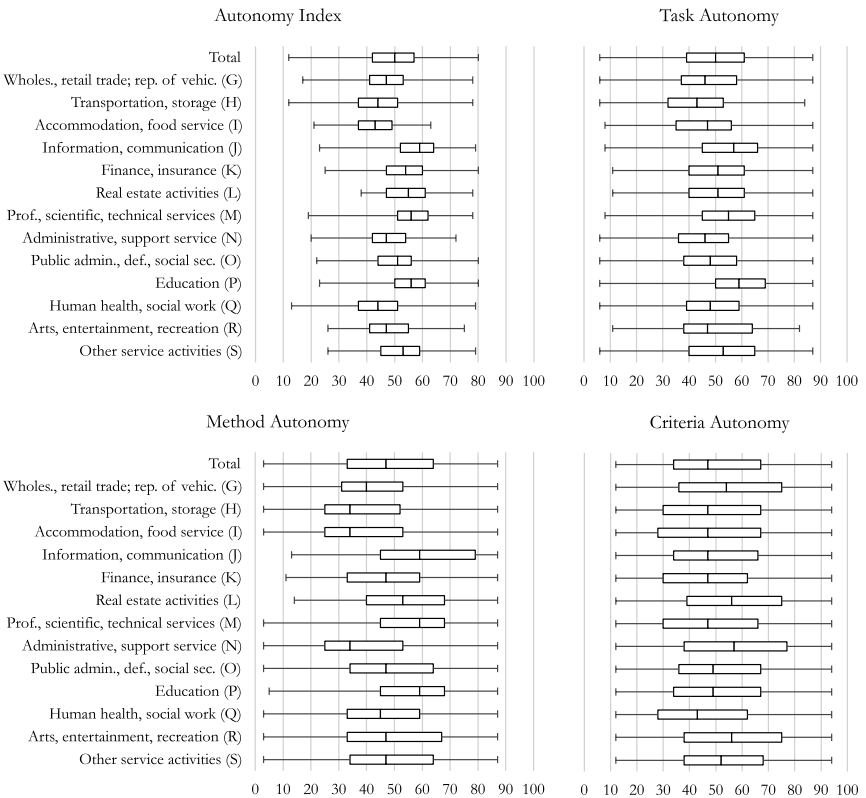
8.1. By service branch and task type

The Autonomy Index aims to quantify the degree of job autonomy in the service sector and thus realize the comparability of branches and other selected variables. The breakdown according to the predefined job autonomy dimensions is intended to show which dimensions are particularly strongly or weakly pronounced: Clearly, the broad heterogeneity of the service sector is reflected in the range of the Autonomy Index by *branch* (Figure 5). The index values confirm the previous assumption of a division into stronger and weaker expressions of job autonomy in certain branches. Information and communication, finance and insurance, real estate, other professional, scientific, and technical services, as well as education, lead the field of high-autonomy branches (also HAS). Trade, logistics, accommodation and food services, or healthcare and social services show negative deviations from the mean in the perceived job autonomy of their employees (also LAS).

Interestingly, however, this division can only be identified in relation to certain autonomy dimensions. As described above, the average index value for job autonomy in the service sector is 49. Differentiation by service branch already reveals clear deviations from this average value in some cases, which suggests that the degree of job autonomy can differ depending on the content and type of task. In turn, the group of branches that employ the most people overall but also have the highest social relevance, often performing direct person-related interaction work, is found to have less perceived job autonomy at work than the few branches with many highly qualified workers that perform less direct interaction work.

Further analysis of the branches according to the individual autonomy dimensions shows that this distinction can only be applied to selected autonomy dimensions: These include Task and Method Autonomy. This implies that the distinction between LAS and HAS is transferred in particular to the freer choice and arrangement of work tasks, a higher level of information, task variability, and influence on the amount of work in the latter group. In contrast, many employees working in LAS tend to work in prescribed work settings, have less job autonomy in their work tasks, and may have to perform more monotonous work. However, when examining Task and Method Autonomy it becomes clear that some

Figure 5: Autonomy Index by service branch (1/2), 2018



branch differences seem to be converging. For example, finance and insurance no longer stand out among the supposedly more autonomous branches, whereas healthcare and social services are more in line with the entire service sector. For these examples, autonomy-establishing or restricting factors must therefore lie elsewhere.

Branch groupings are also less clear-cut in relation to other job autonomy dimensions. For example, the Criteria Autonomy dimension is less pronounced across branches. This suggests that the entire service sector is subject to economic performance and control principles. Pressure to perform at work is considered high, and there are supposedly precise targets for the performance of work. Many employees must go to the limits of their performance to achieve them. These findings also

Figure 5 (continuing)

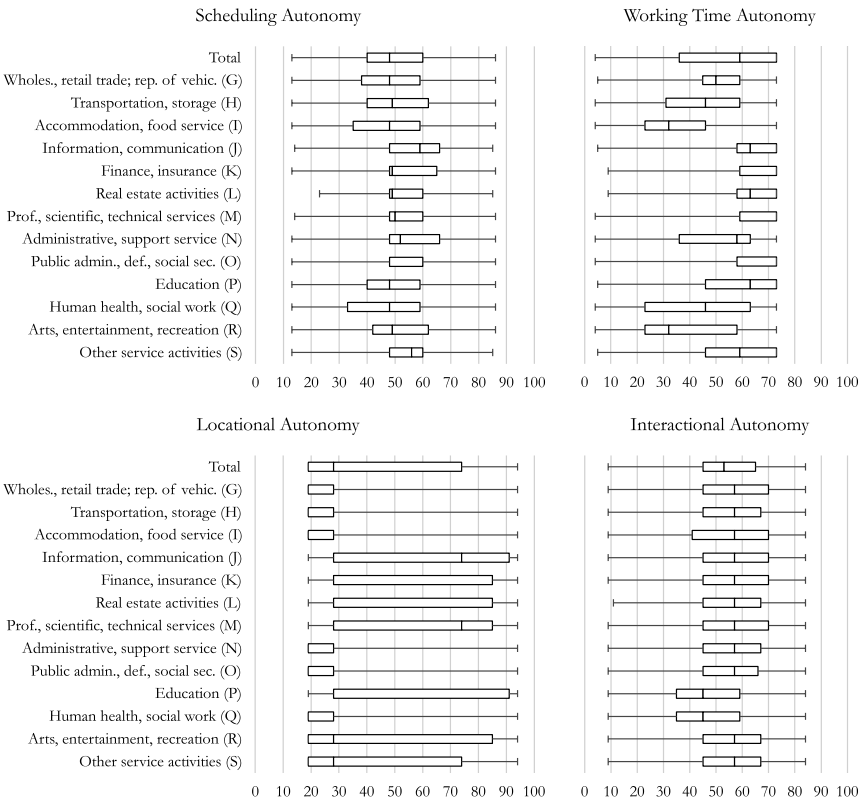
	Autonomy Index			Task Autonomy		Method Autonomy		Criteria Autonomy	
	N	M	SD	M	SD	M	SD	M	SD
Total	11.738	49	11	50	16	48	20	50	23
Branch									
Wholes., retail trade, rep. of vehic. (G)	1.242	47	9	46	15	42	19	53	24
Transportation, storage (H)	785	44	10	42	15	39	19	48	24
Accommodation, food service (I)	323	43	8	47	15	40	17	48	24
Information, communication (J)	746	58	9	55	15	60	20	49	21
Finance, insurance (K)	647	54	9	50	15	49	18	49	21
Real estate activities (L)	113	54	9	51	14	54	18	55	23
Prof., scientific, technical services (M)	800	56	8	54	15	58	19	49	21
Administrative, support service (N)	444	48	9	46	15	40	20	56	25
Public admin., def., social sec. (O)	1.714	50	9	48	14	50	19	52	21
Education (P)	1.809	56	8	59	14	58	18	50	21
Human health, social work (Q)	2.583	45	10	49	15	47	19	45	23
Arts, entertainment, recreation (R)	181	49	10	50	16	49	20	55	23
Other service activities (S)	351	52	9	52	16	49	20	53	22

Source: BIBB/BAuA-ETB 2018. Own calculations.

speak for a high degree of control over work, which has become established across the board in services, irrespective of the content and type of task. However, it is reasonable to assume that the economization and control mechanisms differ from branch to branch. What is noticeable overall regarding Criteria Autonomy is that supposedly autonomy-strong branches underperform, and the trade sector, for example, stands out positively. This may be due to the great heterogeneity within the sector, which covers large and complex corporate structures as well as the smallest economic units. Furthermore, while human health and social services still showed stronger autonomy tendencies in Task and Method Autonomy, the branch comparatively sags in Criteria Autonomy, which again speaks for strong economization tendencies that affect healthcare and social workers.

Regarding Scheduling Autonomy as a proxy for the intensity of work, which reflects the extent to which one's own work can be planned and is characterized by interruptions, the distinctions between autonomy-restricted and autonomy-enhanced branches are again apparent. However, it is less clear-cut (Figure 6). Apparently, work is perceived as very

Figure 6: Autonomy Index by service branch (2/2), 2018



intensive across branch boundaries. It is striking that particularly person-related services show a low level of Scheduling Autonomy, i.e., are particularly burdened in this sense. The possibility to plan one's own work independently and free of interruptions is more feasible, especially in the information and business-related branches. Again, these are the branches with a higher average level of qualification, wages, and overall better quality of work.

The most pronounced branch differences refer to the dimensions Working Time und Locational Autonomy. This is due to the different structuring of work and the degree of direct interaction work. Less Locational and Working Time Autonomy are particularly relevant for those branches that provide person-related services. In the case of Working

Figure 6 (continuing)

		Scheduling Autonomy			Working Time Autonomy		Locational Autonomy		Interactional Autonomy	
Total	11.738	50	16	52	20	42	30	52	17	
Branch										
Wholes., retail trade, rep. of vehic. (G)	1.242	48	16	51	15	32	23	56	17	
Transportation, storage (H)	785	51	17	43	20	32	24	55	17	
Accommodation, food service (I)	323	47	15	35	18	29	22	54	20	
Information, communication (J)	746	56	13	62	15	67	27	56	16	
Finance, insurance (K)	647	54	13	66	10	51	29	56	16	
Real estate activities (L)	113	54	13	63	13	49	29	54	17	
Prof., scientific, technical services (M)	800	54	13	63	14	56	29	57	16	
Administrative, support service (N)	444	55	15	51	18	31	23	56	16	
Public admin., def., social sec. (O)	1.714	53	14	61	17	38	25	53	17	
Education (P)	1.809	49	15	58	15	70	31	47	16	
Human health, social work (Q)	2.583	46	16	45	22	34	25	48	17	
Arts, entertainment, recreation (R)	181	52	16	38	20	44	31	54	19	
Other service activities (S)	351	54	14	57	17	44	30	54	17	

Source: BIBB/BAuA-ETB 2018. Own calculations.

Time Autonomy in particular, there are, by definition, major differences regarding the need for weekend and shift work, as well as on-call duty and the limited ability to plan working hours. The results are unsurprising in this respect, as task content and work requirements can be clearly linked to the results. However, the subsequent comparison of the extent of Working Time Autonomy between 2012 and 2018 (Chap. 8.4) is particularly exciting, as it points to an autonomy-restricting tendency in recent years.

Finally, the dimension of Interactional Autonomy also shows a leveling out across branches. Most rate this form of job autonomy similarly, i.e., the degree of (in-)dependence on colleagues and superiors is rated similarly. This suggests that the basic cooperation of employees, the degree of support, or the need to compromise are independent of the branch. Education as well as healthcare and social services differ considerably. Since both branches are characterized by a high degree of interactional work, it could be assumed that it is also more necessary to frequently take responsibility for others or to make compromises. The complexity of the interaction dependencies between superiors, col-

leagues, and, above all, service recipients imply particularly demanding work and require a lot of coordination.

It is important to keep in mind that high levels of autonomy do not automatically have a positive effect on employees. High levels of Task and Method Autonomy among highly qualified employees are characteristic of the ideal type of the Entrepmployee who achieves performance through the utilization of subjectivity. Low levels of these dimensions also speak for a standardization and formalization of work that aims to keep the subjective part of work as small as possible. All these aspects should be viewed in close connection with Criteria and Scheduling Autonomy, in that they reflect high performance pressure and intensive work – which, however, is transferred differently to employees in the sense of methodical or task-related scope for action depending on the branch.

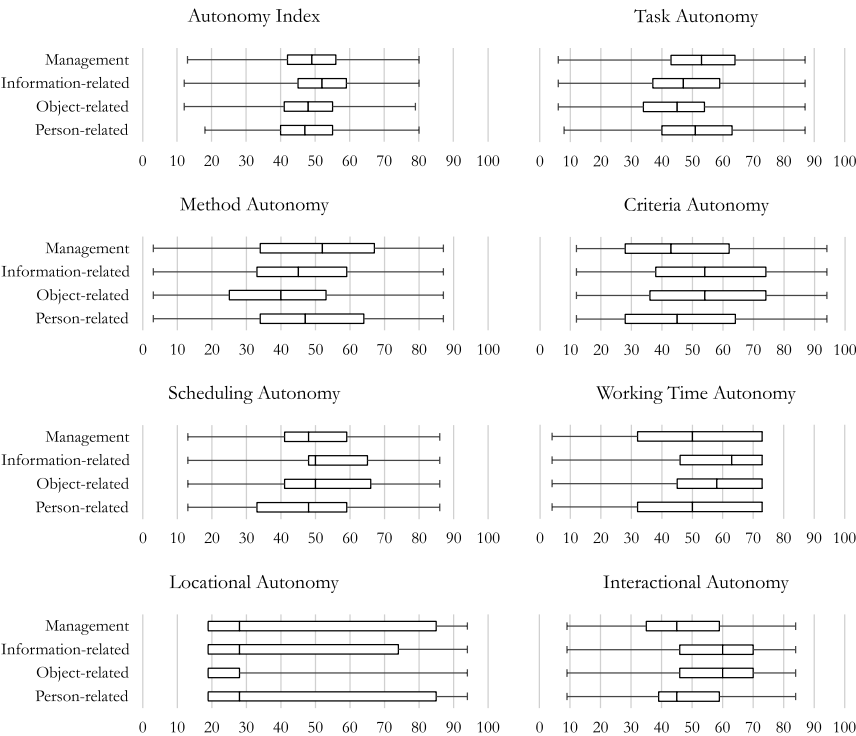
The dimensions of Working Time and Locational Autonomy indicate that only a small group of employees has the opportunity to counter this pressure to perform by means of flexibility in terms of time or place. Most employees have few opportunities to better distribute or even compensate for the pressure to perform. But even the few employees who do have these options are constantly caught between the demands and possibilities of flexibility, i.e., the fine line between setting working hours and locations according to one's own preferences and abilities. Finally, it is also evident that the dependence of one's own work on other people or the support provided at work contributes less to the varying degree of job autonomy overall by branch.

In addition to the branch analysis, the so-called *task types* can provide information about the degree of job autonomy in the service sector without the heterogeneity of a branch classification. Different task types are distinguished as management tasks, information-related tasks, object-related tasks, and person-related tasks. The following profiles can be outlined (Figure 7).

Management: The task type includes all persons with management responsibilities, regardless of the specific service. These employees are characterized by a high degree of task- and method-related autonomy. In most of the other autonomy dimensions, however, their index values are below average. They work under high performance pressure, with targets that are presumably set for them by higher hierarchical levels. It is at the interactional level that differences in autonomy are most evident. This is probably due to the fact that responsibility for other employees is assumed particularly frequently and compromises have to be negotiated.

Information-related: This task type shows the highest degree of job autonomy overall. However, these are mainly expressed in terms of working time and in an interactional sense. The possible influence on target

Figure 7: Autonomy Index by task type, 2018



	Autonomy Index			Task Autonomy		Method Autonomy		Criteria Autonomy		Scheduling Autonomy		Working Time Autonomy		Locational Autonomy		Interactional Autonomy	
	N	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Total	11.738	49	11	50	16	48	20	50	23	50	16	52	20	42	30	52	17
Task type																	
Management	3.493	49	10	53	15	52	19	45	21	49	14	49	20	52	31	45	15
Information-related	4.491	51	10	47	16	47	20	54	23	53	15	59	16	41	28	59	16
Object-related	1.905	48	11	44	15	41	20	54	24	52	17	52	17	32	24	59	17
Person-related	3.345	48	11	51	15	50	19	47	23	46	16	48	21	43	31	49	16

Source: BIBB/BAuA-ETB 2018. Own calculations.

parameters and corresponding performance pressure is also relatively higher. Less pronounced are task- and method-related degrees of autonomy. It appears obvious that the frequent handling of data entails structural limitations. This result is somewhat surprising, since these tasks are aimed at highly qualified employees, who are supposed to have the highest degree of freedom in this respect. Lower values for Task Autonomy could be due to less influence on the amount of work and frequent repetition of work steps.

Object-related: This refers to services that are performed directly on objects, i.e., not primarily on service recipients. These are often tied to a specific locality. Autonomy levels are lower than average in most dimensions. This is particularly true for task- and method-related autonomy. Less choice, scope for action, and influence on the amount of work, as well as more frequent repetition, could be aspects that have a negative impact. However, there are also employees who work under less intensive working conditions, i.e., they show above-average Scheduling Autonomy. It is striking that Interactional Autonomy is just as high as for information-related tasks. Thus, among task types that deal indirectly with service recipients and perform their work on inanimate objects, the perceived support at work as well as the need to assume responsibility appear to be lower.

Person-related: The Autonomy Index of the task type is below average overall. Pressure to perform and precise targets indicate Criteria Autonomy similar to people with management responsibility. In addition, work is perceived as particularly time-intensive. Direct work on and with service recipients is characterized by a more frequent unplannability of work. Likewise, the necessity of working outside of traditional time frames can occur more often. Furthermore, it is striking that the Interactional Autonomy component lags behind other task types without leadership responsibility. This can be attributed to the fact that compromises are negotiated frequently and responsibility for others must be assumed, which is hardly surprising in an intensive interaction activity. The profile of the person-related task type is characterized by high intensity, but it shows relatively high degrees of freedom in Task and Method Autonomy. The type, content, and design of work thus seem to be determined to a greater extent by these employees themselves.

8.2. By selected socio-economic aspects

In previous chapters of Part I (Chap. 1.5), it has already become clear that individual aspects of job autonomy in the service sector can differ considerably according to educational level and sex. However, structured information on the relationship between these socio-economic factors and job autonomy is rarely available. This gap is closed in the following. The analysis of the Autonomy Index according to the level of *educational attainment* clearly reveals that the perceived job autonomy of employees in the service sector relates positively with the level of education (Figure 8).

On average, employees with a university degree report higher levels of job autonomy than those with vocational training or no formal education. This is particularly true for their Task, Method, Working Time, and Locational Autonomy. The latter two trends are unsurprising given that highly skilled employees are less likely to work in branches and occupations that require them to be tied to a specific location or to work outside traditional working hours. Higher values for Task and Method Autonomy indicate that more freedom is given in the selection and execution of tasks as well as their concrete design. However, the dimensions that deviate from this trend are more revealing. Scheduling Autonomy hardly differs according to educational attainment. The intensity of work is high across the board. For Criteria and Interactional Autonomy, the positive connection between education and job autonomy is even reversed.

On the one hand, this indicates that lower-skilled employees are less likely to work under pressure or with strict work performance requirements. On the other hand, these employees also seem to receive more support in their work from colleagues and superiors and are less dependent overall on compromise and the work of others. At least in these two respects, lower-skilled workers appear to be slightly less challenged and stressed in their jobs in comparison to their higher qualified counterparts – which is an overall surprising and promising result.

Regarding the *sex* of the respondents, only minor differences can be identified. The average Autonomy Index of men is one point higher than that of women. Differences are expressed in higher levels of job autonomy for men in Method, Scheduling, and Locational Autonomy. This means that women are less able to decide how to solve a work task, perceive their work as more intensive, and are less mobile at work. Overall, this may be related to the fact that women work more often in person-related services. In contrast, women appear to be less likely to work outside of traditional working hours or to work on call, giving

Figure 8: Autonomy Index by selected socio-economic aspects, 2018

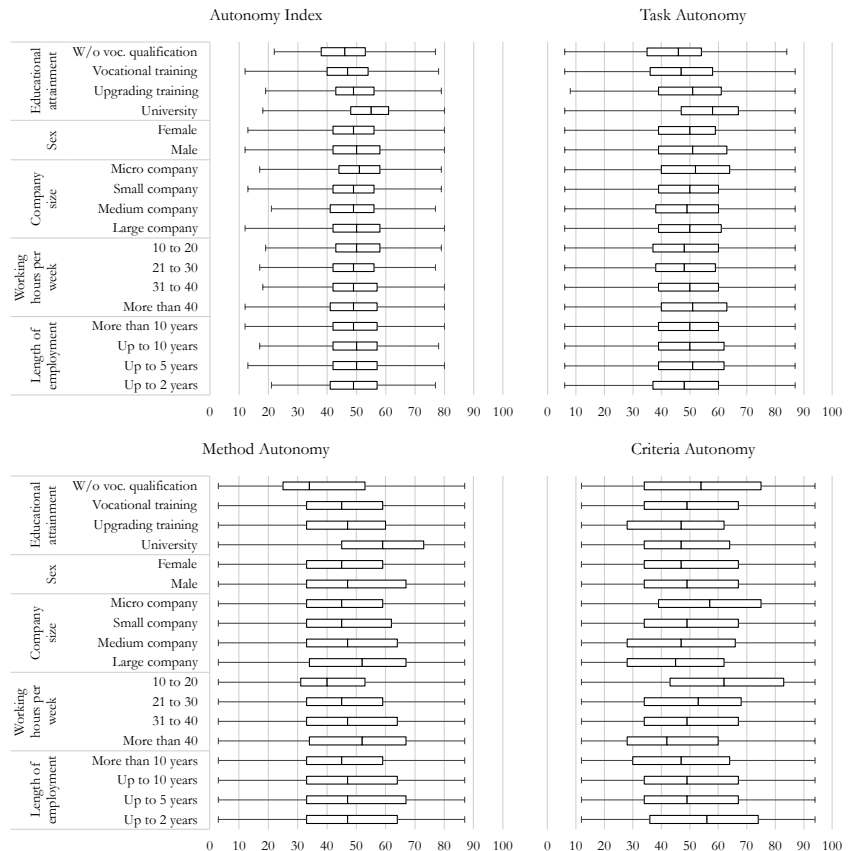


Figure 8 (continuing)

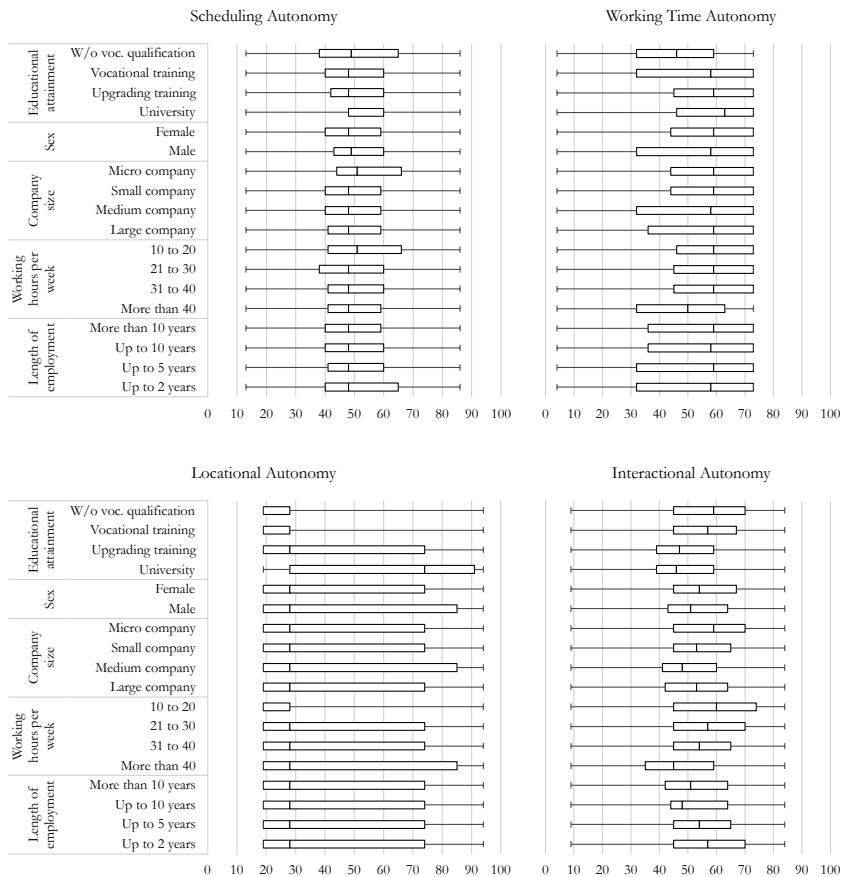


Figure 8 (continuing)

	N		M		SD		M		SD		M		SD		M		SD		M		SD		M		SD				
	Autonomy Index		Task Autonomy		Method Autonomy		Criteria Autonomy		Scheduling Autonomy		Working Time Autonomy		Locational Autonomy		Interactional Autonomy														
Total	11.738	49	11	50	16	48	20	50	23	50	16	52	20	42	30	52	17												
Educational attainment																													
W/o voc. qualif.	607	46	11	45	15	39	19	54	26	50	17	46	20	31	22	57	19												
Vocational training	5.594	47	10	47	15	44	19	50	23	49	16	51	20	34	25	54	17												
Upgrading training	727	49	10	50	15	48	19	47	23	51	14	54	19	44	29	49	16												
University	4.788	55	10	56	15	58	19	48	21	52	14	57	18	61	31	50	16												
Sex																													
Female	7.164	49	10	49	15	47	19	50	23	49	16	54	19	41	29	53	17												
Male	4.574	50	11	50	16	50	21	50	22	52	15	50	20	45	31	52	17												
Company size																													
Micro company	1.331	51	10	52	15	45	19	56	23	53	16	53	19	40	29	57	18												
Small company	3.209	49	10	50	15	48	19	50	23	49	16	53	19	40	29	52	17												
Medium company	3.268	49	10	49	16	48	20	48	23	50	15	51	20	45	31	51	17												
Large company	3.648	50	11	50	16	51	21	47	22	50	15	54	20	45	29	52	17												
Working hours per week																													
10 to 20	1.424	51	11	48	16	42	19	60	23	53	17	55	18	37	27	59	17												
21 to 30	1.971	49	10	49	15	46	20	52	24	49	17	55	18	39	28	54	17												
31 to 40	4.597	49	10	50	15	48	20	50	22	50	15	55	19	41	28	53	17												
More than 40	3.746	49	11	51	16	52	20	44	21	50	15	47	20	49	32	48	17												
Length of employment																													
More than 10 years	6.366	49	10	50	15	48	19	48	22	50	15	54	19	44	30	52	17												
Up to 10 years	2.175	49	11	50	16	49	20	49	23	50	16	52	20	43	30	52	17												
Up to 5 years	1.931	50	11	50	16	49	21	51	23	51	15	52	20	42	29	53	17												
Up to 2 years	1.221	50	11	49	16	49	21	54	24	51	16	51	20	39	28	55	18												

Source: BIBB/BAuA-ETB 2018. Own calculations.

them more Working Time Autonomy. This trend may be driven by the high proportion of women in branches that are supportive of job autonomy in this respect, such as education or public administration, but also by the fact that women are restricted in relation to working atypical hours because of their involvement in care work.

For the analysis of some job-related aspects regarding the autonomy of workers, company size, working hours per week, and length of employment with the company are selected. The aim of this is to discuss the extent to which organizational structures of varying complexity influence individual job autonomy and the extent to which part-time work, as an essential element of the service sector, is related to changes in job autonomy. Finally, it remains to be clarified to what extent company affiliation (also as a proxy for age) and corresponding experiential knowledge can be related to job autonomy.

The *size of the company* is only minimally related to the extent of job autonomy. Two poles could be roughly sketched: micro companies, which are assumed to be less characterized by rigid structures, show higher autonomy values for Criteria Autonomy, i.e., performance pressure and target agreements. This tendency is also reflected in higher Scheduling Autonomy. Interactional Autonomy is also more pronounced in micro-companies. This could indicate that these employees are less influenced by others in their work but also receive more support. In contrast, job autonomy is higher at large companies in the areas of Working Time and Locational – this is less surprising, as it can be assumed that large companies also have company agreements on these topics and time recording is more widespread. Similarly, employees in large companies have more Method Autonomy. From a purely organizational point of view, this tendency could be explained by the fact that, with many employees, it is hardly possible to give everyone precise instructions on their work steps. Accordingly, Method Autonomy increases overall with the size of the company.

Regarding *weekly working hours*, meaningful differences emerge. The overall index initially moves in favor of fewer weekly working hours. The values of the individual autonomy dimensions again follow the pattern of smaller companies in the company size panel. This means that the lower the weekly working hours, the more pronounced the dimensions of Criteria, Scheduling, and Interactional Autonomy. This suggests, rather counterintuitively, that employees who work fewer hours also face less pressure to perform and receive more support at work. Counterintuitive implies that it would stand to reason that people with fewer hours would feel particularly rushed and would be more likely to be bound by precise target agreements to get their work done. Furthermore, there appears

to be a minor difference in autonomy between the groups of employees who work 21 to 30 or 31 to 40 hours per week. It is the group that goes beyond the classic 40-hour week and enjoys methodical and task-related freedoms but loses job autonomy in all other dimensions.

Finally, the analysis of the *length of employment* in the company reveals that individual autonomy dimensions hardly differ. A connection between job autonomy and length of employment can only be isolated at a few points. Criteria Autonomy, i.e., the perception of pressure to perform and the setting of personal goals, appears to be more pronounced with the increasing duration of employment in the respective company. Support at work and dependence on others also tend to move toward more autonomy – possibly also due to a more pronounced internal network at the workplace. Employees who have been with the same employer for many years also seem to become more immobile. However, mobility may also be more a question of age than of affiliation.

8.3. By selected ADM aspects

As already described, the use or possible influence of ADM systems can only be outlined with the BIBB/BAuA-ETB. For this purpose, the skills of employees relevant for the use of ADM following Pfeiffer (2020), knowledge intensity of tasks, changes of an organizational and technical nature in the direct work environment, and the need to make difficult decisions are used as a proxy for describing the possible influence of ADM systems on various autonomy dimensions.

The level of the Autonomy Index according to *ADM knowledge* can indicate the differences that would arise in the actual use of ADM systems. Pfeiffer (2020, p.473) distinguishes between basic and advanced knowledge. The latter refers not only to statistical and mathematical knowledge and the need to analyze data, but also to whether computers are used only as users or beyond. In line with this division, Pfeiffer (2020, p.473) calculates that around 4 % of all employees in Germany already have specialist knowledge and 11 % have basic knowledge of the use of ADM applications. It goes without saying that this approach can only approximate actual knowledge when dealing with ADM systems. As expected, the Autonomy Index clearly differs from the average for the total service sector (Figure 9).

With increasing ADM knowledge, job autonomy generally increases. In particular, the values for advanced ADM knowledge exceed the average values for all employees, in some cases strongly – for example, regarding Task and Method Autonomy, but also in the location- and time-

Figure 9: Autonomy Index by ADM aspects, 2018

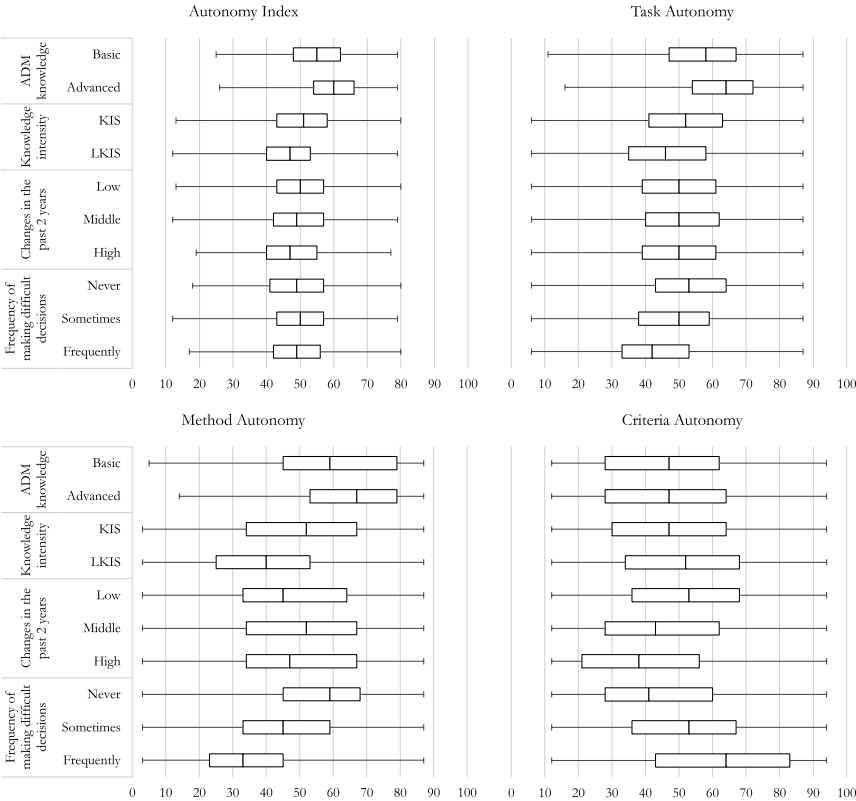


Figure 9 (continuing)

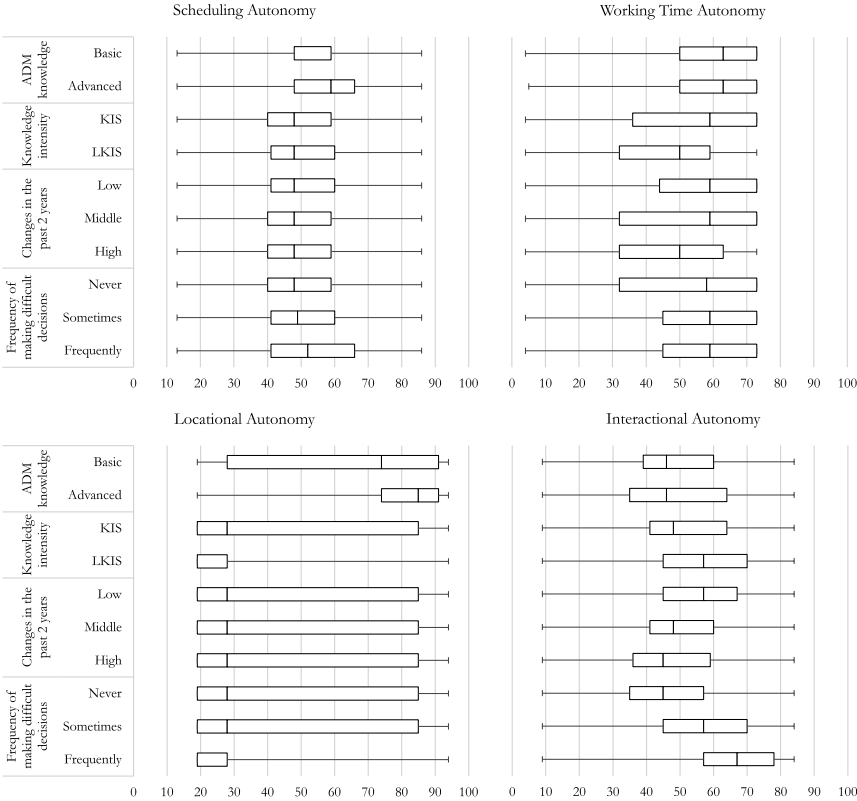


Figure 9 (continuing)

	Autonomy Index			Task Autonomy		Method Autonomy		Criteria Autonomy		Scheduling Autonomy		Working Time Autonomy		Locational Autonomy		Interactional Autonomy	
	N	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Total	11.738	49	11	50	16	48	20	50	23	50	16	52	20	42	30	52	17
ADM knowledge																	
Basic	1.430	55	10	57	15	59	19	46	21	52	13	58	18	62	30	50	17
Advanced	381	59	9	62	13	66	18	48	21	56	13	59	16	73	26	49	18
Knowledge intensity																	
KIS	8.643	51	11	52	15	52	20	49	22	50	15	54	20	47	31	51	17
LKIS	3.095	47	10	46	15	42	19	52	24	50	16	49	18	33	24	55	17
Changes in the last 2 years																	
Low	7.592	50	10	50	16	48	20	53	23	51	16	54	19	47	31	54	17
Middle	1.845	49	11	50	16	51	20	46	21	49	15	51	20	51	31	50	17
High	1.802	47	11	50	15	51	20	41	21	48	15	49	20	49	31	49	16
Frequency of making difficult decisions																	
Never	5.385	49	11	53	15	56	19	43	21	48	14	50	21	53	32	45	16
Sometimes	4.999	50	10	49	15	45	19	52	22	52	16	55	18	45	30	55	16
Frequently	1.350	49	11	43	16	35	19	61	24	53	18	54	19	33	23	66	16

Source: BIBB/BAuA-ETB 2018. Own calculations.

related dimensions. The difference regarding Scheduling Autonomy is much smaller. Overall, employees with these skills still seem to have only a mediocre influence on the scheduling of their work (as well as breaks/interruptions). The tendency for job autonomy to be less pronounced in the criterion-related and interaction-related dimensions is particularly exciting. The perceived pressure to perform seems to increase with growing ADM skills. The previous results indicate that this is particularly true of highly qualified employees, possibly with management responsibility, who work many hours. In terms of Interactional Autonomy, this could go hand in hand with a more frequent need to take responsibility for others or to negotiate compromises. The extent to which there is also less support at work from colleagues or superiors remains questionable for the time being. This component of Interactional Autonomy is thus increasingly isolated as a question for subsequent qualitative analyses.

The analysis of *knowledge intensity* initially fits seamlessly into previous observations. KIS describe in particular those occupations that make a special contribution to the production, dissemination, and application of scientific and technological knowledge and thus stand as an indicator of innovative work performance. They may also be the employees that are currently more likely to be involved in ADM applications from a developer perspective. KIS have higher job autonomy levels in terms of Task and Method as well as Working Time and Locational Autonomy. The design, procedure, time, and place of work execution are more in the hands of the employees. In turn, employees in LKIS are less bound by target agreements, less under pressure to perform, and have more freedom in an interactional sense. According to the present calculation, the time intensity of work performance is roughly the same for both groups. Nevertheless, there is a clear division of services into two groups regarding their degree of job autonomy.

The variable of *changes in work environment* provides information on the extent to which autonomy dimensions differ according to the degree of change in the direct work environment over the past two years. This includes organizational, technical, or product-related changes, for example, the introduction of new ADM systems. By far the largest group of employees has experienced only a few changes in this respect over the past two years. Across all dimensions, the degree of change also tends to decrease job autonomy. This may be related to the fact that the implementation of technical or non-technical changes initially takes some time until they can be integrated into existing processes without errors, until employees have become familiar with them and have developed an understanding of the changes.

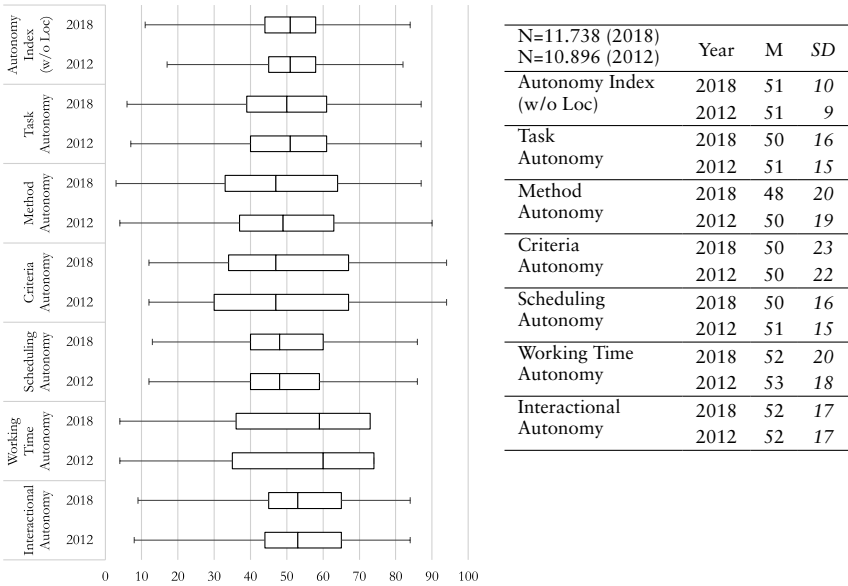
In any case, a frequent aim of such changes to the working environment is to rationalize, which can have the effect of restricting autonomy. Employees who have experienced many changes in their immediate work environment tend to report higher levels of Method Autonomy. However, overall job autonomy is lower in almost all other dimensions. These relatively inconsistent results compared to other levels of analysis can probably be explained by a high degree of discontinuity within strong change processes, which is also reflected in limited degrees of freedom at work.

The *frequency of making difficult decisions* is embedded in this analytical logic in that it can be viewed as a proxy for the degree of intervention by ADM systems at work. ADM systems replace, support, or prepare human decision-making. Thus, if difficult decisions are made frequently, the potential for using ADM systems would also increase. However, the aim of this analysis is not to determine how the use of ADM systems changes job autonomy but rather to isolate which autonomy dimensions are particularly pronounced in employees who frequently make difficult decisions and thus to find out which autonomy profile such an application corresponds to. Employees with decision-heavy tasks therefore have a particularly high degree of task- and method-related autonomy. They are also the employees who tend to work in more intensive environments from a working time perspective and sometimes work under strong target demands. Interactional Autonomy is again clearly below average for people who frequently make difficult decisions. Thus, there appears to be less support at work and more dependence on other people. This analysis can ultimately be used to classify later qualitative findings when it comes to evaluating the actual degree of intervention of ADM systems in employees' work processes.

8.4. Changes between 2012 and 2018

The comparison of the two survey waves from 2012 and 2018 of the BIBB/BAuA-ETB aims at tracing the changes in the individual job autonomy dimensions according to the already-known analysis levels. It is important to note a methodical limitation here: The Locational Autonomy dimension cannot be mapped with the 2012 data set. For the comparison between 2018 and 2012 to be successful, this dimension must therefore be omitted, and a new overall value calculated for the Autonomy Index. As expected, this is higher on average than when Locational Autonomy was included (Figure 10), which was quite low in the 2018 dataset (Figure 4). The remaining dimensions correspond to the previously calculated values for 2018. Detailed summary statistics are provided in Table 26 | Appendix.

Figure 10: Autonomy Index w/o Loc (Total, service sector), 2018 and 2012



Source: BIBB/BAuA-ETB 2018 and 2012. Own calculations.

The aggregated comparison of the six dimensions and the new Autonomy Index (w/o Locational Autonomy) reveals that the overall values for the service sector have hardly changed between 2012 and 2018. The overall index remained at an index level of 51. However, the findings do not necessarily mean that there were no changes at the branch, task, or individual level during the observation period, but may be due to the aggregation level of this analysis.

Minimal changes are visible regarding the dimensions Task (-1), Method (-2), Scheduling (-1), and Working Time Autonomy (-1). This development provides indications of the increasing compression and intensification of work, which are expressed in lower degrees of time-related job autonomy. The results are particularly interesting regarding reduced Method Autonomy.

To describe the change in job autonomy from 2012 to 2018 in more detail, the percentage change of the index values is broken down in the form of heat maps. The changes in the Autonomy Index and the associated dimensions reveal several key branches and dimensions that are

Table 7: Changes in Autonomy Index by branch, task type, 2012–2018

	Autonomy Index (w/o Loc)	Task Autonomy	Method Autonomy	Criteria Autonomy	Scheduling Autonomy	Working Time Autonomy	Interactional Autonomy
Total, service sector	-1,1 %	-2,0 %	-2,9 %	0,5 %	-0,7 %	-1,6 %	0,4 %
Branch							
Wholes., retail trade, rep. of vehic. (G)	-3,1 %	-2,1 %	-4,4 %	-2,2 %	-2,8 %	-5,1 %	-2,0 %
Transportation, storage (H)	-1,2 %	-1,7 %	-8,9 % *	8,6 % *	-1,3 %	-5,2 %	0,7 %
Accommodation, food service (I)	-6,4 % *	-7,3 % *	-7,2 %	-3,9 %	-4,0 %	-10,9 % *	-6,2 %
Information, communication (J)	4,3 % *	0,9 %	3,5 % *	6,1 %	5,7 % *	7,4 % *	2,7 %
Finance, insurance (K)	0,6 %	-2,6 %	-3,0 %	4,5 %	1,1 %	0,9 %	2,7 %
Real estate activities (L)	3,1 %	-2,1 %	-0,5 %	11,6 %	0,3 %	5,8 %	3,9 %
Prof., scientific, technical services (M)	1,2 %	-0,5 %	0,5 %	1,1 %	1,6 %	2,2 %	2,0 %
Administrative, support service (N)	1,2 %	2,3 %	-9,5 %	11,5 %	1,2 %	-1,1 %	1,8 %
Public admin., def., social sec. (O)	0,2 % *	-1,8 %	-0,9 %	-1,0 %	-1,3 % *	2,7 % *	3,1 %
Education (P)	1,6 %	-1,2 %	-1,0 %	2,3 %	1,6 %	5,1 % *	3,8 %
Human health, social work (Q)	-2,9 %	-3,8 %	-3,6 %	-2,4 %	-2,1 %	-4,4 %	-1,1 %
Arts, entertainment, recreation (R)	-3,8 %	-4,8 % *	-5,8 %	-2,4 %	1,3 %	-11,8 %	-0,6 %
Other service activities (S)	0,0 %	-2,6 %	-5,1 %	-1,7 %	1,4 %	3,3 %	4,8 %
Task type							
Management	-1,1 %	-1,6 %	-2,3 %	0,3 %	0,2 %	-1,8 %	-1,1 %
Information-related	-0,4 % *	-0,6 %	-2,9 %	1,8 %	0,5 % *	-0,9 %	-0,2 %
Object-related	-2,1 %	-2,4 %	-5,7 %	1,4 %	-1,7 %	-3,4 %	-1,3 %
Person-related	-2,5 %	-4,8 % *	-4,0 %	-2,0 %	-2,3 %	-3,2 %	1,9 %

Notes: Significance test with Pearson Correlation, $p < 0,05^*$.

Source: BIBB/BAuA-ETB 2018 and 2012. Own calculations.

particularly affected (Table 7): The development of individual autonomy dimensions indicates polarizing trends at almost all levels. The greatest gain in job autonomy is visible in predominantly highly qualified sectors: first and foremost, in information and communication, and to a lesser extent, in finance and insurance or professional, scientific, and technical services. The biggest losses are in LAS. These are also the branches with a high proportion of direct interaction with service recipients.

A differentiated look at the individual autonomy dimensions again distinguishes the developments predominantly between the group of autonomy winners and those in LAS, usually with a higher share of person-related tasks. Accordingly, trade, logistics, accommodation and food services, healthcare, and social work are losing ground on almost all autonomy dimensions. Particularly noteworthy are the time-related autonomy dimensions of these branches, which testify to more intensive work. Method Autonomy shows partly significant reductions, indicating that the way tasks are completed, and new tasks are approached is being restricted. In contrast, some branches surprisingly show high increases in Criteria Autonomy, i.e., a proxy for performance pressure and working toward specific targets. In transport and logistics in particular, this promising development suggests a certain easing of the tense work situation. Nevertheless, the pressure of work seems to have increased precisely in those branches where the intensity of work is already high.

These are also the branches that have seen a deterioration in the deviation from traditional working hours (Working Time Autonomy). In many respects, these results suggest that employees in branches that already have high levels of autonomy have been given more autonomy, while those with the lowest levels of autonomy would have lost. The latter, in turn, represents the vast majority of employees in the service sector. The autonomy winners could already be described as an autonomy elite. However, some of these have also suffered losses in terms of Task and Method Autonomy, such as in finance and insurance or real estate.

The overall picture of changing autonomy dimensions according to selected variables makes one thing clear at first. For most subgroups and in most dimensions of job autonomy, there have been decreases in job autonomy, while gains are evident in favor of selected groups. Thus, inequality trends are discernible. What stands out are decreases in Task and Method Autonomy in almost all subgroups and increases in intensity in the working time sense for those already pressured. In contrast, the values for Interactional Autonomy speak for an increase in job autonomy and increasingly independent work from other people – which is a questionable development in the service sector.

The analysis by *task type* shows a less heterogeneous and polarizing result, but nevertheless an alarming one, especially regarding object- and person-related tasks. Management levels and information-related tasks also show a loss of autonomy, which is only reversed in the dimensions of Criteria and Scheduling Autonomy. At least this development indicates a relaxation for these subgroups in terms of performance pressure and work intensity. Object- and person-related tasks, however, are losing scope for action at almost all levels. Particularly striking are the restric-

tions in Task and Method Autonomy, i.e., the leeway in the scope and execution of tasks. The intensive and extensive time dimensions of job autonomy also suggest trends worth considering, which could potentially aggravate the demanding conditions of work.

Similarly, the analysis according to selected socio-economic and ADM-related aspects leads to results that are noteworthy (Table 8). The differentiation according to *educational attainment* speaks a clear language. Gains in autonomy are almost exclusively observed for university graduates. The lower the level of educational attainment, the greater the loss of autonomy. The polarization of job autonomy according to educational attainment thus appears not only to be high today, but also to be increasing. The intensification of the polarization of job autonomy seems evident. The analysis by *sex* reveals only a few differences, the most striking being that the perceived pressure to perform and work according to agreed goals has increased for women and decreased for men. Both groups show significant losses in their methodical degrees of freedom. Overall, the losses of job autonomy are greater for women, which is likely to further exacerbate the discrepancy between the sexes.

The differentiation according to *company size* does not reveal any clear new findings. There is some evidence that the extent to which the overall Autonomy Index as well as Task and Method Autonomy components decrease is inversely related to company size. Thus, larger organizational structures may be more resilient to changes in certain aspects of working environments. In terms of *working hours per week*, autonomy-restricting tendencies apply above all to part-time employees with 21 to 30 hours. Their work has become more time-intensive and pressured. The same applies to employees who regularly work more than 40 hours.

The *length of employment* in the company has a less pronounced relation to the development of job autonomy. Losses in job autonomy are visible in all dimensions. It is interesting to note that younger employees, in terms of organizational affiliation, lose the most. Considerable losses in Task and Method Autonomy can be identified, in some cases, among more experienced employees.

Considering the ADM aspects of work, the subgroups with basic or advanced *ADM knowledge* are those with particularly high levels of autonomy. These have increased substantially in recent years, especially in the dimensions related to pressure to perform. Connections are clear with the above-mentioned university graduates, as these are the only groups that make relatively high autonomy gains overall. Employees with advanced ADM knowledge make the biggest leap forward in job autonomy. This could indicate a positive relationship between the potential to use ADM and job autonomy. The positive changes at various levels of

autonomy suggest more flexible work with less pressure to perform and fewer time constraints. These results are confirmed regarding *knowledge intensity*. KIS show positive trends for job autonomy. More revealing, however, are the results for LKIS, which are losing job autonomy and are thus in line with previous findings about LAS.

Table 8: Changes in Autonomy Index by socio-economic, ADM aspects, 2012–2018

	Autonomy Index (w/o Loc)	Task Autonomy	Method Autonomy	Criteria Autonomy	Scheduling Autonomy	Working Time Autonomy	Interactional Autonomy
Educational attainment							
W/o voc. qualification	<u>-4,7 % *</u>	-3,3 %	-5,2 %	-3,5 %	-4,9 %	<u>-7,7 % *</u>	-3,6 %
Vocational training	<u>-2,1 % *</u>	<u>-2,5 % *</u>	<u>-4,9 % *</u>	0,0 %	<u>-1,5 % *</u>	<u>-3,7 % *</u>	-0,5 %
Upgrading training	<u>-2,4 % *</u>	<u>-5,0 % *</u>	-4,0 %	-1,1 %	-1,1 %	-2,7 %	-0,6 %
University	<u>1,4 % *</u>	-2,2 %	-2,1 %	<u>3,8 % *</u>	<u>1,9 % *</u>	<u>2,9 % *</u>	<u>5,3 % *</u>
Sex							
Female	-1,2 %	-1,8 %	<u>-2,1 % *</u>	-1,0 %	-0,6 %	-2,1 %	0,2 %
Male	-0,8 %	-2,2 %	<u>-4,0 % *</u>	2,6 %	-0,8 %	<u>-1,0 % *</u>	0,7 %
Company size							
Micro company	-1,5 %	-3,0 %	-5,4 %	0,1 %	2,5 %	<u>-5,9 % *</u>	2,2 %
Small company	-1,4 %	-2,1 %	-2,9 %	0,2 %	-2,6 %	-0,4 %	-0,6 %
Medium company	-0,8 %	-1,6 %	-3,4 %	2,3 %	-0,1 %	-2,5 %	0,9 %
Large company	<u>-0,3 % *</u>	-1,5 %	-1,5 %	-0,2 %	-0,7 %	<u>1,2 % *</u>	0,9 %
Working hours per week							
10 to 20	-0,8 %	0,6 %	-4,6 %	0,7 %	0,6 %	-2,4 %	-0,3 %
21 to 30	-2,5 %	-3,0 %	-4,1 %	-1,2 %	<u>-3,4 % *</u>	-3,5 %	-0,3 %
31 to 40	-0,2 %	-0,8 %	<u>-1,9 % *</u>	0,4 %	0,2 %	-0,6 %	1,5 %
More than 40	-1,6 %	-3,8 %	-2,7 %	1,2 %	-0,7 %	-2,4 %	-0,5 %
Length of employment							
More than 10 years	-1,1 %	-1,7 %	-2,9 %	<u>-1,3 % *</u>	-1,0 %	-1,0 %	1,0 %
Up to 10 years	-1,4 %	-2,8 %	-5,7 %	2,1 %	-0,2 %	-1,9 %	0,4 %
Up to 5 years	-0,9 %	-2,8 %	-2,6 %	2,3 %	-0,5 %	-2,0 %	0,0 %
Up to 2 years	-1,5 %	-0,8 %	-0,9 %	-1,6 %	-1,3 %	-1,4 %	-3,1 %

	Autonomy Index (w/o Loc)	Task Autonomy	Method Autonomy	Criteria Autonomy	Scheduling Autonomy	Working Time Autonomy	Interactional Autonomy
ADM knowledge							
Basic	1,2 % *	-0,4 %	-3,0 %	7,3 % *	0,5 %	1,7 % *	2,8 %
Advanced	2,7 %	1,2 %	0,8 %	9,6 %	2,6 %	6,4 % *	-2,9 %
Knowledge intensity							
KIS	0,1 % *	0,0 % *	1,0 % *	0,3 %	-1,0 %	0,8 % *	-0,3 % *
LKIS	-2,8 %	-2,9 %	-4,1 %	-4,4 % *	1,2 % *	-2,7 %	-3,6 % *
Changes in work environment							
Low	-0,9 %	-1,7 %	-2,8 %	0,4 %	-0,7 %	-1,3 %	0,4 %
Middle	-2,1 %	-3,2 %	-2,2 %	-1,8 %	-1,2 %	-4,1 %	0,2 %
High	-0,4 %	-1,3 %	-3,5 %	1,8 %	1,0 %	0,7 %	-0,3 %
Frequency of making difficult decisions							
Never	-0,6 %	2,4 %	-2,8 %	0,4 %	-2,0 %	-1,6 %	-0,1 %
Sometimes	-1,0 %	-1,8 %	-5,1 %	0,6 %	0,8 %	-1,4 %	0,2 %
Frequently	-1,3 %	-3,1 %	-0,8 %	-0,1 %	-2,0 %	-1,9 %	0,4 %

Notes: Significance test with Pearson Correlation, $p < 0,05^*$.

Source: BIBB/BAuA-ETB 2018 and 2012. Own calculations.

Technical, organizational, or other *changes in the immediate work environment* can only be marginally differentiated. The subgroup of employees who have experienced a high degree of change in the past two years has at least seen smaller gains in Criteria Autonomy and time-related dimensions. However, these forms of technical or organizational changes seem to be less systematically related to changes in job autonomy. Finally, the distinction according to the *frequency with which difficult decisions* occur reveals some interesting findings. Employees with high decision-making demands have lost autonomy, while those who never have to make difficult decisions have made some slight gains. Using difficult decision-making as a proxy for the potential use of ADM is associated with limitations in job autonomy, particularly in the areas of task variability and work quantity.

The profile of autonomy winners of recent years thus shows clear contours overall: They are university graduates, more likely to be men,

who work full-time for larger companies. They have at least basic skills in dealing with ADM and tend to work in knowledge-intensive branches such as information and communication, finance, and insurance, in consulting, or in the science and education branch in information-related activities. These job autonomy gainers benefit above all from greater freedom in the fulfillment of their tasks, in the planning of their own work, and in the working-time framework. Of course, this image is highly stylized, but it also implies the profile of the opposite group, most service workers, whose job autonomy appears at least threatened.

9. Limitations

The aim of the BIBB/BAuA-ETB analysis was to quantify job autonomy by branch, task type, or socio-economic aspect and thus allow direct comparison between branches and time. The project could initially be implemented as intended. Nevertheless, there are methodical and content-related limitations that need to be considered in the interpretation:

Several methodical hurdles can be traced back to the design of the data set. The greatest difficulty arises from differences between the two survey waves of 2012 and 2018, which are reflected in the locality-related developments in working conditions, and only permit limited interpretation of the Locational Autonomy dimension. The question of using ADM is also linked to this problem, in that hardly any questions on that matter are included in the data set, and a connection between job autonomy and ADM can only be nourished in an indirect way. Of course, the question of selecting the right data set must be raised again at this point, especially as the timeliness of data from 2018 means that there is additional potential for criticism (availability not until 2020).

From the author's perspective, the BIBB/BAuA-ETB is still considered an adequate data basis for the intended research objectives, also in retrospect. Other comprehensive data sets are either difficult to access (e.g., Mikrozensus, SOEP) and/or do not reflect the multidimensional concept of job autonomy. For example, the equally extensive BAuA working time survey only covers working time-related aspects, or the more recent DiWaBe survey includes digitalization-related items to a much greater extent, but at the expense of autonomy-related questions. The author is not aware of any more up-to-date data than the BIBB/BAuA-ETB 2018, which deals with the aforementioned job autonomy aspects in this depth.

At the content level, it is important to reflect on the extent to which the results contribute to answering the research question. They represent an essential intermediate step in gaining knowledge about the influence of ADM on job autonomy by making the underlying concept of job autonomy empirically tangible for the first time and establishing comparability within the service sector. The aim is not to establish causality but rather to gain an overview of the relationships within the sector and ultimately to provide a lead-in to the subsequent company case studies, which contrast the highly aggregated results given here with individual case analyses.

At the content level, it is always debatable to what extent the item selection can do justice to the depiction of a complex concept such as autonomy. Again, reference must be made to the attempt at approximation.

This always simplifies the issue, even if an attempt is made to cover as many aspects as possible. Although most of the construction of the individual autonomy dimensions can be based on the subjective perception of the respective item, this is not always successful, as with the approximation in the case of Working Time and Locational Autonomy, which in the objective sense rather assumes a deviation from traditional working time and place relationships. However, a satisfactory Cronbach's alpha for the overall index confirms the construct's reliability.

The consideration of the limitations inherent in the attempt to quantify job autonomy and establish comparability is not intended solely to point out its incompleteness but rather to provide an opportunity to reflect on the need for further research and the possibilities for refining the construct. First, it is obvious to apply the Autonomy Index to the 2024 wave of the BIBB/BAuA-ETB in order to fill the longitudinal comparison of the data with content. Of course, insights into the interplay between ADM skills and job autonomy could also be hoped for. Further analyses within the Autonomy Index are also tempting, especially the consideration of possible interrelationships between the individual dimensions, to identify even more sharply defined job autonomy profiles. In particular, the connections between the performance and interaction-related dimensions (Criteria and Interactional Autonomy) and other indicators could provide further insights not only into the job autonomy relationships in the service sector but possibly also reveal organizational and strategic changes in the branches.

10. Summary: solidified polarizations, less intensity for some

The analysis of job autonomy in the service sector aimed to model and quantify the seven autonomy dimensions to establish comparability between branches as well as to identify changes in the job autonomy of employees within the past decade. This step is also intended to isolate distinctive branches and autonomy situations that are suitable for an in-depth qualitative analysis in Part III.

The evaluation of the BIBB/BAuA-ETB paints an overall picture of reinforced inequalities from the point of view of workers. There is leeway for job autonomy in all dimensions and characteristics of the respondents in the service sector. The working environment for all employees is characterized by an interplay of autonomous and heteronomous moments. Particularly, Method and Locational Autonomy are less distinct, indicating that many service workers not only encounter limitations in how they carry out their duties but are also bound to a particular location of performance.

The separation into less autonomous (LAS) and highly autonomous service (HAS) branches is supported by the Autonomy Index. The area of HAS is led by information and communication, finance and insurance, real estate, professional, scientific, and technological services, as well as education. The branches with weaker autonomy dimensions are dominated by trade, logistics, accommodation and food services, and health-care and social services. Interestingly, there are dimensions of job autonomy in which these two groups are aligned, such as Criteria, Scheduling, and Interactional Autonomy. Differences in the pressure to perform, the ability to plan tasks, or the dependence on other people are therefore blurred in these areas, or all service workers are affected to a similar extent on average. The situation is different for Task and Method as well as Working Time and Locational Autonomy. The differences are most pronounced in the latter, as personal and object-related service tasks, in particular, have to be carried out at fixed locations, detached from traditional working time relationships. In the case of Task and Method Autonomy, the great divide in the service sector is again evident, which gives some employees great freedom in shaping the content of their work and reserves more monotonous, prescribed tasks for the majority.

The comparison between 2012 and 2018 shows that the already autonomy-strong branches belong to the autonomy winners because they were able to perceive increasing degrees of freedom on almost all levels.

Branches with weak autonomy, in contrast, have lost further ground, which results in the overarching theme of increased polarization. It is worth noting, however, that both Task and Method Autonomy have seen significant declines across branches since 2012.

What is welcome, though, is that the intensity and the pressure to perform, transferred to Criteria and Scheduling Autonomy, have taken quite positive developments. At least in part, this also applies to areas of LAS. The development of Working Time Autonomy is worthy of concern, as it points to a further division of the service sector. Overall, it can be summarized that the gains in autonomy are rarely high, but the losses in autonomy are often severe and affect the majority of employees.

The final link to the (potential) use of ADM and its influence on job autonomy remains brief: there is evidence that job autonomy increases with knowledge of ADM use and the knowledge intensity of tasks. The task- and method-related dimensions of job autonomy, as well as aspects of working time and place of work, are positively related to ADM potential. For Criteria and Interactional Autonomy, by contrast, the relationships tend to be reversed. This suggests that performance pressure and the need to negotiate compromises and assume responsibility increase with ADM knowledge. Overall, however, these results only show initial trend lines, the content of which must be filled with life in more in-depth company case studies.

Overall, the results from Part II justify the division of the service sector into LAS and HAS. As already mentioned in the theoretical-conceptual considerations (Chap. 5), certain utilization mechanisms of labor power and operational strategies can be assumed to lie behind this distinction. Within the qualitative case studies, however, it is particularly exciting to fill the statistically similar dimensions of Criteria and Interactional Autonomy with further content.

For an in-depth analysis of using ADM in the service sector, several branches are fundamentally offered. However, two promising examples are isolated based on the present analysis, which are exemplary due to the partial ambiguity of the results (selection criteria in Chap. 12.1): healthcare and financial services. Both branches represent the weaker as well as the stronger autonomy areas of the service sector. They are among the branches that involve a particularly high degree of intensive interaction work, for example, care work in healthcare or advisory work in finance.

Healthcare services, admittedly an extremely heterogeneous field, does not show the typical characteristics of LAS in some autonomy dimensions. The values for Task and Method Autonomy in particular are comparatively high, which speaks for greater freedom in shaping

work. In contrast, the branch scores worst for Criteria and Scheduling Autonomy. This implies an extreme conflict scenario, which allows for methodical freedom at work but frames it through intensity and pressure to perform. This situation is exacerbated by externally determined conditions regarding working time and place. The healthcare sector also lags behind other sectors in terms of Interactional Autonomy. It is questionable whether this can be attributed to too little support at work from colleagues and superiors or whether it reflects the high degree of willingness to compromise and take responsibility. Overall, healthcare represents an autonomy situation of the extreme, which apparently tries to free itself from autonomy constraints but is not allowed to do so.

The finance branch initially assumes high levels of job autonomy and great freedom in the execution of work. However, the opposite trend is already evident in Task and Method Autonomy, which tends to favor more standardized and monotonous work. This is in fundamental contrast to the characteristics of HAS. This must also be considered in connection with clearly defined work goals and pressure in Criteria Autonomy. However, the finance branch is again among the autonomy elite in terms of time and place-related dimensions. The ability to plan one's own work seems to be given, as does the possibility of performing work within the usual time and place framework. Dependence on other people at work is a much smaller problem in the autonomy-related sense than in healthcare services. Employees in the finance branch still belong to the autonomous elite, whose position, however, appears to be based on shaky pillars, which is confirmed by the loss of autonomy or only restrained development since 2012.

PART III

Case study insights: glances into changing job autonomy of service workers

11. Objective

The aim of the two previous parts of this thesis was to establish the theoretical and conceptual basis for the interplay between job autonomy and ADM in service work (Part I). By means of semi-quantitative studies, comparability in the extent of job autonomy in various service branches was established (Part II). Both parts serve as preliminary work for the third part of this thesis, which approaches the influence of ADM on job autonomy in a qualitative way. The qualitative approach to this topic thus complements and completes all previous considerations. Finally, neither a purely theoretical-conceptual nor a semi-quantitative approach can provide an in-depth answer to the question of the possible influence of ADM on job autonomy. This multi-method approach combining quantitative and qualitative elements aims to create as holistic a picture as possible of the relations between job autonomy, ADM, and service work.

Part III of this thesis is devoted entirely to the assessment of employees', company representatives', and experts' views on the influence of ADM on job autonomy. The focus is not only on the intervention of technology in work processes but also on the conditions under which this influence comes to fruition and for which employees (e.g., profession, qualification, or position in the company) this influence may apply. As in the previous analyses, the focus lies on the subjective perspective of employees on how their working conditions have changed using ADM systems. This subject perspective is obtained in the form of semi-structured interviews.

In line with the preceding theoretical and conceptual distinction between LAS and HAS, two branch cases are selected for further analysis: outpatient care (healthcare sector) and banking (financial industries). The social significance and precariousness of the healthcare sector were not only made clear in recent years during the COVID-19 pandemic. Even before 2019, this branch was in a constant state of tension between a shortage of skilled workers, increasing economization, and the need to ensure care quality. More than any other branch, it is characterized by interaction work, especially by women.

In parallel, the demands on good care work have increased: In addition to greater organizational effort (e.g., documentation of care services), the clinical conditions of people in need of help and care have become more complex. Digital technologies are not widespread in the care sector and have so far been used primarily in the planning and administrative areas. The effects of using digital technology on employees

have not been researched thoroughly and must be interpreted as ambivalent (Chap. 13.1). A holistic software solution for digital work processes, including ML-based shift and tour planning, serves as an ADM example in outpatient care.

In banking services, by contrast, the consequences of automation were felt early on in terms of shrinking employment and organizational transformation. The branch is intensively driven by economic constraints and, at the same time, fulfills the role of a link between the real economy and the financial economy, as well as between companies and private individuals. It is indispensable for the provision and retention of liquidity in our prevailing economic system. As Breisig et al. (2010, p.287) note, there is hardly any other branch in which marketization is practiced as intensively as in retail banking. Digitalization manifests in increased task division and specialization, but also standardization and a closer integration of clients into banking processes, which ultimately leads to shifts in tasks away from employees and towards clients (Chap. 14.1). However, both banking and care work have in common a high degree of interaction work. An integrated client approach management system for private clients, which essentially provides product recommendations, serves as an ADM example in banking services.

Regardless of the high proportion of interaction work in each case, with outpatient care and banking services, there are two extremes facing each other: one with rising and sustained demand for employment; the other with declining employment. One with moderate access to and penetration by digital tools; the other with transformation processes, in some cases lasting many years, during which ADM has a more profound impact on work. Also, regarding the change in job autonomy within the past few years, both branches are further drifting apart: Overall, health-care workers lost degrees of freedom at the workplace, while those in finances were able to record minor gains (Chap. 8.4). The aim of Part III is to provide qualitative interpretations and descriptions of these developments. This includes the characterization of changes in the seven job autonomy dimensions using ADM systems, the conditions under which they come to fruition, and their contextualization in the theoretical-conceptual considerations. In this analysis, it is assumed that the characteristics of job autonomy differ not only according to branch (or occupation, qualification, etc.) but also depending on the embedding of the technical system in work processes.

This qualitative approach in the form of company case studies is intended to generate findings regarding the connection between ADM and job autonomy that are not possible using only quantitative methods. After the separate assessment of the case studies (Chap. 13 and 14), some

selected expert insights on the cases but also on subsequent challenges in dealing with ADM are offered (Chap. 15). A critical examination of some limitations of this case study approach methodically frames Part III (Chap. 16). In a final step, the results of the company case studies are compared, embedded in the current scientific debate, and placed in relation to the state of research and theoretical concepts (Chap. 17).

12. Method: understanding and conduct of case studies

As the design of qualitative social research at its core reflects the detailed procedure of a study (Mayring, 2016, p.40), the subsequent remarks comprise a description of the qualitative design (case analysis), the qualitative techniques used (data collection, preparation, analysis) and thus the rough structure of Part III: Case analysis in the form of company case studies serves as the central element of the qualitative design, which is implemented using selected qualitative techniques. A precise case definition, i.e., a breakdown of the criteria for selecting a particular case, is essential (Chap. 12.1). The core sources of information are formed by problem-centered interviews (Chap. 12.2 and 12.3), which are processed by means of summary transcription and analyzed based on a qualitative content analysis (Chap. 12.4).

A company case study consists of various elements: a branch profile (Chap. 13.1 and 14.1) and a case synopsis (Chap. 13.2 and 14.2), which not only lists references to the results of the previous chapters but also reflects the current state of knowledge on employment conditions and technology use in the respective branch. This is followed by a description of the case company, employee structure, specific work organizational properties (Chap. 13.3 and 14.3), and the use of technology in the work process (Chap. 13.4 and 14.4). The interview analysis along the job autonomy dimensions (Chap. 13.5 and 14.5), the consideration of technical barriers (Chap. 13.6 and 14.6), and conditions for changes in job autonomy (13.7 and 14.7) form the core analysis of a case company study.

The analytical framework of a case analysis is particularly suited for analyzing complex social systems (Mayring, 2016, p.41), i.e., grasping the complexity of a research object and the people acting within it under the conditions in which they act. In the present case, the complexity of a case results from the interaction of employees with an ADM system, which in turn is subject to the conditions of working in a specific organizational structure.

Case analysis is a particularly appropriate method for addressing this research topic because ADM systems have not yet penetrated the entire working world, and purely quantitative data sources are scarce or distorted by the rapid pace of technological development. In practice, the application of many (learning) ADM systems is still characterized by trial phases and profitability considerations due to their heterogeneous

degree of maturity. Thus, one way of analyzing the impact of ADM use on employees is a case-by-case approach.

The aim of the company case studies is to capture the handling and conditions of using an ADM system from the perspective of employees in as much detail as possible. In this way, even the smallest nuances of the impact of technology use in the work process are documented. The difficulties of implementing and analyzing company cases lie in their immanent exemplary character, from which conclusions and implications at the branch or sector level can only be drawn with great care.

In the present study, problem-centered interviews (Mayring, 2016, pp. 66–72) form the core elements and the most extensive sources of information. Although the extent and complexity of these interviews are at the expense of the number of interviews conducted, this is to be compensated for by the depth of the interviews and the addition to the findings of the semi-quantitative Part II. Ultimately, the complexity of a case also takes into account the previous experience of employees and their specific working environment (Mayring, 2016, p. 42).

12.1. What is a case?

Fundamentally, a case is the organizational unit of a company. Approaching the selection of a particular company requires the fulfillment of certain content-related criteria, which initially relate to the selection of branches and specific ADM application examples. For both focus branches and ADM examples, several cases come into question for this qualitative analysis.

The selection of the focus branches is based on the theoretical-conceptual preliminary work (Part I) and the semi-quantitative studies (Part II), as well as the availability of and possible access to branch experts and companies. The selection criteria are described along the findings concerning job autonomy, service work, and ADM tools: Concerning job autonomy, i.e., the variable of greatest interest, one branch each is selected from the previous distinction between LAS and HAS (Chap. 1.5 and 5). Striking examples are trade, logistics, accommodation and food services, or healthcare and social services in the first case; information and communication, finance and insurance, or business-related services in the second case. These branches are particularly distinct from one another in terms of the extent, impact, and benefit of job autonomy from the point of view of employees. The findings of the Autonomy Index (Part II) support this selection.

Furthermore, examples of branches are chosen that reflect the specific characteristics of service work, i.e., there are employees in the con-

sidered branch that perform a fair share of interaction work. Hence, their work is highly dependent on their interaction with service recipients. The point in the work process where the technology is used naturally plays a key role. However, even within the service sector – or rather, within companies – there is a wide range of possible applications to choose from. To get as close as possible to the core activities of the service sector, examples are chosen that are close to the interaction between employee and service recipient. In this sense, the focus lies on the tasks and job autonomy of *frontline service workers*. This also excludes pure monitoring or cross-sectional ADM systems from the analysis.

Lastly, the penetration of digitalization processes is used as a further criterion for selecting case examples. A comparison of particularly digitized and less digitized branches can provide additional insights and allow more far-reaching interpretations of the dependence between job autonomy and the existing degree of digitalization. Ultimately, the selected branches must engage companies in which ADM is used in everyday work. The systems are in actual use in the case company. This excludes systems that are currently undergoing basic research or are only available as demonstrators. The description of a before-and-after situation regarding the use of the system as well as the mapping of the implementation phase, if applicable, provides particularly valuable insights regarding the change in job autonomy.

All the above criteria are met by the following case studies: More detailed reasoning on why outpatient care and banking services are chosen is provided in the concluding remarks of Part II (Chap. 10), in the description of the interview initiation and conduct (Chap. 12.3), as well as in the respective branch profile at the beginning of each case study. However, the final selection also considered access to the branch and companies, prior knowledge of the branch's characteristics, and the interests of the author. Overall, this is a non-random procedure that must accept a selection bias (also Chap. 15).

12.2. Data collection

All interviews count as problem-centered interviews (open, semi-structured, qualitative), which are particularly suitable for theory-led research with specific research questions (Mayring, 2016, p. 71). The interviewee is given important degrees of freedom in answering, while the interviewer can orient herself to the interview guidelines. The semi-structured nature of the interviews proves to be the most suitable method for the question of how ADM systems influence job autonomy in the service sector. They

presuppose prior knowledge on the part of the interviewer and interviewee on the specific topic but leave room for explorative elements.

The chosen methods ultimately represent an interpretative process in which the interviewer acts as an interpreter of what is said (Mayring, 2016, p. 10). In this sense, the interview is also an artificially created situation in which, in this case, the daily work of the interviewee is discussed. The success of the interviews depends on establishing a relationship of trust with the interviewee, which in the present cases was achieved through maximum transparency and clarification of the research objectives and content.

There is hardly any alternative approach to problem-centered interviews, such as exclusive field research (e.g., participant observation), because of the focus on the subjective perspective of employees (Menz & Nies, 2018, p. 277). This subjective perspective cannot be observed but must be asked from the employees' point of view (Mayring, 2016, p. 66). The interview enables a stronger subject-relatedness, which is reflected in the later descriptions, interpretations, and attempts at generalization. The semi-structured nature of the guidelines facilitates the subsequent comparability of the interviews within the evaluation (although ad hoc queries within the course of the interview are not ruled out). In this respect, a certain degree of standardization proves to be advantageous.

The interview guidelines are based on the theoretical and conceptual findings of this thesis. The questions are open-ended and can be answered by the interviewees according to their own expertise and interpretation (Mayring, 2016, p. 67). Accordingly, possible answers are not predefined. However, they go beyond simply querying the change in the seven job autonomy dimensions. Especially with a topic such as the use of (learning) ADM, which is still a novelty in many service companies, explorative moments during the interviews cannot be dispensed with.

Exploratory and guideline questions are supplemented with ad hoc questions if applicable. In addition, the interview guidelines have been minimally adjusted depending on the interviewee and the branch. Interview guidelines were piloted in a pre-test with people who are similar to the interviewees in terms of position, qualifications, and branch. This step ultimately served for practice purposes for the interviewer and as a content corrective.

The research topic is addressed in two stages: by surveying employees and conducting selected contextual interviews in their companies, and by carrying out follow-up expert interviews with representatives from politics and related scientific fields. The expectations of employee interviews are clear – employees describe their subjective perception of job autonomy using ADM systems. The associated context interviews (with, e.g.,

management, technology providers or IT staff, and employee representatives) provide additional background information on the embedding of the ADM system in the company.

The expectation of the follow-up expert interviews is not only that the interviewees offer specific knowledge on the research topic, but also that they do so from their institutional or professional perspective. In this way, the information gained from the interview is also evaluated in terms of the role of this institution within a particular network or field of action. The expert interview is therefore not only based on the provision of expert knowledge in the subject area but also on expert knowledge that is linked to certain decision-making authority (Menz & Nies, 2018, p. 281). This expert knowledge is used in particular to critically question the case-based empirical findings in light of the employee interviews.

Initially, *context interviews*, which are methodically classified as expert interviews, serve to gain a basic understanding of the company's organization, the functionality and embedding of the ADM system, as well as the resulting objectives and implementation of the technology from the company's perspective. At the content level, the aim is to clarify the organizational and technical characteristics of the ADM system and to provide basic (also technology-independent) information about the organization of work and objectives in the company from various perspectives. In essence, context interviews are divided into four thematic blocks (Figure 20 | Appendix):

- functions of the technical system in the company,
- efforts caused by the system,
- work organization,
- influence on employees.

In this way, they form the prerequisite for the downstream employee interviews. After all, contextual methods also serve to elaborate on and situate the results of the key methods (Menz & Nies, 2018, p. 276). For the context interviews in companies, 60 to 70 minutes per interview are estimated in advance. When selecting interviewees for context interviews, personal characteristics such as age or sex are secondary. A balanced ratio is desirable but cannot be guaranteed. The decisive criteria are position in the company and availability. A maximum of three to four context interviews are conducted per company.

This is followed by the central *employee interviews*, which have at their core the questioning of the change in the seven dimensions of job autonomy. The employees are thus not only to describe the general handling and organizational conditions of the ADM system but are also to be guided by specific questions to describe the facets of job autonomy

in their work processes. In essence, employee interviews are divided into three thematic blocks (Figure 21 | Appendix):

- subjective perception of the technical system in everyday work,
- influence on autonomy dimensions,
- overall assessment.

In this respect, problem-centered interview guidelines are the main approach, although they can also contain narrative elements within the description of the general handling of the ADM system. Narrative elements are particularly useful when it is difficult to uncover subjective structures of meaning (Mayring, 2016, p. 74). This is the assumption made to some extent in this qualitative study. The interview guideline is strictly oriented toward the seven dimensions of job autonomy defined.

All questions about changes in these dimensions are to be answered by the interviewees in the context of their experience with the respective ADM system. For interviews with employees, 60 to 90 minutes per interview are estimated in advance. When selecting the interviewees for the employee interviews, three main requirements are defined: They are capable of reflecting on the working conditions with and without the technical system. Furthermore, there is a balanced representation of different qualification levels, working time models, and sex. Overall, the demographics of the entire workforce in the company and the branch are targeted. Due to the small number of cases, however, this information is not analyzed systematically but is included selectively in the interview evaluation. At least four to five interviews with employees are conducted for each company.

In the last step, *expert interviews* are conducted to define the possible influence of ADM on job autonomy from a political, scientific, and company partnership perspective. The aim of these interviews is to critically evaluate the empirical results of the company case studies and to situate them in the current state of research. The expert interviews therefore build on the company cases and facilitate the validation of the theoretical and quantitative preliminary work. For this purpose, insights from the context and employee interviews are specifically mirrored to the experts. Based on these, the influence of using ADM systems on job autonomy is discussed. In essence, employee interviews are divided into two thematic blocks (Figure 22 | Appendix): The discussion of the respective case study results and the conditions for autonomy-promoting technology use.

Finally, the expert interviews are intended to raise the research perspective from the employee and company level to the branch level and thus also fulfill an additional exploratory function in the research design (Menz & Nies, 2018, p. 280). For expert interviews, 60 minutes per

interview are estimated in advance. When selecting the interviewees for the expert interviews, emphasis was placed on a balanced gender ratio. Other decisive criteria are the field of expertise and availability. A total of four interviews were conducted for this purpose. The ADM-related fields of expertise are in the following areas:

- regulation, strategical foresight, public administration,
- occupational health and safety, standardization,
- technology development, research funding, care technologies,
- labor law, workers' participation.

12.3. Interview initiation and conduction

A total of 20 interviews were conducted, partly digitally and partly in person, whereby the personal exchange generally offered advantages in terms of subject-relatedness, openness, and flexibility in the conduct of the conversation. All interviews were audio-recorded. For a list of interviews, interview type, interviewee specification, interview day, and duration, see Table 27 | Appendix. Each interview was followed by the preparation of a postscript. This step resulted in the subsequent recording of impressions and content reflexes beyond the immediacy of the actual interview. It also served to reconstruct and retrospectively characterize the conversation and was thus intended to support the interpretation process.

The interviews were conducted according to the semi-structured interview guidelines. At the beginning of each interview, the aim of the research project, the research question, and the embedding of the interview in the thesis were explained. The order of questions was situationally changed. Likewise, depending on the course of the interview, some questions were omitted because they had already been answered. Overall, the time frame set for the employee interviews (60 to 90 minutes) was largely adhered to. The context and expert interviews were occasionally arranged with a more flexible time frame based on the consent of the interviewees.

For Case I, the research of a concrete case study in the form of a company in outpatient care was carried out via the technology provider, who was already known to the author as a pioneer in ADM-based software solutions in care from previous research. In a blog post on the website, the provider advertised the successful introduction of their software solution at an outpatient care service. The managing director of this care provider was contacted by email and asked for an exchange appointment. During this initial online meeting with the managing director and care

manager, the exact goals, procedure, and scope of the research project were explained. The company was found to meet all the necessary criteria to qualify for a case study.

Hereafter, within a time frame of four weeks (October to November 2022), four presence days were completed at the company location, during which most of the interviews were conducted, a presentation of the company's goals, organization, and use of technology took place, and an accompaniment of an employee at a shift was made possible. The technology provider was contacted separately and asked via video conference about the specifics of their technical system. A total of three context interviews were followed by five employee interviews. All interviews were conducted in separate rooms with the interviewees, who were first given a brief introduction to the research question and its relevance. All employees were given a consent and privacy statement, and the right to withdraw. The necessity of audio recording and anonymous data processing was explained.

For Case II, several universal banks, which, according to previous online research, use ADM, were contacted by email with a request for cooperation. The selection of the companies contacted was based not only on compliance with the content-related selection criteria described above but also on the aspect of feasibility at the company's location. The present example was the only one to respond positively to this inquiry. From the first contact to the first interview, a period of just under four months passed, during which three meetings were held with board members and higher-ranking employees of the company to isolate a concrete use case of ADM that could be considered for the research project and to convince the company that a collaboration is of mutual interest.

The sheer size of the company, including multiple levels of hierarchy, considerably prolonged this concretization process. Within a time of twelve weeks (April to July 2023), four presence days were completed at the company location, during which the majority of the interviews were conducted, and a presentation of the company's goals, organization, and use of technology took place. A total of four context interviews were followed by four employee interviews. The spatial conditions as well as the concrete conduct of the individual interviews are comparable with Case I.

The initiation and conduct of the complementary expert interviews were much less complicated and seamless than the case studies. Selected experts were contacted directly with an interview request via email, which was followed by positive responses without exception. Since the expert interviews were intended to mirror and discuss the results of the case studies, it was important to schedule them after most context and

employee interviews. Within a time of four weeks (June to July 2023), all interviews were conducted digitally.

12.4. Data preparation and analysis

The audio files of the interviews form the basis for the transcription and evaluation by means of qualitative content analysis. The interviews are transcribed in the form of a summary. Only content that subsequently proves to contribute to answering the research question is selected. In this way, the interview material is reduced, systematically standardized, and generalized at the beginning of the analysis (Mayring, 2016, pp. 94–95). Voice inflections and pauses on the part of the interviewees are neglected. This form of transcription is particularly useful for processing large amounts of material if the focus of analysis is on the content-related components (Mayring, 2016, p. 97).

The summary transcription of all interviews forms the starting point for the detailed interpretative evaluation and has the advantage that the essential interview content is transcribed in a concentrated form. Depending on the length of the interview, the transcriptions comprise three to five pages. The interviews are first analyzed in German using the software MAXQDA. The English translation takes place after the interpretation has been completed to minimize misunderstandings.

The interviews are analyzed using qualitative content analysis, following Mayring (2010). This technique is characterized in particular by its step-by-step material analysis with strict methodical control (Mayring, 2016, pp. 114–115, also in the following). In comparison to quantitative analysis approaches, this allows the context of material elements as well as latent structures of meaning to be considered while still giving room for interpretation to striking case examples. In essence, it develops a system of categories from the interview material. This category system secures essential information, sorts it, and ultimately allows a systematic interpretation of the information.

In detail, this qualitative analysis relies on the summarizing content analysis, which reduces the material to essential content that, while ultimately abstracted, still allows conclusions to be drawn about the source material. The development of the category system essentially follows an inductive approach with deductive elements, i.e., the formation of categories is based on the interview content and was concentrated step by step. A deductive element is only found in relation to the application of the theory-based dimensions of job autonomy, which are used as a structuring factor for the analysis of the material. The category system

formed serves as the central interpretation of the interview material. The category system was initially developed along Case I and transferred to Case II to create maximum comparability in the analysis. The analysis of the expert interviews follows a less complex method. Since the interviews were rather similar to exchanges and discussions of the case study results, their analysis resembles more of a summary. The core content and expertise of the experts are offered in condensed form.

13. Company Case I: good practice in outpatient care

13.1. Branch profile: outpatient care

The introductory branch profile contextualizes the case study results. It summarizes key assumptions and findings on the care sector from preliminary work, describes the average degrees of job autonomy for care workers, and addresses the organizational particularities of outpatient care. Finally, the branch profile also provides an overview of technology adoption in the care sector as well as selected research findings on the impact of technology use on care workers.

13.2.1. *Retrospective: What do we know so far?*

Previous considerations on the extent of job autonomy in the service sector (Chap. 1.5) initially reveal the following branch profile: Healthcare workers, which include outpatient care, typically perform LAS. They are among those workers who report the least scope for shaping their work. This is reflected not only in the large share of workers with little influence on the amount of work they do, but also in terms working hours and ability to plan work independently. This picture of a highly intensive and stressful job is completed by a constant feeling of being rushed and interrupted at work. More than one-third of employees are forced to make quality cuts at work. From this aggregated perspective, limited job autonomy of healthcare workers is obvious (Table 1).

The branch analysis along the seven job autonomy dimensions follows a similar path (Chap. 8.1): human health and social work activities, the statistical reference for outpatient care, clearly fall into the field of less autonomous branches with relatively little job autonomy. What is remarkable, however, is that the development is less reflected in the content-driven job autonomy dimensions such as Task and Method Autonomy. With Method Autonomy, the branch even departs from other LAS. Perhaps the high degree of interactional work both enables and requires the possibility of determining the way of working independently and situationally. However, the fact that healthcare services are also strongly guided by external performance goals, i.e., price constraints and econo-

mization efforts by insurers and private health providers, is reflected in the lowest level of Criteria Autonomy in the entire service sector.

The aforementioned intensity of work in healthcare replicates the lowest degree of Scheduling Autonomy across all service branches. This means that employees have little influence on work scheduling, speed, and independence from interruptions, which suggests that work is highly situational. Unsurprisingly, healthcare services are comparable to other typical person- or object-related professions in that Working Time and Locational Autonomy indicate relatively few degrees of freedom. Interestingly, the branch also stands out in that Interactional Autonomy is considerably below average. This indicates a higher degree of dependence on colleagues and superiors, little support from them, as well as the need to constantly assume responsibility and make compromises. Overall, the working conditions in healthcare services paint an extremely heterogeneous picture of job autonomy. This may also be an indication of the richness of work demands.

The analysis of the average change in job autonomy between 2012 and 2018 (Chap. 8.4) indicates declining job autonomy in all dimensions: Job autonomy in healthcare services has decreased in the period under review. Not only are there considerable losses in the content-related dimensions of job autonomy (Task and Method Autonomy), from which almost all service branches suffer. Additionally, it is also the time- and performance-based aspects of job autonomy that are losing ground in the field of healthcare services. This means that the branch's employees are becoming entangled in the autonomy-restricting tendencies of person- and object-related services. If there is one assumption that should be taken from these findings into the qualitative approach, it is the following: The combination of decreased degrees of Method Autonomy and, at the same time, more intensive and performance-related work suggests constant conflicts at work in the sense of contradictory work requirements.

The observation and perception of increased work demands, for example, in the form of higher workloads, is additionally confirmed when progressing digitalization in the healthcare sector is considered. For more than half of the employees, the amount of work has increased, resulting from digitalization. Similar trends apply to the need to handle several work processes simultaneously and the feeling of being monitored and controlled at work. However, the question of changes in the scope for decision-making at work yields somewhat interesting results. Compared to all other service branches, most employees in the healthcare sector report that digitalization has not brought any changes for them (Table 17 |

Appendix). Regardless of digitalization, decision-making authority often seems to remain with healthcare workers.

Since these findings deal with digitalization in general and in retrospect, no direct assumption is made about the influence of ADM systems on job autonomy in healthcare. However, based on the theoretical and empirical considerations so far, work in the branch is characterized by high intensity and organizational constraints. The creation of new degrees of freedom at work is a central solution to provide some relief from these burdens. As will be shown later, the use of technology may contribute to this.

13.2.2. *Employment, content & work demands*

Within the care sector, a constant area of tension arises between a shortage of workers, the maintenance of qualitatively good care, and the work-organizational (and thus directly economic) predetermined caring reality (Kumbruck & Senghaas-Knobloch, 2019, p. 154). There are clear differences in terms of care provider, related work organization, services offered, and the status of digitalization (Wolf-Ostermann et al., 2021, p. 35). Particularly due to the high proportion of private care providers (67 % in 2021, Destatis, 2023b), the usual economic objectives and organizational structures are assumed for these facilities. However, they resist this logic in terms of pricing structures, which can only be changed in partially regulated negotiations with health and care insurers – and thus also affect the staffing levels in care companies.

To express the disproportionate employment on a labor market level: Care work is a cross-regional shortage occupation. As of 2021, a total of around 1.7 million care workers are employed in Germany (subjects to social security contributions, Bundesagentur für Arbeit [BA], 2023a, p. 4). Over 80 % of employed care workers are women; almost half work part-time (BA, 2023a, pp. 10–11). The gender ratio is even more pronounced in outpatient care, which counts a total of around 430 thousand workers, most of them care workers, 85 % of whom are women (Destatis, 2023a). Care workers face an increasing number of people in need of care. In 2024, the German care insurance funds counted just under 5.6 million people in need of care. Many of them are cared for in professional outpatient settings, i.e., just under one million people (Bundesministerium für Gesundheit [BMG], 2024, p. 1; Destatis, 2023b). In both outpatient and inpatient contexts, the number of people in need of care has increased massively in recent decades. The number of people

cared for in outpatient settings has more than doubled in the past 20 years (Destatis, 2023b).

The media and scientific portrayal may distort the actual picture: Outpatient care settings form the main pillar of care for the majority of people in need. The key actors are both professional care workers and informal caregivers (partners, children, other relatives, neighbors). By law (§ 3 SGB XI), people in need of care should be cared for at home in an outpatient setting for as long as possible. Therefore, the importance of good working conditions in outpatient care can hardly be underestimated.

The range of tasks performed by care workers in the outpatient setting is potentially very extensive (nursing and care measures in line with SGB V and SGB XI). It ranges from support in household and everyday management of persons in need of assistance, their medical and nursing care, to professional counseling of informal caregivers involved (BMG, 2023). What stands out about care work in the series of service activities is the work close to the human body, which partly involves invading the intimate sphere and privacy of people in need of care.

Care work consists to a considerable extent of administrative tasks, but the interactive part of care work is still an underestimated, albeit highly demanding one. Kumbruck and Senghaas-Knobloch (2019, p.142) describe that the quality of the care activity depends on the ability of the care worker to shape the interaction relationship with the person in need of care in such a way that the latter allows the actions and does not resist them. The interaction between the person providing care and the care recipient is interspersed with feelings and emotions on both sides. The subjective part of the work is expressed in the essential interaction work, i.e., in dealing with one's own as well as other people's emotions (Kumbruck & Senghaas-Knobloch, 2019, p.144).

There is plenty of empirical evidence that care professions have to work in a permanent pressure situation in addition to physical strain (e.g., DGB-Index, 2023, p.2). Many care workers very often or frequently feel rushed or under time pressure (76 %), do not receive important information (89 %), are faced with demands that are incompatible with each other, or have to cut back on the quality of work outcomes (DGB-Index, 2018a, pp. 7–8). The latter point may have devastating consequences for people in need of care. Experts in the care sector tend to expect a further increase in psychological stress among care workers in the future (Glock et al., 2018, p.34). This assessment is all the more drastic in light of the fact that care workers are absent from work more often than most other professions (M. Meyer et al., 2021, 469; Techniker Krankenkasse [TK], 2019, p.25).

The specific conditions between inpatient and outpatient care may well differ: more frequent requirements for minimum performance, as well as less support from supervisors and colleagues, to the disadvantage of outpatient forces; in contrast, less loss of breaks, deadline and performance pressure, interruptions, and parallelism of work processes, as well as less frequent working to the performance limit, in favor of the outpatient setting (Petersen & Melzer, 2022b, pp. 7–9). However, outpatient care workers more often report emotional exhaustion and problems switching off from work (Petersen & Melzer, 2022b, p. 10) – clear indications of work without temporal limits, which is possibly even more pronounced in the outpatient than in the inpatient setting.

From an organizational point of view, outpatient care is characterized by work away from the team in the private rooms of those in need of care with strong mobility requirements (Petersen & Melzer, 2022b, p. 2). Personal exchange with colleagues and supervisors (e.g., team meetings or handovers) becomes even more important for care workers as they work alone on a daily basis. A major challenge of working alone is that no quick on-site help can easily happen. Hence, the communication and information requirements are particularly high, especially regarding handovers, which can rarely be performed directly between colleagues.

Partially unplannable work rhythms are a major organizational challenge (Bleses et al., 2018, pp. 21–23). Unplannable situations occur daily when caring for people. However, unpredictable, non-plannable moments in outpatient care do not only have to occur due to health emergencies. Likewise, non-billable, hidden services arise that are not covered in care documentation. Examples include cleaning up, reading documents aloud, getting the mail, or simply being there for the person (examples in Lezock & Klewer, 2014, p. 34). The task-related and work-organizational challenges in outpatient care accumulate, especially in the decentralized nature of work. Again, reliable communication and information channels are all the more important.

A considerable amount of time in outpatient care is spent traveling (mainly by car). Very often, there is not enough time planned for these patient-to-patient trips (Petersen & Melzer, 2022a, p. 1). Atypical working hours and constant availability are the norm. Specifically for the outpatient setting, there are so-called shared services, which include longer breaks between working hours during the day (Petersen & Melzer, 2022a, p. 1). Furthermore, working schedule uncertainty is a major problem. More than half of all outpatient care workers are always or often affected by unforeseen changes. These aspects of uncertainty and stress are often intensified at the management level (Petersen & Melzer, 2022a, p. 2). According to Janson and Rathmann (2021, p. 352), this demand

for flexibility represents a constant source of stress, which should be countered in particular by granting job autonomy.

In this sense, the promotion of job autonomy goes hand in hand with the issue of higher recognition of care professions, which has accompanied the discipline for many years. Potential dimensions of upgrading care professions include staffing levels, working hours, and professional development opportunities (Schildmann & Voss, 2018, p.6). Within these dimensions, many elements of job autonomy can be identified: More appropriate staffing levels would allow greater freedom to shape and plan work. The same applies to flexible and, above all, more reliable working hours. The upgrading of care professions and job autonomy can thus certainly be thought of together. More recent research suggests that the use of technology in care has quite some positive effects, but – as this case study also shows – these depend largely on the organizational conditions of work.

13.2.3. Job autonomy in (outpatient) care & technology use

There is comprehensive empirical evidence on the basic work and strain situations of care workers. However, research approaches addressing care technologies are mostly limited to the effects on care recipients (e.g., Lutze et al., 2021) and, to a lesser extent, to the influences on care workers in the inpatient setting (e.g., Fuchs-Frohnhofer et al., 2017). Many studies tend to focus on evaluating the implementation of technology, determining acceptance among stakeholders, and the integration of technology into everyday care (e.g., Hülsken-Giesler et al., 2019; Saborowski & Kollak, 2015; Weber et al., 2022). So far, there are hardly any setting-specific insights into the requirements and needs for the use of novel AI systems, including learning ADM, in care (Wolf-Ostermann et al., 2021, p.2) – this is especially true for outpatient areas. Findings on the organizational or psychosocial effects of using these systems in the care context are virtually nonexistent (Wolf-Ostermann et al., 2021, pp. 19–20). This is at least partly attributable to the fact that AI systems are mainly used in medicine, i.e., in diagnosis, surgery, therapy, radiology, drug development, or healthcare management (Neu et al., 2022, pp. 50–52), not in care work.

There is hardly any precise data on the actual use of digital systems, let alone ADM in the care sector. A rarity is Braeseke et al. (2020, p. 39) depicting digital technology in outpatient care: Almost three-quarters of outpatient services use organizational software, e.g., for tour planning and time recording. Mobile devices for internal communication are also

widespread (80 %). More than half of all care providers use technical tools to support the care of people. Haug (2021, p. 192) adds that only a few outpatient services use digital documentation systems (29 %) or monitoring systems (9 %). Except for the use of mobile devices, outpatient facilities are thus considerably less digital than inpatient facilities. The use of technology is clearly dependent on the number of clients, i.e., on the size of the company. It increases with the number of clients (Braeseke et al., 2020, p. 40). What remains is the realization that in many care facilities, digitalization is still (if at all) limited to digital documentation, personnel resource planning (PEP), and efficiency calculation. Healthcare statistics distort the reality here. Medical work and hospitals are permeated with digital elements. However, these are to be distinguished from care facilities because, for a long time, they were regarded as areas in which technical support was neither necessary nor desirable (Daum, 2017, p. 13). A certain *time lag* is suspected in the information technology support of care facilities compared to hospitals (Hielscher, 2014, p. 19).

The reduction of care work to purely interactional elements, where technical aids only interfere, fits into the well-known de-professionalization narrative around person-centered and social services. However, a distinct shift away from this attitude is visible. On the one hand, this may be due to the demographic and employment-related pressures for change in the care sector (Hielscher, 2014, p. 13). On the other hand, technical services for care are now available at lower barriers, with higher reliability and being easier to handle in everyday work.

The fact that care work has not been intensively technologized to date is not attributable to a lack of acceptance or affinity for technical innovations, as may be suspected (Evans et al., 2018, p. 1). Care workers tend to be positive, curious, and not very fearful of new technologies (Merda et al., 2017, p. 123; Rösler et al., 2018, p. 17). Technical support systems receive the greatest rejection when malfunctions occur or no time is provided to use (and learn) them (Saborowski & Kollak, 2015, p. 136). Technical innovations are also viewed critically if they risk a loss of interaction quality with people in need of care and an increase in their isolation. Consequently, the use of technology is particularly rejected if the interaction work is negatively influenced (e.g., Sävenstedt et al., 2006, p. 22). Ultimately, the usefulness and usability of assistive technical systems depend on development and implementation (preferably participatory, Lutze et al., 2019, pp. 223–226) and reliable functionality, but also on basic technology acceptance by care workers (overview in Krick et al., 2019, p. 7) and the care setting (e.g., Hülsken-Giesler et al., 2019). In this context, there is even the possibility that care workers perceive

themselves in direct competition with the technical system in the care process (Saborowski & Kollak, 2015, p. 138).

The actual benefits of digital technologies in care have hardly been systematically proven for care recipients, let alone for care workers (Lutze et al., 2019, p. 221). Many findings on the effects of technology use on care workers are ambivalent at best. Rather, the potential for time relief or the dangers of overburdening care workers with even more tasks are frequently reported (Daum, 2017, p. 36). Whether the effects are relieving or easing the burden, increasing the amount of work, or decreasing the effort, as well as granting autonomy or creating additional restrictions, remains largely unclarified. There are indeed reports of relieving effects using technology. However, the potentially positive effects are often overshadowed by increasing work intensification, time pressure, and incorrect use of the technology (Tisch & Meyer, 2020, p. 695).

For example, recent case studies on the effects of care technologies on the tasks, processes, and workloads of care workers in Germany and abroad describe a frequently relieving and thus large added value for the everyday life of care workers in an inpatient context (Lutze et al., 2021, p. 104). These findings indicate that the use of digital technologies has a considerable impact on the work processes of care workers. A positive effect of using digital technologies in care is often cited as the creation of a common information base and improved communication channels.

The use of digital, mobile devices for care documentation, which makes access to real-time information available at the Point of Care (PoC), proves to be particularly effective (Lutze et al., 2021, p. 132). This also results in a stronger focus on the work location close to the person in need of care. Information is available in a more condensed and clearer form. In combination with sensor systems, there are fewer unforeseen situations.

Indications of the autonomy-enhancing effects of using digital technology come from the perception of being able to handle the systems competently and to carry out digital documentation promptly. Care workers report an improved ability to plan tasks and an increased sense of security through monitoring (Lutze et al., 2021, p. 38). The variety of work tasks is increased; monotony and interruptions of the workflow are reduced. In some cases, the new possibility of working from home is reported (Lutze et al., 2021, p. 92). However, the study also indicates that digital technologies do not assist in complex decision-making (Lutze et al., 2021, p. 108). Thus, in crucial situations, the decision-making authority remains with care workers.

Just a few years ago, it was attested to outpatient care that hardly any digital technology would be used to support both care workers and

recipients. This may in part have to do with the need for the sovereignty of care receivers in their own homes (Braeseke et al., 2017, p. 6). As it is made clear above, this is only true to some extent; technical aids for administration and organization are used – albeit depending on the specific tool and the size of the company.

Important digital systems in the outpatient setting include digital care documentation (1) and systems for tour planning and service recording (2) (Braeseke et al., 2017, pp. 9–11). The latter systems comprise two central functions: performance and tour planning for care workers and the possibility of mobile (flexible) recording of services provided to the patient. Both form central elements of the technical system in the case study.

In the case of digital documentation (1), the consequences for the employees have so far been quite ambivalent from a research perspective. Generally, the implementation of new technologies carries the risk of standardization. Technical applications are bound to a certain degree of formalization and rule-basedness. For example, regarding the use of an electronic patient file in hospitals, it was found that the job autonomy of employees is rather restricted (Petrakaki & Kornelakis, 2016, p. 233). Although care workers initially perceived the technology as conducive to information access, at the same time, documentation efforts increased as synchronization problems arose between systems. This even led to the point where employees purposefully bypassed the system and avoided its use to maintain sovereignty over their work process (Petrakaki & Kornelakis, 2016, pp. 233–234). However, it is also evident that it is not the use of a technology on its own that has led to increasing standardization and less job autonomy, but that the (increasing) requirements for care documentation already include standardization and formalization (Lutze et al., 2021, p. 120).

In contrast, there are examples where using tools for digital documentation has reduced the time required for administrative tasks (Lutze et al., 2021, p. 67). After all, a certain degree of formalization also contributes to process quality and consistency. The extent to which digital care documentation is beneficial to company control mechanisms has hardly been investigated to date. In principle, it allows for checking care services performed in real time and drawing conclusions about the productivity of individual care workers. Care work thus becomes much more transparent (Hielscher et al., 2015, p. 12). The consequences are again a question of employee data protection as well as corporate strategies. This at least raises the question of the extent to which digital documentation is also perceived as a form of control (Hielscher et al., 2015, p. 13).

Digital shift and tour planning (2) replaces time-consuming analog planning (especially for the care managers) and enables a relatively sim-

pler reaction to short-term changes (e.g., cases of illness or traffic jams). Thus, it is also about the dynamic adjustment of planning in contrast to static pre-planning in analog settings. The very complexity of creating shift and tour planning for care services, which ultimately results in mathematical matching, makes the use of learning systems attractive for the planning process (Karl, 2022, p. 12). For the care worker on tour, this includes using a mobile device that logs work time (Daum, 2017, p. 19).

Thus, a change in work processes is expected using shift and tour planning (as well as digital documentation of service delivery). The proportional increase in the flexibility of work planning initially suggests an expansion of the degrees of freedom for (managerial) employees (Daum, 2017, p. 37). From the company's point of view, great potential for efficiency is expected in the coordination of care services (Hahnel et al., 2021, p. 10). Travel times can potentially be reduced, and staff can be deployed more efficiently. This may also have a positive impact on the working hours and conditions of care workers (Hahnel et al., 2021, p. 17).

Outpatient care facilities that use tour planning and service recording systems could potentially see several improvements that are not limited to economic interests only. There are also signs of increased quality of care as well as subsequent client satisfaction. However, statements on a possible improvement of working conditions and the quality of outpatient care workers are only possible to a limited extent. In the cited study, about two-thirds of respondents concede that the use of the systems has reduced the stress of employees, and just under half state that it allows them to spend more time with those in need of care (Braeseke et al., 2017, p. 14). Disadvantages mentioned by users of tour planning and performance recording systems include the complexity of the systems. Apparently, there is a discrepancy between the manageability of these systems in practice and the technical performance spectrum. However, what is hardly judged negatively by users are organizational and financial attractiveness as well as acceptance by care workers and care recipients (Braeseke et al., 2017, pp. 14–15).

Specifically, learning systems in shift and tour planning can potentially have beneficial effects as they can include a variety of information in the decision-making process, i.e., for example, individual care wishes and needs, availability and qualification of employees, but also route specifications (Wolf-Ostermann et al., 2021, p. 25). Accordingly, the optimization problem should ensure that the skills and availability of care workers are adapted as optimally as possible to the care recipients and that information flows are guaranteed across stakeholders.

However, an often-neglected factor in this calculation is that this data must first be systematically collected, implemented in the systems,

and sustainably maintained. Automated tour planning in particular is regarded as having the potential to have the highest feasibility in the set of requirements (Wolf-Ostermann et al., 2021, pp. 25–27). Robust studies on the impact of using ML-based service and route planning systems are not currently available (Karl, 2022, p. 12). What is clear, however, is the expectation level and these systems. Workloads in shift and tour scheduling are to be minimized, and optimized tour scheduling in turn is to lead to time savings for care workers (Karl, 2022, p. 12).

This form of digitalization of outpatient care work clearly contributes to transparency in terms of time and content of work. The consequences of this transparency are still difficult for employees to assess (Daum, 2017, p. 19). It depends on the utilization of these technologies as a control instrument by management. Thus, increases in deadline and performance pressure for care workers are possible. Care workers themselves see the danger of increasing time pressure and savings in personnel associated with the use of modern technologies (Rösler et al., 2018, p. 17).

13.2. Case summary

“If you want to work at [case company], you have to work digitally, and you have to do it from the very beginning,” which is how the managing director describes the company’s technology-related organizational framework. This approach is both a resource and a requirement for employees. It is a selling point, especially for younger care workers, but those digital tools must also be learned and applied correctly. From the company’s point of view, digital work comprises investment costs and continuous maintenance, as well as the utilization of optimization potentials in administration and planning. Finding out what it entails for employees is the aim of this case study.

The company example is an outpatient care service in a rural area in Eastern Germany, which was founded in 2021 and employs a total of eight people, including the managing director (IT specialist) at the time of data collection. Working hours are reduced. Great importance is attached to the reliability and predictability of working hours. The company’s capacities are not yet fully utilized on the client side. The employees combine many years of experience in the care profession, mainly in the inpatient setting, yet the team is relatively young. Distinctive features of outpatient care include working alone in the rooms of people in need of care with high mobility requirements.

This company example uses a highly integrated software solution that moves administration, accounting, work scheduling, and planning

completely into the digital space. Tour planning is ML-based. On tour, care documentation is recorded via ML-based voice input; handovers as well as performance and working time are recorded on networked tablets, which also provide access to the tour plan and care-relevant information on the clients. The goals of technology use are standardization, process reliability and quality, and enabling remote work. The desired efficiency gains are evaluated in combination with employee and client preferences.

The statements of the employees interviewed paint an overall picture of considerably increased job autonomy using the technical system. The employees report more self-determined work situations due to the reduction of time spent on documentation and performance recording, the increase in flexibility regarding the place of work, and more efficiently designed tour plans. Autonomy-strengthening moments are recorded across all job autonomy dimensions. The satisfaction with and functionality of the system is described as clearly positive. However, technical malfunctions and misuse can have the potential to restrict job autonomy. Overall, the technical support for planning and administrative work is perceived by employees as promoting autonomy – but it also does not interfere with the core of care work, i.e., the interaction work with people in need of help and care.

The learning elements of the system mainly express themselves positively in terms of content-, goal-, and intensity-related dimensions of job autonomy (Task, Method, Criteria, Scheduling Autonomy). New freedoms through process digitalization are more likely to be recorded in working time and location-related job autonomy dimensions, as well as regarding cooperation in the team and with clients (Working Time, Locational, Interactional Autonomy).

The changes in each job autonomy dimension accumulate in a series of potential positive effects on working conditions: a contribution made to the quality of care, improvements regarding workload, and an easing of interaction work. The conditions for creating positive experiences of job autonomy in dealing with the system are essentially nourished by organizational aspects: the absence of utilizing performance-related employee data as a control instrument and the visible prioritization of client requirements in all phases of everyday care work.

The case study is structured as follows: The description of the case company and its organizational characteristics (Chap. 13.3) is followed by the embedding of the technical system in the daily work processes of the employees (Chap. 13.4). The emphasis is placed on the learning aspects of the system (Chap. 13.4.2). This is followed by the central case analysis, i.e., the description of the ADM system influencing the seven

job autonomy dimensions (Chap. 13.5). In addition, technical hurdles and problems in dealing with the system are identified (Chap. 13.6), and finally, the effects and conditions of changed job autonomy are discussed (Chap. 13.7).

13.3. On company and employees

The company case study is based on an outpatient care service founded in 2021 and located in a rural area in Eastern Germany. As an outpatient care service, the company takes on six central areas of responsibility for people in need of help and care:

- care counseling (e.g., on financing and organizing care),
- housekeeping support (e.g., shopping, cleaning),
- other support activities (e.g., organizing leisure activities, exercises for mobilization),
- basic care (e.g., personal hygiene, nutrition, mobility support),
- medical treatment care (e.g., wound care, medication, insulin therapy),
- respite care (e.g., care and provision when regular caregivers are unavailable).

At the time of data collection, eight people are employed in the company: the managing director (trained/studied IT specialist), a care manager, four care professionals (3-year vocational training), and two care assistants (1-year vocational training/semi-trained). Two care workers are male. All employees work full-time (35–40 hours per week). Most of them have been working in the care profession for several years. The interviewed persons are aged between 22 and 52 years. The average age (approx. 35,5 years) in the company is relatively low for the care sector. The number of fixed clients totals 34, ranging in age from 12 to 91, with a clear majority over the age of 70. There are a variable number of clients who only claim short-term services. Most clients receive services corresponding to care levels 2 to 3.⁴⁹ According to its own statements, the company is not yet working to full capacity with this number of clients, which is why the acquisition of new clients accompanies the daily work of the employees just as much as the recruitment of new care workers.

⁴⁹ In relative terms, the care level of people in need, which in the insurance sense represents the degree to which a person requires care and roughly translates into care-related efforts, is on average somewhat lower in outpatient settings than in the inpatient sector (Bundesministerium für Gesundheit [BMG], 2024, pp. 1–2).

The allocation of care duties is guided by the respective qualifications of the staff, i.e., medical treatments must only be carried out by professionals. Care assistants tend to take over housekeeping activities, other supporting tasks, and basic care. This can be deviated from, e.g., if necessary, care professionals can also take over the typical tasks of care assistants.

Planning and organizational tasks are divided between the managing director and the care manager. Business management and financial matters are the responsibility of the managing director and founder. A unique feature of his role is his background as an IT specialist, which is the reason for the strong affinity and interest in a high degree of digitalization in the company.⁵⁰ The day-to-day care business is the responsibility of the care manager, who makes decisions on all care-related issues. In particular, she takes over client management and work planning for the care workers. In work planning, a distinction must be made between shift planning and tour planning. Shift planning refers to the determination of the shift weeks for a staff member and is done, if possible, six weeks in advance. Tour planning refers to the scheduling of the exact sequence of individual deployments to clients on a given day. The tour plan can always change at short notice.

Compared to other outpatient care services, the working hours are slightly shorter, from 07:00 a.m. to 09:00 p.m. (usually 06:00 a.m. – 22:00 p.m.). The weekly schedule varies greatly from person to person. Basic shift models for care workers include early, late, day, and shared shifts, as well as on-call duty. Office shifts are usually only covered by the managing director and the care manager. Maintaining an appropriate work-life balance is a high priority for the company. Many employees state that they have also chosen the company because the working hours are shortened and little work is done on weekends, not on public holidays or at night. Generally, great emphasis is placed on the regularity and reliability of the working hours.

The distinctive feature of this team composition and cooperation lies in their previous experience: Most of the employees had worked in an inpatient setting before joining the company, i.e., in hospitals or care facilities for the elderly. In the outpatient setting, there was little previous experience, which led to an ongoing joint learning process regarding

50 While no representative data is known on the qualifications of managing directors in care companies, it is reasonable to assume that they generally have a background in care or business administration. A particular affinity for the integration of digital systems into the work of the case study company can be legitimately assumed.

the organization of work. This is also reflected in the distribution of tasks, which was changed repeatedly in the work process, for example, particularly affine people take on more tasks in the areas of sales and marketing.

It is evident among many of the interviewees that previous experience in the inpatient setting has dissolved a partly negative attitude towards outpatient care (which was often already established during vocational training). Work in the outpatient setting is described as more routine, less physically stressful, and with less responsibility, but also less standardized. There is a greater sense of security in everyday working life, also because less serious medical cases are treated in the outpatient setting. According to the employees, the feeling of safety is maintained when working away from the team because communication channels between colleagues are always open, and solo work, which is potentially extended by the possibility of working remotely, is thus not perceived as such at all. The care manager aptly describes, “If the team works, then it is also possible to work alone and with fewer people”.

The company refrains from calculating to the minute or even to the second for individual deployments with clients. A “piecework processing of clients” under sometimes “unrealistic and absurd” time assumptions, which are determined by external price specifications, is not supposed to happen in the company. In this respect, the case study differs from larger care services and at least tries to avoid the ongoing economization of healthcare to some extent. Of course, as in any other company, performance and productivity are weighed up. Target/actual times in route planning are compared, and attention is paid to an optimized matching of more expensive skilled workers and cheaper assistance services. The crux of the matter is that this multitude of time- and location-bound data has so far not been used to intensify work but to lead to more efficient processes, which is welcomed by all involved. This is not to say that the company is not profit-oriented; it simply does not push rationalization and intensification to an unbearable limit for care workers.

However, the company cannot completely escape the given socio-economic and legal conditions in (outpatient) care. The most critical socio-economic factor influencing its ability to survive is the legal framework for financing and billing care services. The company is externally controlled in the pricing of its services, as these are set by health and care insurance funds for certain periods of time. Possible surcharges on these prices depend on the clients’ willingness to pay and are usually only in the low single-digit percentage range.

It is hardly possible to react to short-term price changes in operating resources and other necessities, such as increased prices for energy and

fuel in 2022 and beyond. Such developments pose enormous challenges for small care services in particular. The competitive situation between care services in the region is putting additional pressure on the company – both in terms of recruiting staff and new clients. According to the company, there is hardly any cooperation, for example, regarding the workload of individual care service providers. There is an overall lack of regional coordination of care services, which leads to the assumption of considerable losses in efficiency and quality regarding the deployment of staff and the care of people in need.

13.4. ADM usage in the work process

The company uses a technical system developed by one of the current market leaders in software solutions for the social economy in Germany. The system was available to all employees when the company was founded. The goals of implementing the technology are described in a comparable way by all parties involved: The aim is to achieve standardization, process reliability, and quality, as well as independence of location, which should also result in an improvement in working conditions. A direct influence on the core activities of care work is not intended, but rather the optimization of all organizational processes leading to these tasks.

“That we can all work in a uniform way” forms the core of the technology use and refers not only to the increase in standardization (e.g., no handwritten documentation), but also to the minimization of media disruptions⁵¹, and the central availability of information independent of location and time. Overall, business objectives are accompanied by ensuring the highest possible quality of care-related processes. It goes without saying that using the technology serves to increase business efficiency. However, the optimization of staff scheduling, and the location-independent nature of the technology also facilitate fewer burdensome conditions and flexibility options for care workers.

51 Cross-linking with other systems: Although it is intended that the processes run as free of media disruptions as possible, if not exclusively within the system, this does not succeed with regard to all business and organizational elements. The parallel use of MS Office applications and MS Teams can hardly be avoided (especially calendar and email functions). Other, lower-threshold communication channels, such as telephone and messenger services, are also used.

13.4.1. Basic functional spectrum

The company uses almost the complete range of services included in the software solution. Open functionalities are precisely defined hierarchically and reflect the division of tasks. This means that employees, in particular, only have access to a limited number of applications that they need for their daily work. Essentially, the overall system comprises modules for:

- administration and accounting,
- personnel resource planning (PEP), both in stationary use by the managing director and care manager in the office,
- care and service documentation,
- recording of working time, and care services, both in mobile use by care workers.

The software solution for administration and accounting forms the basis for all other modules of the system, especially PEP, because all the necessary data is stored, from the clients' background data to their diagnoses and illness histories to staff data. Furthermore, it enables the digital mapping of essential company processes, from the preparation of offers/contracts for clients to prescriptions from doctors' orders and their billing. Data entry is only partially automated. The function of administration and accounting is used exclusively by the managing director and the care manager, which is why it plays only a subordinate role in the following.

PEP refers to shift and tour planning. Due to the small number of employees in the company, shift planning is still done manually, but it is feasible with technical support. Tour planning uses the learning elements of the ADM system. It is based on individual deployments, i.e., stays and service provision for a single client. This turns tour planning into an extremely complex planning step because, on the one hand, it must consider requirements for the care service, which can be provided for an unrestricted or restricted period of time.

On the other hand, the provision of these services is linked, in particular, to the qualifications and availability of the employees. With qualification, the dynamics of individual tours usually increase, since complex treatments can only be carried out by professionals but are often limited in time (e.g., administration of medication for a period of two weeks on a doctor's order). In addition, there are routes and traffic situations that must be used as efficiently as possible between clients. The care manager is responsible for planning the tours.

The care and service documentation, as well as working time and performance recording, are centrally accessible for employees via tablet. The

Figure 11: Home screen on tablet for employees, Case I

<div><div></div><div>Risk/potential analysis</div></div> <div><div></div><div>Handover</div></div> <div><div></div><div>Documentation</div></div> <div><div></div><div>Performance and time recording</div></div> <div><div></div><div>Messages</div></div> <div><div></div><div>Tasks</div></div>	<div><div>Welcome, care professional</div><div>Monday, October 17, 2022 to Monday, November 14, 2022</div></div> <div><div></div><div>Wound documentation (resubmission)</div><div><div>Client1</div><div>October 21</div></div></div> <div><div></div><div>Birthdays</div><div><div>Client2</div><div>85 years</div><div>October 17</div></div><div><div>Client3</div><div>82 years</div><div>October 25</div></div><div><div>Client4</div><div>87 years</div><div>October 28</div></div><div><div>Client5</div><div>67 years</div><div>November 1</div></div><div><div>Client6</div><div>36 years</div><div>November 5</div></div></div> <div><div></div><div>Necessary further assessments</div><div><div>Client7</div><div>Fall</div></div></div>
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Source: Provided by the case company, October 2022. Own replica.

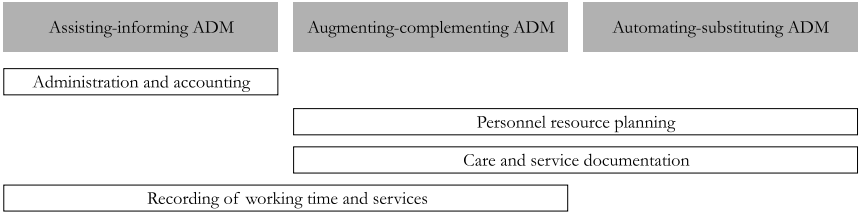
essential functions are directly displayed on the home screen (Figure 11): handover book and documentation, as well as performance recording and, if applicable, specific duties. In addition, important, daily updated information (e.g., wound documentation and client birthdays) is listed. Within the handover book and the care and service documentation, colleagues are informed about the course of illness, state of health, or other care-relevant data, which are also recorded for accounting purposes. The documentation can include text or images and uses ML-based voice input for the former. The tablet is not only a tool for documentation but also a central means of communication between care workers. However, acute communication solutions remain messenger service and telephone.

The working time and service recording refers to two distinct functions: Working time recording includes the digital start and end of each deployment, as well as the start and end of a shift, by simply clicking on the respective point on the tablet. This information on time is indispensable for the exact billing of services in the respective situations

and means nothing else than that the employees start their service with a click as soon as they are sitting in the car and start the assignment with a click as soon as they arrive at the first client of the day. Service recording describes the digital checking off of individual tasks that must be completed for a client. In the case study, all tasks are already checked off in a default setting, so it forms more of an overview of pending tasks.

The four functions of the system are categorized differently according to the depth of their intervention in work processes (Figure 12 and fundamentally, Chap. 3.3):

Figure 12: Classification in ADM categorization, Case I



Administration and accounting fall into the category of assisting-informing ADM, as they only enable digital processing and networking and are thus considered prerequisites for all other functions. In particular, it is the simplified access and presentation of information that constitutes this function. PEP contains elements of augmenting-complementing as well as automating-substituting intervention in work processes. For the work of the care manager, this signifies that tour planning is automated to the greatest possible extent, but that post-processing is carried out based on knowledge and experience. Since the latter work step is predominantly perceived as a positive corrective, an assignment is considered a supporting, complementary element.

Care and service documentation is assigned to both categories. Work steps are automated, especially through voice input. Ultimately, care workers must remember to provide all the necessary documentation services and record their contents; the initiation is assumed to come from the care worker. The system provides the formal framework and, if necessary, reminds the user of certain documentation requirements, which justifies the complementary character. The recording of working time and services is an assisting-informing aspect of the system. It digitizes the recording of the time cornerstones. However, it also takes the form of a guidance system by giving an overview of the time sequence of work and showing all the services that must be provided for a client, so that

a complementary working relationship also arises between this function and the care worker.

13.4.2. *Elements of learning ADM*

Most of the functionalities described fall under the digitalization of work processes and rule-based ADM from a technical perspective. However, those are closely linked to learning ADM, as it is fundamentally based on digital processes. In combination with the highest possible data quality, digital processes enable the use of learning elements of the system. Two functions of the system use learning functions, largely referring to ML: tour planning and voice input.

On the staff side, the data basis for calculating a tour is the shift time, fixed/desired times, place of residence, and qualification. On the client side, the care effort and, if necessary, the time schedule, as well as individual preferences regarding time, a certain care worker, and his/her sex, are considered. If only these restrictions were included in the tour planning, the system would rather count as a pure mathematical optimization problem. However, pattern recognition is added when data comparing target/actual tour times, repeated staff-client assignments, as well as real-time traffic conditions and traffic rhythms via traffic models are taken into account. These data can be weighted differently for the calculation of the tour. Depending on the planning preference, employee-oriented, client-oriented, economically efficient, and a standard setting are available. In the company, client-oriented weighting is selected (Figure 13).

The results of the automated tour planning are not used without post-processing. This need for post-processing in tour planning interferes most clearly with the care manager's work areas in terms of technical functionality. Although the ML-based suggestion of the tour plan could be adopted, the consideration of client and employee preferences based on experience gives reason to deviate from this plan. For example, individual deployments are exchanged, travel times are changed, or deployment times are varied. The high degree of standardization in the algorithm specification also has a restrictive effect on planning. Employees benefit indirectly from automated tour planning in that more efficient planning is available for them and short-term changes can be rescheduled much more quickly, i.e., from capacities freed up for the vital role of the care manager.

The ML-based voice input function is not supplied directly by the technology provider but is integrated into the hardware of the tablet.

Figure 13: Weighting for client-oriented preference in tour planning, Case I

Request plan suggestion

Request plan for 24.10.2022

Planning preference

Presetting

Client-oriented

Preferred employees

Balanced workload

Profitability

Short routes

Punctuality

Gender preference

Source: Provided by the case company, October 2022. Own replica.

The underlying language models can therefore not be accessed or influenced by the provider or the company. It is essentially used within the context of documentation by care workers. As will become clear in the following, this functionality should nevertheless not be underestimated because it enables the low-threshold use of times and ways that would otherwise not be available. The voice-to-text function replaces manual typing and has a considerable influence on the scope of administrative tasks for employees. However, it does not always function seamlessly: An internet connection is necessary, and care-specific terms are sometimes not recognized (Chap. 13.6).

13.5. Influence on job autonomy

13.5.1. Overall evaluation

The overall assessment of the technology use and its functioning is consistently positive across all employee groups (care manager, professionals, and assistant care workers). The most important tasks in everyday care are covered. Critical voices are only raised if technical malfunctions occur, which proves the high importance of the reliable functioning of the technology and technical infrastructure.

Satisfaction with the handling, learning, and usability of the system is high overall, although this assessment is only valid because the core of the care work, i.e., the interaction work on and with the client, is only indirectly influenced. Technology is regarded as an aid to enable administrative and planning tasks, to have a constant overview of them, and ultimately to fulfill them. What counts for care workers also applies to the care manager: Only in combination with experience and knowledge does the system function as a support tool in everyday work. Thus, despite the positively assessed functioning, deviations from the recommendations of the system do not only occur occasionally but are normality.

Autonomy-enhancing elements in dealing with the system as well as positive tendencies regarding workload relief are clearly recognizable: A contribution is made to the quality of care, work is noticeably eased, and interaction work is facilitated in some cases. Autonomy-increasing moments are found in all job autonomy dimensions. The question of whether care workers perceive their work with the system as more self-determined is answered in the affirmative throughout. However, this self-determination is not expressed exclusively through the functionalities used by the system but is centrally conditioned by the possibility of deviating from system specifications. This opportunity for action is accompanied by the constant compulsion to determine the (subjectively) correct combination of technology, experience, and knowledge. From the workers' perspective, however, this negotiation process is perceived as clearly fostering job autonomy.

The assessments of relieving and supporting moments in dealing with technology are more ambivalent. Reliefs are not clearly distinguishable from increases in job autonomy, i.e., what is considered to be conducive to job autonomy is often also perceived as relieving from work burdens. Potential burdens are essentially nourished by two sources: the possible occurrence of technical hurdles, especially if they cannot be solved by the employees themselves, and the fundamental necessity to use the system or

its permanent integration into the work process in the sense of *thinking of it*. Ultimately, employees are driven by the will to complete all tasks as independently as possible.

Table 9: Effects of the ADM system on employees and care manager, Case I

Autonomy Dimension	Positive effects (+)	Negative effects (–)
Task	– Information access and standardization	
Autonomy	– <u>Lower work quantity</u>	
Method	– Execution of care work unaffected	
Autonomy	– <u>Deviation from system instructions</u>	
	– Reminder feature	
Criteria	– Higher sense of security	– Reliance on planning and information
Autonomy	– <u>Better results in tour planning</u>	– Nuances of performance measurement
Scheduling	– <u>Time gains</u>	– Sequence of clients given
Autonomy	– Sequence of tasks unaffected	
	– Work speed unaffected	
	– Higher predictability of the tour	
	– Breaks unaffected	
Working Time	– Gains in time off work	– Risk of delimitation
Autonomy	– Higher predictability of work schedule	
Locational	– Information at PoC	
Autonomy	– Location-independent administrative tasks	
	– New meaning of office	
	– Home as place, start and end of work	
Interactional	– Higher quality of information and communication	
Autonomy	– Administrative tasks away from client	
	– Support from colleagues	

In the following, the positive and occasionally negative effects of using the technical system are described systemically according to the respective job autonomy dimension (overview in Table 9). Which influences, in particular, can be attributed to learning ADM? As already described above, the digital, rule-based, and learning ADM elements of the system are closely interwoven – as are their effects on job autonomy. Effects that can be attributed to a particularly high degree to the learning elements of the system are highlighted separately. In the following, a distinction is made between effects on care workers and those influences that *also* affect the care manager.

13.5.2. Job autonomy dimensions

Task Autonomy

Task Autonomy asks about the possibility of choosing work tasks independently, task variability, changes in the amount of work, as well as the availability and holistic nature of tasks and information. In the case study, positive changes in the dimension of Task Autonomy are expressed primarily in the improved access to information within the framework of process standardization. Mild autonomy-strengthening moments result from a partly reduced work quantity for employees and the care manager. If no technical hurdles occur (Chap. 13.6), no negative influences on Task Autonomy can be identified.

Information access and standardization (+)

The transfer of all care-related documentation duties as well as patient-relevant information to the digital system is reflected in the experience of more holistic information in everyday work, which is entered into the system in a standardized form and passed on to colleagues. This mainly concerns tour and shift schedules, service recording, documentation, and client-relevant information (e.g., diagnoses). Although much of this data is still entered into the system manually or by voice input, where in an analog case data was available in various locations, there is now much greater clarity and centrality of the data, which is also distorted by fewer media disruptions.

Employees have instant access to a shared database to perform tasks from any location via tablet. Information and communication flows between care workers are centralized and standardized, which results in, for example, early meetings in the office or ad hoc arrangements being eliminated. There are considerable time delays in passing on information in the analogous setting, which are minimized by the system's networking aspect. A higher quality of the available data results not only from location-independent, immediate access but also from the unalterability and sheer readability of the information. This has a positive effect on the transparency of tasks.

Clarity, centrality, access, and higher quality, especially of client-relevant data, are core elements and intentions of system use. They essentially contain enabling moments in care work, i.e., a changed, process-securing data basis for decision-making. Ultimately, the high availability of information also pays off in terms of care workers' sense of security. The system informs, reminds, and helps not to forget anything. What might

be considered banal in other work contexts is of enormous importance in care because access to information, with all its complexity, also provides relief.

Lower work quantity (+)

Information access and standardization go hand in hand with more diversified, but at the same time reduced, workloads for care workers. What sounds counterintuitive at first is the result of the elimination of information arrangements, i.e., the improved availability. Information contexts can be accessed more qualitatively. This applies again to information relevant to the smallest details (e.g., course of illness) as well as to organizational aspects such as tour planning, which does not have to be constantly remembered. This gives employees the perception of working more efficiently. Thus, efficiency gains are understood as an objective of care workers because searching for information and scheduling tours are administrative tasks that employees also want to optimize.

Less workload is also expressed for care workers in faster documentation and performance recording, which are made possible by the functions of the tablet – many tasks that had to be done by hand in the analog case are finished with a click on the tablet or a brief voice input. Information access and process standardization are considered prerequisites for these efficiency gains.

The care manager, whose task is to organize staff scheduling, also experiences a lower daily workload. Shift and tour planning are centrally supported by the learning element of the ADM system, which takes over the manual planning. Admittedly, this is more of a pre-planning, because a post-processing of the ADM-based tour plans is usually necessary. Nevertheless, this pre-planning also results in considerable time savings for the care manager. After all, the daily tour planning in particular often has to be adjusted ad hoc, be it due to staff absences or short-term changes in the needs of the clients. Since ADM-based tour planning is perceived overall as a positive corrective and support tool, autonomy-promoting tendencies are assumed despite the need for reworking by the care manager. The amount of work is reduced (Task Autonomy) and the corrective function of the system supports the execution of the planning activity (Method Autonomy). In combination with knowledge and experience, better work results (Criteria Autonomy) can thus be achieved in less time (Scheduling Autonomy).

The care manager considers the preferences and needs of care workers and clients, which the system cannot yet optimally achieve. Deviations from the original system proposal are the norm, not the exception.

However, it is a fact that the automated staff scheduling is perceived by the care manager as a great relief in her daily work. Ultimately, this facilitation is only made possible by accepting the system's error-prone nature. The automated staff scheduling is not perceived as an obligation but as a suggestion. Thus, an interplay between control of the system and the perception of the system as a corrective (e.g., in capacity planning) arises because, under the condition of correct data entry, the system also contributes to process reliability.

Method Autonomy

Method Autonomy asks for the possibility of determining procedures, ways, and tools for the performance of tasks. Within the dimension of Method Autonomy, autonomy-strengthening elements are essentially visible in the non-intervention in the interaction work with clients, the possibility to deviate from the suggested staff scheduling by the technical system, and its corresponding reminder functions. The indirectly supporting components of the system thus have a methodically strengthening effect, whereby the work with the clients and the performance of care activities are less influenced. If no technical hurdles occur (Chap. 13.6), no negative influences on Method Autonomy are evident.

Execution of care work unaffected (+)

The fact that all care activities on and with the client are carried out largely unaffected by the system should be distinguished from a deliberate deviation from the tour planning. The planned time frame for the interaction work is given, but the actual implementation of a task is the responsibility of care workers and their assessment of the care-related necessity. The content and organization of the care time are at the disposal of care workers and clients. Of course, in the case of tasks in treatment care, there are greater ties to the preservation of qualitative care, but these remain uninfluenced by the system overall. Ultimately, it is a combination of acting to the best of one's knowledge and conscience as well as the client's wishes.

Deviation from system instructions (+)

The conscious, active deviation from the ADM-based tour plan testifies to the perception of methodical degrees of freedom at work. Both the care manager and care workers occasionally deviate from the recommendations and specifications of the system. However, this is not a deviation

without reason but rather a situational weighing of the meaningfulness of a work step for the client's well-being. Experience-based assessments are usually preferred to system recommendations. How exactly a task is carried out at the client's is up to the care workers. The system's suggestions are always subject to review, and the perception of self-determination in this review is high.

The priority in decision-making in the daily work routine is constantly oriented towards the appropriateness of a measure for the client. Finally, there are nuances in care work, such as the situational condition of a client or the rejection of a measure, which cannot be planned for by the technical system. These situations are unpredictable, thus requiring subjectifying work actions that are largely incompatible with the formality and standardization of the technical system. The role of the system is ultimately again that of a corrective and non-binding suggestion.

Reminder feature (+)

The reminder function of the system follows the effects of information centrality and standardization on its autonomy-strengthening properties. Reminder functions of the system range from the simple indication of clients' birthdays to the resubmission of information on wound documentation. The reminder elements thus cover different care complexities in the sense of supporting interaction work up to medical care. These reminder functions are reflected in an at least partial easing of situational action by creating greater plannability. Since these reminders can also be viewed prior to a deployment. This higher level of plannability also helps in preparing for work with the client. However, the reminders are not to be understood as instructions but as suggestions. In particular, the meaningfulness in terms of care is assessed based on experience.

Criteria Autonomy

Criteria Autonomy asks to what extent the criteria for the evaluation of one's own work performance can be determined by oneself, which work objectives can be set and pursued, and to what extent responsibility is taken for these. The change in Criteria Autonomy thus also depends on the work objectives that care workers set for themselves. When asked in which situations care workers consider that they have done their job well, the answers were unanimous: when all the clients' needs have been met and they express a feeling of gratitude and satisfaction, the day has been well filled and all tasks have been completed.

There are no deviations between care workers in this assessment, and it marks motivation and work objectives in care at the same time. Using the technical system does not directly influence the assessment of when work was well done. The criteria for evaluating work remain self-determined. However, the technology supports the fulfillment of these goals because it gives scope to consider and serve the client's needs in many ways. The technology itself does not give any instructions; these result from the care needs of the clients and originate from the care manager.

Nevertheless, deploying the technical system has more ambivalent consequences for Criteria Autonomy. In a positive sense, the creation of greater security at work and better work results for the care manager can be mentioned. However, there is also greater dependence and a partial transfer of responsibility to the system. Signs of performance and productivity measurement are visible. Further restrictions can occur if technical barriers (Chap. 13.6) arise.

Higher sense of security (+)

Care workers perceive the use of the system as working in higher security. Security refers to the feeling of having thought of everything and not having forgotten any task, person, or service. For employees, *ticking off* individual services and clients in particular is a security-enhancing factor that gains relevance, for example, with new and unknown clients. The system helps to avoid errors, and care workers are usually sure that everything is done when it is marked as finished in the system.

In addition, the degree of standardization introduced strengthens care workers' sense of security because all information and messages from colleagues are always available in the same form, structure, and quality. Thus, deploying the system also contributes to safeguarding the quality of care. This perception depends essentially on trust in the quality of the stored data, the assumption that the information is correct, and that the system functions properly. This perception of a higher sense of security is an ambivalent aspect regarding Criteria Autonomy, since relinquishing responsibility in the sense of relying on the system also contains elements of restricting job autonomy (see below).

Better results in tour planning (+)

Although automated tour planning is usually reworked, for the care manager, this option means more than just reduced workload, methodical freedom, or time gains; it also refers to better work results. The combination of automated drafting and individual adaptation of the tour plan

reflects process reliability since all necessary information is also included in the planning. For the care manager, this results in all relevant data being brought together during staff scheduling and that any incorrect or over-planning is pointed out. The system indicates errors in planning and thus acts as a welcome corrective. All error indications or further remarks on the part of the system can be ignored at any time. The recommendation and notes are not a requirement.

Reliance on planning and information (–)

The reliance on planning and given information is closely related to a higher sense of security. According to unanimous descriptions, the system “keeps the employees’ backs free” regarding organization, time, and performance planning. The overview and plannability of work tasks are increased, and the next work step does not always have to be immediately thought of and planned in advance. Employees rely on the functioning of the system and the correctness of the stored data and processes. The daily structure does not have to be constantly remembered. This reliance on the system is thus partly equivalent to relinquishing responsibility for one’s own daily routine and thus has autonomy-restricting tendencies. However, this example also clearly shows that supposedly autonomy-restricting aspects of the system do not necessarily have to go hand in hand with a negative perception in the sense of burdening care workers.

Nuances of performance measurement (–)

The rejection of exploiting work pressure to the maximum was emphasized several times by care workers, the care manager, and the managing director. Performance and productivity measurements do take place and are evaluated. However, the amount of time- and location-related data has not been used for work intensification so far. Only one indication of such a tendency can be identified: Shortly before the scheduled time for a deployment with a client expires, a message appears on the tablet that there is one minute left for the completion of the tasks. This instrument is intended to be a means of informing the care manager in time about the extension of the deployment or to end the deployment in a short period of time. Care workers are either unaware of the expiration of this minute or reject it completely, sometimes judging it very negatively and ultimately ignoring it. Obviously, this information triggers a heightened sense of stress among them. No consequences arise from ignoring the notice, which speaks for the company’s credo of *no rushing*.

The processing of the last minute is regarded as potentially conflictual and restrictive of job autonomy as far as it does not make sense for care workers, especially since there are small buffer times between assignments anyway, and this instrument could easily be removed from the view of the tablet by the management. It must therefore be assumed that this notice is aimed at speeding up work, which runs counter to self-determined goal-setting and achievement in the sense of Criteria Autonomy.

Scheduling Autonomy

Scheduling Autonomy asks to what extent the sequence, prioritization, timing, and speed of task completion can be determined, break times can be chosen, and interruptions and uncertainties can be dealt with. Positive influences of the system use are particularly visible in terms of time gained for both care workers and care manager, as well as in the fact that the sequence of tasks for clients remains undirected. The speed of work remains self-determined in the perception of care workers. The ability to plan the tour is increased, and break times can be largely arranged. The fact that the order of the clients is strictly prescribed by the system has a slightly restrictive effect on job autonomy. Further restrictions can occur if technical barriers (Chap. 13.6) arise.

Time gains (+)

Additional time becomes available to care workers through faster documentation of care activities. Using the tablet, this is possible regardless of location and relatively independent of time. For example, places and times that were previously not available can be used for these tasks (especially travel times between clients). Immediate documentation of all information is usually not possible in the analogue case but must be done at least in part in the office. A more seamless integration of this task into the work process thus becomes possible, which also reduces the risk of forgetting information.

This does not mean that these times and places must be used, but rather that they are additional opportunities. Time gains are conditioned, in particular, by the possibility of voice input. This not only offers enormous time advantages compared to handwritten documentation of information but also to digital typing of documentation. These advantages are more considerable as the documentation obligations for care workers have increased considerably in recent years. Even though some care-specific terms are not recognized by the system's voice input, the quality

of this form of documentation is considered high. Some employees even describe this voice input function as what really makes the system practical and brings the greatest added value to everyday life. This timesaving (little as it may be) is also used by workers to spend more time with clients.

The care manager as well as the care workers also benefit from other time savings from using the system. These are mainly expressed through simplified tour planning. Even if these are reworked by the care manager, the proposed tour planning, especially through the resubmission of already planned tours, holds enormous savings that can be deployed for other tasks. This also means that a higher degree of parallelism of tasks is possible. Likewise, the care manager gets the security of having thought of all the details of planning, but at the same time retains the upper hand in determining the tour plan. The time saved by the care manager should not be underestimated, as it is not uncommon for tour planning to have to be rearranged several times a week, yet it does not lose any of its complexity. It gives the care manager the leeway of not having to keep capacities free for these imponderables and unplannability. The care manager can only exploit these time savings if she provides not only experience of client and staff needs but also of the possible incorrect outputs of the system.

Sequence of tasks unaffected (+)

Although the technical system provides a framework for the performance of work tasks, the prioritization and sequence of individual tasks can be determined by the workers themselves. Both factors – prioritization and sequence – result from the experience-led care necessity. Scheduling Autonomy therefore remains uninfluenced according to the perceptions of care workers. Within performance recording, precise time guidelines are given for the completion of all tasks with a client. However, the deviation within a certain range is planned for. The decisive factor in the consequence of this deviation is how it is handled in the organization.

Not only the directly interaction-related tasks at the clients, but also the administrative-planning tasks can basically be arranged independently by the care workers as long as they are completed within a certain time frame. In this respect, using the system creates new freedoms in that times and tours can also be used for these tasks, independent of a specific location. The complexity of planning and administrative tasks may thus be equalized in terms of both time and space.

Work speed unaffected (+)

Time savings, for example, through faster documenting, do not result in work being intensified. This is supported by the fact that the care workers describe being able to largely determine the speed of their work themselves. Although time constraints are set by the tour planning with buffer time, they still perceive their work speed as self-determined. The care manager and the managing director recognize that employees work at different speeds anyway and that these cannot be squeezed into time frames that are precise to the second. Care workers are also not supposed to be faster than specified. Rather, the scheduled services should be completed for the client.

However, this planning only includes the beginning and end of the respective deployment at the client's, not the time spent on site. The intention of planning is, of course, that there is no time wasted. This awareness among care workers appears to be a condition for the perception of a self-determined work pace.

Higher predictability of the tour (+)

Work in care is work in unplannability. One can only try to reduce this unplannability. A way to do this is to have the possibility of accessing the shift and tour schedule at any time. What, without using the system, had to be looked at every morning in the office, and possibly short-term changes could only be seen then, is now permeated by a higher level of plannability due to the easy access to information via tablet. Care workers often view the next day's schedule the evening before they go on duty and check it again in the morning to make sure it is correct. This access to information makes it possible to start the working day from home. Transparency and plannability go hand in hand because there is also clarity about the consequences in the event of a necessary deviation from the tour plan. In particular, the short-term nature of tour changes can at least be somewhat mitigated by making update messages visible to all care workers on the start screen. However, elements of uncertainty, exemplary when entering the house of a client, always remain.

Breaks unaffected (+)

As far as breaks are concerned, according to care workers, self-determination continues to prevail to a large extent. In principle, certain time windows are set for taking breaks. However, the system does not change

the fact that these breaks can be taken freely within the time slots. The tablet's location independence also enables taking breaks in places that were previously out of the question, such as at home. The autonomous moments when taking breaks are not dependent on the system but are inherent in care duties.

Sequence of clients given (–)

The order in which individual clients are dealt with, i.e., the sequence of a tour, is predefined. Of course, this also applies in a technology-free setting, but in this scenario, it is always necessary for care workers to think about and visualize the next work deployment. This step is partly eliminated by using the system, and, according to the care workers, part of the responsibility is transferred to it. There is a much greater overview of one's own daily schedule and its structure. This again shows the difference between the system's framing and the execution of the actual task. The planning is present, but the actual execution is not. The pre-structuring of the system hardly allows for independent deviations. This also serves to safeguard the quality of care and guarantee the sensible timing of certain care activities.

Working Time Autonomy

Working Time Autonomy refers to the extent to which it is possible to determine the beginning and end of working time and to influence total working time, overtime, or on-call duty. Positive effects on Working Time Autonomy are visible in time savings at the beginning and end of a shift as well as higher certainty in shift planning. Possible autonomy-restricting tendencies become apparent in relation to an increased risk of delimitation between private and professional life.

Gains in time off work (+)

Care workers not only gain time at the task level but also in terms of their total working time. These translate into new opportunities to work in a more location- and time-independent way. Optimized route planning essentially enables savings in travel time, which not only brings added value to the individual's everyday working life but is also precious for the company in an economic sense. Ultimately, care workers are much quicker to engage in value-adding activities when travel times are low (which are hardly counter-financed). Care workers benefit most from starting and finishing work at home. There is no need to go back to the

office for ad-hoc changes to the schedule. Semi-automated route planning thus results in optimized daily scheduling.

Higher predictability of work schedule (+)

Similar to the greater plannability of everyday work in relation to the tour schedule, the accessibility of the shift schedule also brings security and transparency for care workers. Although a certain degree of uncertainty remains, the overall accessibility of the shift plan, the latest a couple of days in advance, conveys the feeling of planning sovereignty over one's own working day in the near future and thus the perception of higher degrees of freedom in the interaction of work and leisure.

Risk of delimitation (-)

According to the care workers' assessment, there are no noticeable tendencies towards increasing delimitation, but at least the danger of delimitation must be pointed out. The possibility of remote work, especially access to client information and staff scheduling from home, opens the potential for the dissolution of boundaries. Access to information about the next working day serves essentially to secure and plan one's own work. In this respect, the possibility is positively assessed by the care workers, but this working time is hardly ever billed; it is done in free time. At least if these tendencies increase in the future, there is a danger of an additional delimitation of the already emotionally stressful work. It must be noted that care workers evaluate this form of delimiting work differently; some see it as a possibility to shift documentation tasks into the private sphere, while most perceive it only as a short source of information and not as part of their actual work.

Locational Autonomy

Locational Autonomy asks about the possibility of determining the place of work within or outside the regular workplace. The availability of information at the PoC at the right time and the shift of administrative tasks away from the client clearly strengthen job autonomy using technology. The office takes on a new meaning as a social space. Care workers' homes are added as a new locality at the beginning and end of service. Autonomy-restricting aspects can hardly be identified in terms of locality. Implicit self-restrictions, for example, in relation to coming to the office, are based on voluntariness and are not technically induced but organizationally desired.

Information at PoC (+)

The location-independent availability of all care-relevant information has a positive impact on the job autonomy of care workers at the task level. In concrete terms, this means that all information can be accessed at the PoC, i.e., where it is most urgently needed, even in an emergency. The convergence of all information should not be underestimated, especially if one recalls the analogous case where information is distributed in the office, at the client's or simply in the care workers' memory. The availability of information at the PoC conveys centrality and security, even in emergency situations, not to fail due to the non-accessibility of important data (e.g., contact information of treating doctors or medication plans).

Location-independent administrative tasks (+)

The possibility of carrying out care documentation at any location creates new freedoms for care workers. It is not tied to the client's home or office and can be done on the road, between client visits, or in other familiar places. In addition to the basic time savings due to faster documentation via voice input, places that were not previously available can be utilized for this task. For example, workers report that documentation is often done in the car or on the way from the client to the car. This has several advantages, including the fact that this task can be actively moved away from the client and that there is less danger of a documentation backlog after the tour has been completed. The latter not only relieves care workers, at least in part, of the burden of completing an often unpleasant and time-consuming task but also contributes to the quality of care if the documentation can be checked off immediately after the visit to the client. Notes in between or possible media disruptions are eliminated. Aspects of convenience also come into play when, in exceptional cases, documentation can be moved "to the couch".

New meaning of office (+)

The need to come to the office has basically disappeared for all care workers with the use of the technology. Nevertheless, they come to the company's premises, albeit less frequently than necessary in the analog case. Why is that? Ultimately, it is the team idea that drives them. While care workers spend most of their working day away from the team, they all report how much they benefit from strong team structures in the background. The ratio between working time spent in the office, on the road, and with clients has changed relatively little using the system. In the man-

agement area, the ratio is largely unchanged, but this is based on personal preferences. The care manager, in particular, tends to reject working from home. Care workers spend by far the most time with clients – estimated at 75 % of the time. Time spent in the office has decreased, but for no person (although technically possible), to zero.

In relation to job autonomy, this shows that the principle of voluntariness creates new degrees of freedom. Interestingly, the importance of the office for the team also seems to have changed. Exchanges now take place less about care- and client-specific topics; after all, all this information is stored within the technical system. Rather, the exchange shifts to coping with emotional tensions and stresses, whether resulting from work or private life. Of course, people still exchange information about work-related topics, document information together, and draft reports. However, this collaboration in the office seems less coercive. There is a more conscious coming together, actively seeking closeness with colleagues.

Home as place, start and end of work (+)

The basic possibility to access work-relevant data from home and to start and finish work there is described by care workers as extremely autonomy-enhancing, even if the actual work done at home is rather small. Starting and finishing daily trips from home takes away the feeling that care workers make unnecessary journeys and waste time – avoiding this as much as possible is also strongly in their interest. Work-life balance has increased. Work with clients, i.e., interaction work, which also constitutes the meaningful character of their work, can be started a lot earlier. The aforementioned access to shift and tour schedules as well as client-specific information has a positive effect by creating planning security, which is urgently needed in this job. Very few care workers report working from home more extensively, and if so, only in exceptional cases.

Interactional Autonomy

Interactional Autonomy asks about the dependence of one's work on other people, be they colleagues, supervisors, or clients, and how work is influenced by them. When asked to what extent cooperation and interaction with clients, colleagues, or other sectoral actors are affected by the technical system, all care workers stated that they do not perceive any direct changes, especially in dealing with clients. In particular, questions arose about changed agreements, handovers, further information and communication flows, or dependencies on other actors. Influences

using the system are nevertheless visible, even if the respondents do not perceive them directly as such. In particular, the quality of information and communication between care workers has been strengthened. A considerable innovation is the possibility of removing administrative activities from the clients' premises. Autonomy-restricting moments cannot be identified in the interactional area.

Higher quality of information and communication (+)

The transfer of information and communication flows to the digital world, and thus their availability and standardization independent of time and place, have an indirect autonomy-strengthening effect for care workers. They are more independent of their colleagues and can do their work independently and without consultation. The aim of using the technical system was to make data available to all care workers in the same quantity and quality. The formal standardization of this information results in a clear transparency of contents, entries, and completed tasks. This change also creates security in maintenance and trust with colleagues. After all, the system can hardly be bypassed by care workers in terms of time stamps. The simple abandonment of handwritten entries also contributes to error prevention and the quality of information and communication.

Administrative tasks away from client (+)

Care workers utilize the time gained to spend more time with clients. Even if it is not a lot of time but rather a few minutes, it is still quality gained with the client, which is welcomed by both sides. The possibility of location-independent documentation and the completion of other administrative tasks not only brings job autonomy gains regarding the location of care workers. It also offers the possibility of not having to do these tasks at the client's place. This approach of removing administrative tasks from the client's home as much as possible has positive interaction consequences for both sides, clients and care workers. The latter can spend their time with the clients, only interacting and providing care. They are not forced to perform administrative duties, as clients do not always understand that these must be fulfilled. In the end, the tablet as a work tool does not always have to be taken with the client but can also remain in the car.

By taking this step, care workers may be relieving themselves of emotional stress. Not only is the necessity of documenting on site sometimes difficult for clients to understand. Also, the documentation may not be

free of constraints when clients are on site. In particular, documenting emotional problems with clients is a burden or may not be possible if the person in question is looking over your shoulder. So, this also has the effect of increasing the privacy of care workers and reducing the need for emotional labor. The clearer separation between interaction and administration thus has advantages in terms of the quality of both care for the client and work for employees.

Support from colleagues (+)

The new forms of digitality in information and communication flow visibly influence the relationship between care workers in the team. Care-relevant information has been moved to the digital realm, which means that interaction between colleagues can drift more clearly into the private sphere. The new importance of the office already described opens new scope for mutual support. Where handovers and arrangements with clients were necessary and in the foreground before, there is now more space for the everyday support of colleagues.

There is an open culture of discussion regarding the functionality and optimization possibilities of the technical system. The handling of the system is learned together; central training by the provider only took place at the beginning of the introduction for the management level. It is also clear that new time has been created to support each other emotionally, to strengthen team cohesion, and to respond to the needs of individual team members.

13.6. Technical barriers, misuse, and areas of improvement

The technical functionality of the system is described and perceived as positive by all interviewees in the company regarding the coverage of daily care and business routines. The system's reliability is considered high. Nevertheless, system failures and technical barriers still occur in some areas. Improvements in the scope of functions have also been mentioned. The cause of these difficulties cannot always be traced back to the system; they may also be attributed to a lack of technical infrastructure in the region or to incorrect handling of the system on the part of the care workers. Regardless of the cause, these technical hurdles have an influence on job autonomy – usually a negative one, as will be shown. These types of unforeseen efforts with the system are briefly outlined below and differentiated according to the affected group of people, i.e., care workers and care manager (Table 10).

Table 10: Impact of technical barriers on employees and care manager, Case I

	Task Autonomy	Method Autonomy	Criteria Autonomy	Scheduling Autonomy
Technical barriers (employees)				
Failing technical infrastructure	Higher work quantity			Time losses
Patchy synchronization	Lack of information	Procedure possibly unclear	Work goals questionable	Time losses
Missing functions	Higher work quantity			Time losses
Technical barriers (care manager)				
Usability issues		Work tool selection		
Manual corrections	Higher work quantity			Time losses
System coverage	Information overload			

Failing technical infrastructure

Fundamentally, there is no ability to work in the company if there is no access to the system – for example, in the case of power or server failures. These situations turn out to be particularly problematic because care workers can hardly influence their solution. The same applies to access to the internet or network coverage in the region. On the one hand, the structural conditions in the offices occasionally lead to network failures. On the other hand, there are locations in the region where mobile internet access is not or only to a limited extent possible. The latter may have an impact on the mobile activities of care workers: The documentation and access to care-relevant data usually work without an internet connection (local data storage), which is the main function of the tablet. But since the voice input function relies on digital voice models, its use is impossible in offline mode. Network and system failures that are regionally or locally determined do not flow directly into the consideration of the job autonomy dimensions because they are system-independent. Only the voice input function can be evaluated as such and, in the event of occurrence, potentially has a detrimental effect on the amount of work (Task Autonomy) and the time required (Scheduling Autonomy).

Patchy synchronization

Incorrect data synchronization is a problem for care work that should not be underestimated. This mainly occurs when the tablet is not connected to the internet (even for a short time). The problem is best illustrated by an everyday example: A care worker completes a deployment with a client in the morning, starts the assignment on the tablet, performs all the listed tasks, ends the assignment, and, if necessary, directly carries out the documentation and reporting on the assignment. The data for this process should be stored in the system and be accessible to the next colleague who is on site at noon for another deployment with the same client.

If this does not happen, several cumulative situations of uncertainty can arise, such as the fundamental lack of information (Task Autonomy), which can result in the care procedure being characterized by uncertainty (Method Autonomy). In addition, it is also possible that the work objectives are unclear (Criteria Autonomy) and that there is at least a lot of extra work (Scheduling Autonomy). The danger, both for clients and care workers, is that there may be duplication of work or that certain tasks are not fulfilled. This problem is currently only compensated for in the company by working in an experience-based and situationally knowledgeable way, i.e., employees constantly question and check work tasks.

Missing functions

Some desirable functions of the system are mentioned by care workers, which do not represent a malfunction but indicate that the system is worthy of improvement. On the one hand, the missing learning function of the voice input was listed – although it works well overall, certain care work-specific terms (e.g., decubitus) are not recognized and corrected manually. However, the system does not remember these corrections. On the other hand, the care-specific presetting and selection options for documentation and reporting are still expandable (e.g., description options for wound documentation). Overall, the missing functions mentioned refer to care-specific scopes and information layers (e.g., also reanimation information for clients), which can potentially result not only in additional work (Task Autonomy) but also in greater time expenditure (Scheduling Autonomy).

Usability issues

The different usability of stationary and mobile management tools is not perceived as a malfunction but nevertheless as a limitation. The functions of administration and accounting are only available in the office. Staff planning could be done by the care manager on the tablet, but the use of functions on the PC is regarded as more convenient and well-structured. Usability therefore restricts the choice of work tools and, thus, Method Autonomy at the management level.

Manual corrections

Several work situations can result in manual data corrections in the system, usually by the care manager. For example, in the case of individual deployments with clients, it can easily happen that these are started or ended too early/too late due to mistyping. Since accurate time recording is highly relevant for billing and administration, these errors cannot be ignored. However, since the care workers cannot correct them themselves on the move, the care manager must make changes on the PC. Another cause of minor manual rework is the occasional incorrect transfer of client data from month to month. Even if the frequency of this type of correction is limited, it does create additional work for the care manager, reducing Task and Scheduling Autonomy.

System coverage

Although present in a mild form but nevertheless repeatedly reported by management, there is a certain degree of information overload due to the range of functions and the complexity of the system. This does not apply to care workers on tour, as the range of functions on the tablet is reduced to the essentials of everyday business. In practice, however, especially for the care manager, questions of presentation and prioritization often arise in the PC version of the system. The menu navigation and scope of functions are not yet fully suitable for everyday care practice in the company. Many functions and menu items are simply not needed/used. Others are hidden in the menu tree. This information overload also potentially affects Task Autonomy.

Finally, these hurdles, misuses, and suggestions for improvement have occurred with decreasing frequency since the introduction of the system. However, when they do occur, they may partly nullify the positive effects on the job autonomy of the care workers and the care managers or potentially turn them into negative ones.

13.7. Impact and conditions of changed job autonomy

Work in care thrives on a high work ethic, connectedness, and responsibility for clients. The prioritization of client needs acts as a broad tenor in the assessment of the relevance and usability of the technical system. It is valued as assistance if it supports care work and contributes to care quality. As soon as the recommendation of the system differs from one's own assessment of the fair care of clients, it is deviated from. In this context (and actually in relation to employees), Voß (2012, p.370) outlines the necessity of self-professionalization: Under conditions of delimitation, workers have to develop individually and situationally what their professionalism and quality of service are and how they deal with the given circumstances without giving up their professionalism.

The analysis of changed job autonomy must also be evaluated in light of this. The technical system clearly creates more scope for action and decision-making for care workers. This is perceived very positively because they see and experience the added value that the technical system can bring to their own everyday work. However, the results should not be overestimated, as the direct interaction work with clients, which at the same time functions as a constant work effort and resource for meaning, is only influenced to a small extent. Hielscher (2020, p.42) describes this form of technology use as *instrumental pragmatism*, which provides that technology is used situationally as it is needed but is not in the focus of interaction work. In view of the highly tense work situation in care, however, it is advisable to make use of any potentials regarding working conditions, coordination, and efficiency.

The described changes in each job autonomy dimension accumulate in a series of positive effects of technology use, which are intended to underline these potentials: a contribution made to the quality of care, improvements regarding working conditions, and an easing of interaction work.

A contribution to ensuring the quality of care is directly derived from the process standardization that using the system entails. The availability of information and new communication channels, as well as their quality, were increased by the formalization step. All necessary care-relevant information and the overview of the tour plan are available to every care worker in the same form and structure, most notably at the PoC. In combination with the fact that the core of care work, in particular interaction work and the exact execution, sequence, and prioritization of related tasks, is only influenced to a small extent using the system,

this results in a higher sense of security in everyday work and thus also enables a higher quality of care.

The changed tasks of the care manager contribute to this assurance of care quality in that the corrective functions of the automated tour planning and, overall, the new digital-conditioned centrality of the data lead to an improvement in the planning results. These more efficient results should not be underestimated in that they not only contain a purely economic added value for the company but also optimize the distribution and coordination of tasks for care workers, which should also lead to a lower workload.

Aspects of workload reduction for care workers are achieved in two ways: On the one hand, using the technology has resulted in a reduction of administrative efforts. The intensity of the necessary pre-planning of a tour has decreased as the daily schedule and the services to be provided are constantly transparent. Being able to depend on the system and not constantly think about the next task at hand relieves the pressure on care workers. Furthermore, documentation and communication channels are available without media disruption and in standardized form. In particular, the possibility of voice input creates time savings and streamlines the daily work routine.

On the other hand, the flexibility of time and place has a clear liberating effect. Care workers can operate location-independently, organize their work speed more freely, save travel time due to the start/end of the shift, as well as access information from home. The ability to plan work independently has thus increased and contributed to the overall facilitation of work. For the care manager, too, there is a clear gain in time and a reduction in the amount of work, especially due to the automated scheduling of tours, which only takes a fraction of the analogue time, even if there is a need for postprocessing. These urgently needed freed-up capacities for the care manager make their work slightly less intensive.

Even though the demands of successful interaction work can never be completely minimized, moments of relief are identified using the system. The aspect of cooperation with clients and dealing with one's own emotions is facilitated as long as administrative work is moved out of the client's rooms and the time gained is used for working with them. The interactional aspects of care work with the client can thus be intensified, and the potential for conflict due to the necessity of administrative tasks is reduced.

The cooperation and emotional work in the team are also simplified because, on the one hand, the quality of information and communication has increased, and thus conflict potentials and dependencies have decreased. On the other hand, new spaces for growing together in the team

are created by shifting large parts of care-relevant communication to the digital realm, thus creating more time and space for mutual (also private and emotional) support, for example, in dealing with technology. Ultimately, in addition to these interventions in cooperation and emotional efforts of care workers, the facilitation of planned, rational action, as is necessary for administrative tasks, leads to relatively more job autonomy in the performance of situationally demanding interaction work.

The conditions for the realization of these positive effects in changed job autonomy can be distinguished between technical and organizational ones. The technical conditions include aspects already described: Technical hurdles, malfunctions, or incorrect use by care workers must be minimized as much as possible. Fulfillment of this condition is easier in the case of corrections that are caused by the care workers themselves, who can be remedied through greater sensitivity, experience, and training in the use of the system. Obstacles that cannot be overcome by the company itself are more challenging. In terms of software reliability and technical infrastructure, the company is, to a certain extent, exposed to these externalities.

Maximizing the underlying data quality is another technical condition for the positive shaping of job autonomy. The care manager summarizes that “The system is only as good as we maintain it”. She is also the one who must manage the main part of the manual data administration and entry. It would certainly be desirable to automate this step as much as possible. The company is dependent on third parties in that the exchange of data between clients, doctors, or health insurance companies hardly works without media disruption, so manual entries are still indispensable. This point is connected to the third technical condition, namely the striving for a holistic system, freedom from media discontinuities, and the avoidance of isolated system solutions.

The organizational conditions for creating positive experiences of job autonomy in dealing with the system are essentially nourished by the corporate philosophy, “We all know how it should not be”. All care workers have had unpleasant work experiences in various constellations regarding stress, cooperation, and planning in care. They are determined to counteract a renewed setting of poor working conditions and the rush to provide care, with the promotion of job autonomy being both a condition and an objective of this endeavor.

The non-utilization of performance-related employee data, which is basically available in large quantities in the form of time and location-related data, as a control instrument and for optimizing performance is an essential organizational condition. Of course, target-performance comparisons are carried out in particular in tour planning. However, it

is recognized that individual care workers need different lengths of time for assignments; some complete them faster, some a little slower. If the quality of the work is good and deviations are within a certain range, the work targets are achieved. There are no consequences for non-compliance. This factor is closely linked to the distribution of tasks between the managing director and the care manager. Recognition of professional boundaries takes place through a clear separation of care-related and business management considerations. In the former, both client and staff preferences are considered in the planning process. Significant importance is attached to planning and proportionality in the distribution of tasks, which also noticeably strengthens team cohesion.

In the day-to-day use of the technical system, the final condition for achieving positive job autonomy is that the use of technology and the reliance on the system should only take place in consideration of experience and knowledge about clients and care workers. Blind trust in the technology outputs hardly takes place. Certainly, this restriction also entails additional work compared to full automation, for example, tour planning, but it also requires the setting and experience of autonomy of action, in which one can and should always act at one's own discretion. The necessity of subjectifying work action is thus not rendered obsolete by technology but rather acquires an even greater significance in daily work.

What ultimately remains questionable is whether the organizational conditions of non-utilization of performance-related data and thus the rejection of work intensification, as well as the view of the technical system not as a requirement but as a corrective-supplementary support tool, will also be maintained if the company continues to grow and efficiency gains turn out to be smaller.

14. Company Case II: universal bank in change mode

14.1. Branch profile: banking services

The opening branch profile fundamentally places the case study findings into perspective. It summarizes important findings about the banking branch from earlier research, discusses the average levels of job autonomy for bank advisors, and focuses on the organizational peculiarities of banking services. Finally, the branch profile offers a summary of technology use in the banking industry as well as study findings on how technology use affects bank advisors.

14.2.1. *Retrospective: What do we know so far?*

Previous considerations on the extent of job autonomy in the service sector (Chap. 1.5) initially reveal the following branch profile: Employees in financial and insurance activities, the statistical reference for banking services, typically belong to autonomous services. While many employees have little control over the amount of work they do, a considerable share have freedom over their work schedules, the planning of their work, or the ability to contribute their own ideas. Especially in the working time situation, fewer restrictions are evident compared to other service branches. Weekend work is a rarity, and night work is practically non-existent – at least in official statistics. Moreover, even before the COVID-19 pandemic, a large proportion of employees were able to work remotely (37 %, DGB-Index, 2020, p.20). However, a particularly high work intensity shows how these degrees of freedom are exploited. Employees in finance are often under time pressure, interrupted, and exposed to contradictory work demands (Table 1). Thus, the typical characteristics of autonomous work are identifiable in the finance sector, but so are areas of conflict that may indicate a disruption within the group of autonomous services, as the following results show.

The analysis of the branch along the seven job autonomy dimensions confirms this impression (Chap. 8.1): Again, financial services fall into the top range of autonomy profiles on average. However, the scores for the individual autonomy dimensions paint a more heterogeneous picture. In terms of Task and Method Autonomy, the branch loses ground in com-

parison to other autonomous branches, indicating that there is less self-determination in terms of the amount, type, or variety of work done. Employees in the branch also report pressure to perform and reach certain targets. However, considering Scheduling Autonomy, the branch again shows higher levels of job autonomy, i.e., the ability to plan and prioritize work and to deal with interruptions. The highest levels of Working Time Autonomy are found in finance across the entire service sector.

Finally, the branch shows above-average values in terms of Interactional Autonomy, i.e., the degree of support and dependency on colleagues, superiors, or service recipients. Overall, financial services also serve as an example of the attempt in work organizations to compensate for the dwindling scope for action regarding the content and objective of work with greater freedom in setting the time and place.

The previous analysis of changes in job autonomy between 2012 and 2018 (Chap. 8.4) paints a picture of slightly increased job autonomy: The job autonomy gains are very moderate in total and extremely moderate compared to other autonomous services such as information and communication or real estate. Considerable losses are recorded, in particular, for Task and Method Autonomy, which confirms ongoing tendencies towards more standardized and monotonous work. Scheduling Autonomy and aspects of working time have virtually remained constant. Only Criteria Autonomy shows a high increase, which goes in line with the developments of other autonomous services. This indicates that performance targets may be set more independently. In combination with decreased task- and method-related features of job autonomy, these developments describe a working environment with more standardized ways of conducting certain tasks.

Additionally, reviewing the relationship between job autonomy and digitalization provides some valuable insights into the branch. Exemplary, increased work intensity is reflected in the fact that at least half of employees in finance both complain that the processes to be overseen simultaneously and the total amount of work have increased with digitalization. For most employees and service branches, digitalization has little, if any, positive impact on decision-making. The same applies in principle to the finance industry, but compared to other services, a particularly large share of employees describe their freedom of decision-making as having been restricted. However, the proportion is still moderate (Table 17 | Appendix). In banking services in particular, two-thirds of employees also report increased control and monitoring at work and, in most cases, only very marginal opportunities to influence the way in which technology is used at the workplace (Roth & Müller, 2016, p. 55). These results may suggest that the use of ADM systems in this branch

also leads to a decline in job autonomy as far as employees' freedom of decision is concerned.

The initial situation in the banking sector thus reveals a picture of opposing developments regarding job autonomy. The type, method, variability, and amount of work can be determined less often. Working time and location aspects of work counteract this autonomy-restricting tendency. The question arising is in which direction the possibilities of self-regulation in terms of work goals, dependencies, and interactions with service recipients are evolving.

14.2.2. *Employment, work organization & perpetual structural change*

"The bank advisor has become obsolete" (Kanning, 2017). This or similar titles accumulated around the German financial branch, especially in the 2010s. To what extent the profession may have become obsolete due to digitalization is only a minor question in the following. However, light is shed on the pressures for change to which this profession and the branch are subject. For this purpose, it is essential to briefly outline the changes in the financial branch over the past 10 to 20 years. The distinctive feature is the early start of the digital upheavals, which helped to join the group of digitalization pioneers within the service sector. It is also the depth of change, which has not stopped at the digitalization of work processes but encompasses entire business models and has thus had a considerable influence on employment in finance in recent years.

Overall, financial and insurance services make up only a smaller part of the service sector (4 %, Table 15 | Appendix), and the proportion of female employees is average at 55 %, as is the part-time rate (29 %, Figure 18 | Appendix). Employment and apprenticeship rates have been declining for years. In 2022, around 970,000 people were assigned to this branch. Employment stagnated between 2018 and 2022 (Table 16 | Appendix). This makes finance and insurance one of the few service branches not to have grown. This fact alone indicates that it is undergoing change and that different transformation processes are playing out than in other service branches.

There have been reductions in employment, particularly among full-time employees and people with no formal education or vocational training. At the same time, the trend towards higher qualification among employees is observable (Burkert, 2019, p. 4). This puts pressure on employees with classic vocational training and additionally reduces the supply of previously respected and high-quality entry opportunities in the branch.

For a long time, bank advisors were considered an exceptional case among professions because there were particularly many secondary school graduates among the trainees, and the profession of the bank advisor was considered extremely prestigious (Haipeter, 2006, p. 58). However, today's bleak job prospects for bank advisors are not due to a lack of adaptability to changing organizational and business forms. Rather, it is reduced demand for the sales skills that are at the core of bank advisors' work (see overall in Haipeter, 2006).

Essential aspects of a neo-Tayloristic organizational change have become apparent in the financial sector over the past decades (Büssing & Glaser, 1998, p. 591), which can hardly be separated from the use of technical systems: In addition to the reorganization of business segments and the regional reduction of the branch network, employment was massively reduced. The reduction of the branch network follows a far-reaching structural change in the financial sector that began in the 1990s and took place in particular in corporate restructuring in the form of centralization and process automation (Büssing & Glaser, 1998, p. 591). This depletion of the branch network gained further momentum in the mid-2010s (M. Schwartz et al., 2017, pp. 1–3).

However, this trend is the result of corporate mergers rather than outright market exits. The capacities of the banking sector have hardly changed in response (Buch, 2018, p. 9), but a market concentration is evident, the aim of which is to take over entire market segments. Centralization and specialization of trade thus go hand in hand in the lean banking model of the 1990s (Büssing & Glaser, 1998, p. 591). In particular, the dismantling of the branch network could only take place through extensive automation processes that shift access to products for clients into digital omni-channel constructs. The starting point for these restructurings is increased cost pressure on the financial industry (deteriorating cost-income ratio, declining return on equity) as well as, especially in the recent past, low interest margins (Burkert, 2019, pp. 9–10).

Likewise, overall societal trends have an impact on employment in the financial sector: Globalization has led to the outsourcing of tasks, especially at large banks (Brown, 2011, p. 51). Demographic change influences the demand for banking products and the regional density of banking services (Burkert, 2019, pp. 9–10). Digitalization also creates a changed state of competition in the branch. FinTechs and BigTechs offer new financial products and can be in a competitive or cooperative relationship with traditional universal banks (Beier et al., 2016, p. 2; Glock et al., 2019, p. 18). What they have in common with younger direct banks is that hardly any physical business presences are created, but instead, interaction with clients is completely online.

It is important to distinguish between traditional universal banks with (still) extensive branch networks (e.g., Deutsche Bank, Sparkassen, or Volksbanken) and newer direct banks (e.g., ING-DiBa, or the so-called neo bank N26) with little or no stationary branch presence for clients. Many employment trends, such as staff or branch reductions, do not apply to the latter. Traditional universal banks usually refer to the structures and characteristics discussed below.

Already at the beginning of this structural change, a polarization of qualification requirements, quality of work, and job autonomy was predicted for the finance branch. Büssing and Glaser (1998, pp. 591–592), for example, expected that only a part of the financial sector workforce will be employed in qualified, autonomy-strong jobs with client interaction, while another part experiences devaluation, dequalification, and insecurity in their employment relationships. Both groups also face time flexibility as a work requirement. The authors should be right in many respects.

However, at least in traditional banks, bank advisors still play a vital role in terms of sales targets, as they are the employees with the most client contact. They function as an intermediary between complex financial products and empowered clients, who are increasingly performing tasks that were previously the responsibility of bank advisors. A division between employees in banking is made by means of the front and back offices. The front office refers to employees who are in direct contact with clients, for example, who accept client requests at the bank counter. Back office employees manage banking operations such as transactions or loan processing. They rarely have direct contact with clients. In parallel, there are sales experts or bank advisors who specialize in certain financial products.

Automation and organizational transformation may affect these groups in different ways (Zanker & Drick, 2011, p.133). In the past decade, specialized sales staff has increasingly been subject to an optimization logic, which is expressed in an even greater shift away from client advice towards a business orientation based on sales figures only. This means that salespeople are told in detail what productivity (products sold per period) should be achieved within client sales. The extent to which the product offered corresponds to the client's wishes and the quality requested is often of secondary importance. This presents not only clients but also salespeople with burdens and contradictory requirements (Roth, 2012, p.12). In a comprehensive study on new management strategies in banks, Breisig et al. (2010, pp.139–141) describe extremely short control phases, usually lasting a month or sometimes a week, in which key figures and targets, such as the number of contracts

concluded and client meetings conducted, are collected and analyzed at both the team and individual level. This change testifies to more intensive conditions, as the performance indicators of employees were previously evaluated in an annual cycle.

The challenges for companies in the financial sector include increased competition, changing market conditions, and shifting client demands. Companies are responding by cutting costs and trying to attract new clients (Roth et al., 2015, p. 39). The measures taken to implement these goals fall under the umbrella term *industrialization of finance* (e.g., Meutgens, 2014, pp. 239–240; Roth et al., 2015, p. 39). According to Roth et al. (2015, p. 42), this industrialization is taking place along the three dimensions of standardization, automation, and specialization, although the developments in these three areas are not always clearly distinguishable. Likewise, quite different effects of these three movements on the job autonomy of employees and task variety can be assumed.

Standardization primarily affects the product range and the process design in sales and the back office (Roth et al., 2015, p. 42). Employees report an increasing feeling of being interchangeable as employees because the IT-based product standardization hardly allows for variations in process execution. Work instructions and individual process steps are predetermined.

Qualifications and professional experience thus become partly obsolete (Roth et al., 2015, p. 43). Shortly after the financial crisis, highly standardized work processes for employees in banking could be identified. This is paralleled by a system of work monitoring and control. This combination clearly contributes to a decrease in employees' scope for action and responsiveness to unplannable work situations (Roth, 2012, p. 54). Automation is closely linked to standardization tendencies. Fully automated processes (e.g., payment and credit transactions) are also called dark processing⁵² in finance (Roth et al., 2015, p. 44).

Specialization, in combination with standardization and automation, manifests itself in the greater separation of sales and back office processes (Roth, 2012, p. 45), which particularly distances employees from the holistic nature of their jobs. The processing of product sales is shifting further to back office operations. This is also where centralization comes into play, as back office work is no longer conducted at all locations. Fewer tasks remain for individual branch employees, especially since dig-

⁵² Dark processing refers to the distribution and processing of client requests being fully automated. The intervention of bank employees is supposed to take place only in individual cases for post-processing or error correction (Meutgens, 2014, p. 246).

italization implies that tasks are increasingly being outsourced to clients (Roth, 2012, p. 46).

Certainly, it can be positively argued that the processes described have led to a reduction in the workload (elimination of simple tasks, less error-proneness) of employees in banking. Yet, the share of routine tasks performed by employees is expected to continue to decline in the future (Glock et al., 2019, p. 52). However, the lack of holistic tasks due to the separation of administration and sales, a de-skilling of many employees, and higher demands on a few specialized employees seem to outweigh this (Glock et al., 2019, pp. 55–56). Roth et al. (2015, p. 56) go as far as to speak of a two-class workforce. The result is less job autonomy and a devaluation of work. The scope for action and decision-making by employees in banks is mostly expected to continue to decrease further in the future (Glock et al., 2019, p. 51).

The industrialization of finance is paralleled by internetization. The transfer of analog products and services into digital ones, on the one hand, aggravates the reduction of staff and, on the other hand, increases the demands on the digital knowledge and time flexibility of the remaining employees (Roth et al., 2015, p. 55). The latter refers to the consequences of internetization from the client's point of view. Financial products can be accessed at any time. Thus, the expectation arises that client inquiries can also be processed by bank advisors at any time. In this context, there are not only new debates about extended working hours (partly implemented in the form of outsourced service centers), but also concerns about the increasing unpredictability of workloads due to the unpredictability of client inquiries (Roth et al., 2015, p. 61).

Expert estimates on the future significance of interaction work in banking are not yet clear. They suggest a reduced share of interaction work (Glock et al., 2019, p. 52). It can be assumed that the future relevance of interaction work will develop differently depending on the occupational field. Direct advisory work, however, is becoming less frequent but more digital (Roth et al., 2015, p. 48).

Ultimately, these developments are also inherent in increasing competitive behavior and decreasing social support (Laaser, 2016, p. 1013). This development is even more worrying, as collegial behavior among coworkers and the perceived meaning of work have long been seen as integral work resources (Roth, 2012, p. 56). Since employees who are in direct contact with clients are also particularly affected by emotional demands and required to hide their personal feelings at work (Roth, 2012, p. 56), it is important to discuss what new burdens and restrictions on job autonomy these employees will be exposed to in the context of using technologies.

14.2.3. *Job autonomy in banking services & technology use*

Work in finance is permeated with technological applications. Some voices even go so far as to claim that banking and technology are synonymous (King, 2019, p.249). Indeed, the financial branch is among the leaders in terms of the degree of digitalization in Germany. A substantial number of employees are already using learning applications (38 %, DGB-Index, 2022b, p.16). The branch has an exceedingly high proportion of digital processes, digitized services, and use of digital tools (BMWi, 2018, pp.21–33). However, digitalization and the use of digital technologies are not so much drivers of structural change in the financial branch, but rather a reaction to increasing rationalization efforts. Thus, no single technological innovation can be cited as the decisive factor for changes in the branch.

Traditional universal banks, in particular, are equipped with extremely heterogeneous technical structures. Work processes are based on individual solutions, silo applications, and a mixture of in-house and external applications (Glock et al., 2019, p.65). Traditional banks are thus faced with the challenge of creating compatibility between IT systems and consolidating the in-house software landscape. Banks see themselves in the necessity of implementing operational efficiency goals, which are considered the driver for the standardization and automation of tasks in the front and back offices (Brühl, 2017, p.6).

Learning ADM applications are now believed to achieve further process and product improvements with the enormous amounts of data in the financial branch. Processes are expected to be streamlined and products offered in a more individualized way (Deutscher Bundestag, 2020, p.153). Indeed, ML-based guidance systems in client service have already led to productivity gains, especially for lower-skilled workers (Brynjolfsson et al., 2023, pp.13–14). Such developments thus contribute to the empowerment of certain employees but also deprive qualified personnel of their status in the company. Similarly, it has been shown in some cases that client satisfaction and employee loyalty develop positively (Brynjolfsson et al., 2023, p.22).

The hope of a further increase in efficiency is immediately apparent in the possible use of AI systems in the financial arena (Neu et al., 2022, p.30). However, reducing this to purely efficiency-enhancing measures is a simplification. In view of the increasing competition in finances, client loyalty and addressing the right client with the right product in a holistic and tailored manner are decisive targets for banks. AI-based software solutions for predicting client preferences and probable success rates are used across the entire banking spectrum (Neu et al., 2022, p.30). Targets

of these systems are often referred to as the next best offer or the next best action.

As far as the use of data-intensive ADM applications is concerned, long-standing regional universal banks in particular have competitive advantages because they not only have a large client base and their transaction data (Leonhardt & Wiedemann, 2017a, p. 168, 2017b, p. 25) but are also perceived as more trustworthy than their younger and sometimes much more digital competitors (van Geenen et al., 2015, p. 138). However, this data treasure is both a curse and a blessing for universal banks since the use of client data is rigidly bound to data protection and finance specific⁵³ regulations, which completely prohibit many analysis options at the individual level, force anonymization or only open them up selectively.

Consent to access and use the given client data (Leonhardt & Wiedemann, 2017a, p. 169) thus has a gatekeeper function in the relationship between the application potential of learning systems and actual usability. Similarly, traditional universal banks in particular lack the right technologies to use their wealth of data (Leonhardt & Wiedemann, 2017a, p. 168).

The sheer mass of data, which is further enriched by banks' omnichannel presences, is suitable for processing by the current range of ML methods and could hardly be processed in real time by bank advisors in a similar way (King, 2019, p. 246). For example, robo-advisors (ML), chatbots/virtual agents (NLP), or models of client behavior (DL) currently rely on these methods (King, 2019, p. 244). Learning systems are thus available in various applications for banking. In the front office, chatbots, creditworthiness checks, and robo-advisors are particularly worthy of mention (Glock et al., 2019, p. 28).

Direct interaction with clients is thus affected in many ways. Front desk tasks in branches have been reduced but are also less in demand due to digital offers. In the back office, automated processing and credit and risk management are essential tasks. The extent to which the quality of the products offered to all clients can be achieved through the often-

53 The use of algorithms in banking is subject to additional regulations compared to traditional private companies due to their specific importance for the monetary affairs of the entire economy. These include, in particular, that the responsibility for ADM-based decisions lies with the company management and that there must be a minimum level of explainability and transparency in decision-making by ADM (BaFin 2018, pp. 37–38).

propagated absence of technical bias (King, 2019, p.246) is hardly debated at present.⁵⁴

Insights into the consequences of ADM use on employees in banking, especially bank advisors and front desk service workers, are still scarce. This may also be due to the fact that process digitalization, system consolidation, and the translation of existing systems into learning ADM systems are difficult to separate from each other. The specific influence of learning systems on job autonomy and working conditions can therefore only be assumed based on previous findings on digitalization processes in finance. One difficulty (as is so often the case) is that it is hard to identify which systems use advanced data analysis or which already use ML. Examples for the further development of technical support systems for employees in client service are ADM-supported recommendation systems (1) and automated credit scoring and allocation (2).

In the application of such systems, banking does not escape the well-known conflict between individualization and profitability (e.g., Leonhardt & Wiedemann, 2017b, p.26), i.e., how individually and time-consuming can financial advice and services be offered to optimize profit margins? Regional banks with stationary branches have too low profit margins to offer individual advice to a broad mass of clients. Client segmentation, i.e., the grouping of clients according to their assets, among other things, also determines how much time is available for individual advice, regardless of the technology. Recommendation systems (1) are used to increase the completion rates of these advisory attempts. This means that conflicts between individualization and profitability should be broken down as far as possible with technology (Leonhardt & Wiedemann, 2017b, p.26).

Recommendation systems are designed to better serve the needs and wishes of clients. They are supposed to make more holistic offers and thus ultimately also increase closing rates (Leonhardt & Wiedemann, 2017b, pp.25–26). These systems use the descriptive and transactional data of clients to calculate which products could be purchased. Recom-

54 So far, studies have shown that ML in credit approval processes can have various consequences for the social welfare of individuals and society, i.e., that they can contribute to inequality or help to smooth it. The direction of the impact depends on the presence of algorithmic bias against specific groups (e.g., gender bias), see Bauer et al. (2020, p.5). The more biased the system is, i.e., the more the built-in algorithms reproduce inequalities and discriminations in given data, the more likely individual and social welfare is reduced (Bauer et al., 2020, p.5). In this context, however, it has also been shown that flawlessly functioning systems (although it remains questionable to what extent these exist in reality) significantly outperform credit agents (Bauer et al., 2020, p.29).

mendation systems are used to actively approach clients with a specific product at a specific time.

Recommendation systems can be divided into context-independent (static) and context-dependent (dynamic) logics (Leonhardt & Wiedemann, 2017b, p. 27). By default, recommendation systems operate context-independently, i.e., they use known descriptive and transaction data about the client. It is therefore the classic information on income, cash receipts, travel behavior, spending preferences, or marital status that is used in client analyses. Context-sensitive recommendation systems use situational, time-, and place-related client data, provided that the corresponding data is available, and use these for equally situational offers. This can be, for example, the offer of travel or casualty insurance when transactions are made to travel agents or abroad (Leonhardt & Wiedemann, 2017b, p. 27).

Depending on the functional scope of the recommendation system, various effects on bank advisors are likely. In any case, the client approach is usually not completely automated, i.e., bank advisors do not become completely obsolete. They continue to play a considerable role in sales. However, they are deprived of their job autonomy regarding the manner and content of addressing the client. This also calls into question the strongly experience-based approach of bank advisors.

Furthermore, restrictions are to be expected regarding the scheduling of work. The breaking up of traditional time regimes may be exciting if the recommendation system determines, for example, that certain clients can only be reached after 8 p.m. Are bank advisors supposed to be more flexible? To what extent bank advisors will rely on the recommendations of the system and whether they will also take responsibility for the performance results if they are deprived of the autonomy to decide how and when to approach clients remains questionable.

Credit scoring and allocation (2), as a second example, fundamentally uses ADM to evaluate the extension and prices of credits (van Overbeke, 2022, p. 2). From a corporate perspective, they are intended to speed up credit decisions, increase the volume of checks, and minimize risks. Previous technical solutions to support and automate credit scoring have also been based on basic ADM procedures (regression, decision trees). These mainly use structured data on the financial history of a client to be checked. The novelty of the application of ML methods in this area lies in particular in the evaluation of unstructured data to assess creditworthiness. This even includes data that only has slightly to do with the financial situation of private bank clients, such as social media activity and mobile phone use, to obtain a “more nuanced view” of the financial stability of clients (Financial Stability Board [FSB], 2017,

pp. 12–13). This also applies to corporate clients. For example, newspaper articles are also searched for information on the creditworthiness of companies (Friedrich et al., 2021, p. 57).

The example of the home credit sector illustrates particularly well the impact that the introduction of automated credit scoring can have on bank advisors: The assessment of the creditworthiness of clients and the subsequent decision on granting a loan were almost completely automated in the UK⁵⁵ (Terry et al., 2022, p. 673). The job autonomy of credit agents to influence credit decisions was drastically curtailed with this step. This has also created new tensions in the interaction between credit agents and clients, as previously qualified, creditworthy clients are no longer classified as creditworthy by the system (Terry et al., 2022, p. 674).

The decision is made by the system, but the conflict with the client must be settled by the credit agents themselves. This form of automation is regarded as a safeguard for credit agents to protect them against the granting of bad loans that will not be repaid (Terry et al., 2022, p. 674). The use of the system is thus also regarded as a tool for error prevention. The change in job autonomy, however, is the surrender of any responsibility for the credit decision because the assessment is made by the technology. This change in the relationship between the credit agent and the client may, therefore, also have a certain relieving effect on credit agents. However, it undermines the client's commitment to repayment, which was previously also based on a strong agent-client relationship (Terry et al., 2022, pp. 676–677).

Companies should therefore not question the benefits of a qualitative agent-client relationship but positively emphasize them. After all, with a multitude of product offers, clients still prefer the human consulting

55 Particularly in international comparison, the automation in German banking, especially in credit scoring and lending, was slower for a long time. In the financial hub of the United Kingdom, algorithmic credit scoring was quickly adopted in the 1980s, and employees in this area were replaced. In Germany, although automation and digitalization processes were introduced in a similar way, the complementary use of these systems was initially undertaken (van Overbeke, 2022, p. 5). The purely quantitative assessment of credit risk was enriched by qualitative information from employees (C. Lane and Quack, 2002, p. 31). Thus, it can be assumed that not only bankers but also executives were able to maintain their job autonomy, at least in part, for longer. It was not until sometime later that the German banking system reacted to cost and rationalization pressures by cutting jobs across the board, which can also be attributed to changes in the institutional and regulatory framework (van Overbeke, 2022, pp. 5–6). From today's perspective, however, the German finance system has aligned with the more market-oriented international financial systems in terms of automation and employment consequences.

service provided by the bank advisor to the detached digital transaction (Zerfaß, 2016, p.204). The stability of client relationships seems to be linked to changes in job autonomy in bank sales. Besides this, the challenge of the following case is also to identify ADM-specific influences on the work of bank advisors and whether they differ from known phenomena of digitalization.

14.2. Case summary

“It’s a nice tool to target and activate sleeper clients” – This quote from a bank advisor emphasizes the key added value of the ADM system, namely, to target unattended/passive clients. However, it also implies that the system is considered by advisors as a complement to their work. From the bank’s perspective, the focus lies on achieving sales targets. The two views do not contradict each other, as both are concerned with addressing and advising clients in a holistic manner, which is supposed to be supported by the technical system. Nevertheless, bank advisors find themselves in a constant conflict between sales goals and client needs, which the ADM tool now intervenes in.

The case study company is a traditional universal bank in Eastern Germany with over 70 branches. Its main objective is to provide financial services to private individuals, businesses, and public institutions, while its profit orientation remains unchanged. The central players involved in client business are the sales control team, which is responsible for ensuring that the bank’s sales targets are achieved, and the approximately 280 bank advisors, who are the primary contacts with clients. Depending on their seniority, an advisor manages a client base of up to 1.000. The day-to-day work of bank advisors mainly consists of client meetings, in which work is done to meet individual sales targets.

The case company uses a holistic technical system for addressing clients, the core of which is making product recommendations. The essence lies in addressing the right client with the right product at the right time. The system uses ML to calculate clients’ affinities for certain products and links these to time windows in which a purchase is particularly likely. This provides bank advisors with a supplementary tool and provider of ideas to complement the individual client approach system (including resubmission). On the functional side, the system thus fulfills the tasks of automated client selection and the creation of alternative courses of action for advisors.

The statements of the employees surveyed point to a predominantly positive picture of the ADM system. Increases in job autonomy are noted

in several areas of work. In particular, advisors feel empowered by the fact that they are freed from the rigidity of the client approach, both in terms of content and timing. In addition, the system appeals to previously unattended/passive clients, which opens up a new clientele. Advisors feel supported in achieving their sales goals, while their actual interaction work with clients is largely unaffected. However, there was a long way to go before these positive effects were achieved because the quality of the system's results was riddled with errors at the start of implementation, and its acceptance suffered as a result. Extensive follow-up work by sales control and advisors improved the quality of the system significantly.

Elements promoting job autonomy in dealing with the system occur in particular in the content-, method-, and goal-related dimensions (Task, Method, Criteria Autonomy). However, under certain circumstances, these are also countered by autonomy-restricting tendencies, such as the partial lack of transparency and inadequate information or the inherent control mechanisms of the system. The positive effects on job autonomy of bank advisors, nonetheless, outweigh the negative effects at the time of the study.

The changes in the dimensions of job autonomy have ambivalent effects on advisors: While there is certainly an improvement in advisory services, both in quantitative and qualitative terms, the day-to-day work is facilitated. However, the work of advisors is also riddled with more contradictions. The distinct organizational conditions for creating positive job autonomy experiences are the preservation of experience-based interaction work with clients and the use of the ADM system as an option, not an obligation.

The case study's remaining chapters are organized as listed: A description of the case company's organizational traits (Chap. 14.3) and the integration of the technological system (Chap. 14.4) is followed by a highlighting of its learning elements (Chap. 14.4.2). The major case analysis, which describes the impact of the ADM system along the seven job autonomy dimensions, is then presented (Chap. 14.5). The impacts and conditions of altered job autonomy are further investigated (Chap. 14.7), preceded by a list of technical difficulties with the system (Chap. 14.6).

14.3. On company and employees

The company case study is based on a traditional universal bank located in Eastern Germany. As a universal bank, it provides an extensive range of services for its clients, such as:

- basic financial services (e.g., cash and payment transactions),
- lending business (e.g., granting of loans),
- deposit business (e.g., savings deposits),
- investment business (e.g., securities trading) and
- other financial and investment services (e.g., life insurance).

The bank's assignment is to provide access to funds and transaction opportunities for the broad population in a regional context, to guarantee financing alternatives for companies, to promote housing construction, and to provide municipal bodies with financial resources. Even though the branch network and thus the number of employees had to pay tribute to the turbulence of the financial market in the past 20 years, the bank still maintains a broad physical network to remain accessible for clients. Compared to other banks, the company has a large, but shrinking, client base.

The bank is embedded in a multi-level organizational structure. It is integrated into a financial group with a total of approx. 280.000 employees in Germany. Each bank in the group has a regional focus. The case study bank employs about 1.500 people and covers a large region, including both urban and rural areas. It is part of a regional association, which is preceded by a supra-regional umbrella association. The umbrella association acts as an interest representative of the individual banks in the association and defines the basic market and business strategy. This also includes the use of technical systems.

In addition, various service providers operate for the umbrella organization, i.e., they implicitly belong to the banking group. The most important for the case study are the IT service provider, which supplies the technical infrastructure, also for the ADM system, and the service provider for risk management, which has developed the system's algorithms. For the following considerations, it is important to understand that the umbrella organization, including the service providers, is in a supplier-client relationship with the case study bank.⁵⁶ Individual banks may (or must) purchase products from the service providers. Particularly

⁵⁶ Another organizational body is the workers' council, which is legally legitimized and able to co-determine the introduction of new technologies in the company. From the council's point of view, there is a relationship of trust between them and the management that has been built up over many years. So far, there is no company agreement on how to deal with the ADM systems; this would follow if the employees also expressed concrete needs. This reactive behavior on the part of the council is also due to the fact that there is simply a lack of capacity to build up ADM skills. The legally possible invocation of co-determination rights on the use of technology is considered a last resort measure.

regarding using the ADM system, conflicts of interest are evident because of this relationship, which has been reflected in the time-consuming implementation phase.⁵⁷

The organizational structure of the bank is no less complex, so only the immediately relevant aspects for the contents of the case study are mentioned below, in particular, the users of the technical system and the stationary sales units, i.e., the work of bank advisors in the active client business. For these bank advisors, sales management (*Vertriebsmanagement*) is the central pace-setting organizational unit. Sales management is divided into the sales control unit (*Vertriebssteuerung*), which directs the stationary trade in branches, whether private or business, and the internet branch unit. The approximately 20 employees manage all client segments and sales units. They are responsible for the retail business, i.e., private clients, with the majority of the bank's 500.000 clients. Their task is to manage resources, i.e., to ask about the most profitable use of advisory services.

Sales control operates as a central actor in this case study, as it plays a key role in shaping the specific tasks of a bank advisor. Their analyses determine the targets of the individual advisors in a branch. In this way, sales control, as the designation surely suggests, also functions as a kind of control instance that demands relevant results from advisors. Not surprisingly, the relationship between sales control and advisors can be described as ambivalent and conflictual, at least at times.

The interviewees in the bank also include members of sales control and management, but mainly bank advisors in direct contact with clients. All of them are members of the ADM test group. The interviewees are mostly between 40 and 53 years old at the time of the interviews and have undertaken similar career paths at the bank. Starting with school-leaving qualifications and an apprenticeship as a bank clerk, the advisors and senior advisors have also completed specific training as business administrators, some as business economists. In higher positions, a univer-

57 The case study bank is a pilot bank to test the recommendation system. After successful testing, the system was rolled out across the entire banking group. Within a test group, employees from all branches exchange information with sales management to adjust the quality of the ADM results. The advisors within the test group have been working with the ADM results daily for several months. The rollout of the ADM system was postponed several times in the case study bank because the quality of the results was unsatisfactory. The service providers promoted it as a plug-and-play solution, which quickly turned out to be a misjudgment. In-house rework and fine-tuning of the system were carried out over several months, so it was not until mid-2023 that the overall rollout was completed.

sity degree is not uncommon but not necessary. It is worth noting that almost all of the interviewees have been working at the bank since their vocational training, some for well over 30 years. They may have changed positions, but not their employer. The underlying attractiveness of the bank as an employer can hardly be disputed.

A total of eight people were interviewed, four of them in the course of the context interviews: the chairperson of the worker's council, an executive board officer, the head of sales control, as well as a data analyst in sales control. The four employee interviews were conducted with two senior advisors and two advisors, three of whom had additional branch responsibility. The bank advisors all work in different branches. The interviewees in the context interviews were mainly men (three); in the employee interviews, they were mainly women (three). Half of the interviewees work full-time with 39 hours per week. The other half works part-time at 32 to 35 hours.

The organization and division of labor in the bank is classically hierarchical, i.e., top-down from the board of directors via the sales department to the branch directorates, branches, and individual advisors. The bank in the case study counts more than 70 branches with around 280 (senior) bank advisors in retail business in August 2023. The employees of a branch are made up as follows: the head of branch, a few product specialists, senior advisors and advisors, and service staff. The group of senior advisors differs from advisors in a few respects: Senior advisors counsel more affluent clients, i.e., those with a higher business relevance for the bank. They spend more time advising individual clients, and their client base is smaller. A rough estimate is 300 to 500 clients for senior advisors and up to 1.000 clients for advisors.

At the branch and advisor level, which is depicted here, there are rather flat structures between branch management, advisors, and service staff. Branch managers are usually active in a hybrid function as managers and in client business. In some examples, advisors also share branch responsibilities. The sense of accountability of all employees in a branch is the reason for a flatter organizational structure. The advisors, in particular, are each responsible for their own personal sales target fulfillment. For advisors, tandem structures with service employees are also essential, i.e., they can transfer certain tasks to the service employees in a guiding function (push relationship).

The typical working day of a senior advisor or advisor is characterized by client meetings lasting up to two hours each. Advisors usually arrive at the bank before 9:00 a.m. (branch opening) to hold team meetings and prepare for individual client appointments. From 9:00 a.m. onwards, client appointments are lined up, so follow-up work and processing must

wait. However, advisors are free to organize their client appointments and processing time within the working hours. The only determining factors are the opening hours of the branch and the statutory working time regulations.

In practice, the clocking component of a working day, i.e., which clients are approached at a certain time, is based on the individual re-submission systems of the advisors. This means that most advisors have their own system and procedure for regularly approaching clients, which they have built up over years. Experience-based interaction with their clients is at the core of their advisory work. In most cases, they know many of their clients personally. However, this only applies to actively attended clients. Every advisor has a certain number of unattended/passive clients. As will be shown in the following, the ADM system complements the experience-based approach to active clients by attempting to access unattended clients.

Irrespective of the technology used, advisors work towards their individual sales targets, which are set annually. They are derived from the calculated potential of the respective client base and, in practice, signify that an advisor should sell a certain number of individual products. The exact targets of an advisor are set by the sales management, which receives the expectations regarding sales performance from the board of directors. The top-down setting of work targets is problematic in that they distribute key performance indicators based on expectations of market development but do not ask what can realistically be achieved bottom-up. In other words, advisors are in a constant state of conflict between contradictory requirements on the part of management expectations and simple client demand. Ultimately, it is up to each advisor to find a strategy for dealing with this conflict.

Positive monetary incentives for advisors are linked to the achievement or even surpassing of targets, just as negative incentives are linked to non-achievement. The task of sales control is to support advisors in achieving their goals. In practice, this vague description is expressed in the fact that it is fundamentally left up to advisors to decide how exactly they achieve their sales targets. However, sales control intervenes in the achievement of targets, especially in the data analysis of client potential. So, it is not the case that advisors can perform their work completely free of constraints. In part, they are given instructions by the sales control department.⁵⁸ One interviewee expressed it more cynically with the

58 The weekly monitoring of sales progress is actually done in a very visible and timely way, namely by means of a traffic light system. If the traffic light is green, advisors know

words, “The good employee is only the one who achieves his goals”. However, if they achieve their targets, by whatever means, advisors move in a relatively justification- and conflict-free space.

As a link to the socio-economic conditions in which the advisors and the bank operate, it is important to mention that the bank can hardly afford any consequences in terms of personnel if the targets are not met. As in many regions and branches, shortages of skilled workers are clearly noticeable in the case study company. The current age structure of the workforce suggests that this problem will worsen. The fact that the bank can hardly offer its employees the same financial conditions as some private banks makes the situation even more difficult.

Both issues, the age structure and competitiveness, affect not only the employees but also the clients. On the one hand, from the bank’s perspective, it is obvious that the average age of its client base is high and that, in the long term, this must lead to a reduction in the still comfortable client base. For younger clients, other, more digital banks that convey a less traditional image of finance are often more attractive. On the other hand, other financial institutions are also more attractive to clients because they can offer cheaper products through fewer advisory services.

The bank is very aware that it cannot win the price war in the industry. Its strategy is based on client loyalty, which is created through a strong bond between advisor and client. The bank wants to offer higher-quality advisory services and differentiate itself from the competition by attaching significant importance to holistic advisory services. This means that not only individual products are sold to the client, but that security in all areas of life is to be provided through appropriate products. The (physical) advisory service provided by the employees is thus also a core element in securing the bank’s future.

However, the bank cannot rely on mere client loyalty. Clients’ requirements are constantly changing. This means that the digitalization of processes and accessibility for clients play a key role. In this context, the bank has some catching up to do compared to other banks. Interestingly, the advisors do not necessarily feel the changed client preferences. The demand for physical consultation remains high. The general trends in

that they have achieved their goals in the past week. If 95 % of the targets have been achieved, the traffic light turns yellow, and below that, it turns red. In view of these indicators, it is certainly an ambitious self-assessment tool. It seems only logical that it is also an instrument for monitoring performance. However, it must also be added that there are no immediate consequences in the short term if the targets are not met.

banking over the past 20 years, i.e., the reduction of branches and employment, did not stop at the case study bank. However, it has become increasingly clear that clients still demand a physical presence and the preservation of cash transactions.

Finally, the macroeconomic situation of the past years also posed several challenges for the bank. The lengthy period of low interest rates proved to be particularly problematic, especially as the bank has a high surplus of liabilities, i.e., clients have a lot of money on deposit. By contrast, there are only a few companies that need liquidity, so the bank is forced to take greater risks in generating returns. Meanwhile, these tensions caused by low interest rates have eased.

14.4. ADM usage in the work process

The ADM system, the impact of which is being examined, is supplied by the service provider of the bank's umbrella organization in terms of both technical infrastructure and content. It is a tool of client approach management and fundamentally comparable to a recommendation system of clients who are particularly likely to purchase a certain product.

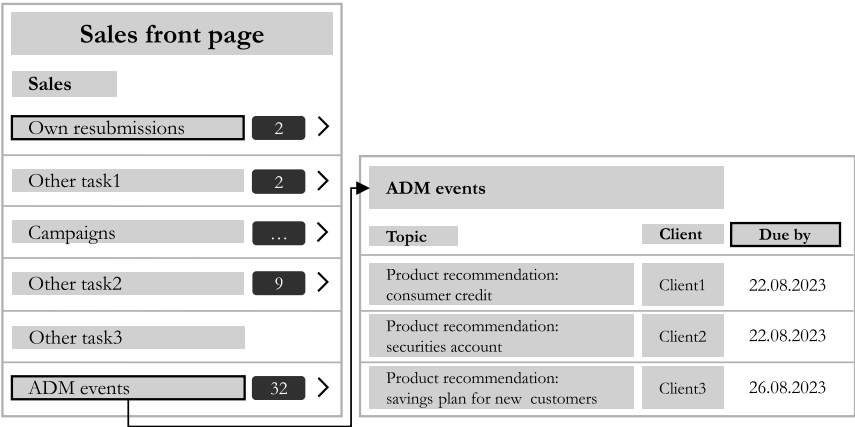
The goals of using the technology are manifold. Unsurprisingly, the primary objective is to expand the effective business, i.e., to increase the closing rates. Basically, the system is intended to support advisors in achieving their sales targets and to distribute resources as sensibly as possible, not only within the group of advisors, but also in sales control. In particular, the valuable advisory time should be used as effectively as possible. Client permeation is not only to be increased in terms of content and time but also the principle of the holistic nature and quality of service offered to clients is to be pursued. Especially passive and unattended client potentials should be activated by using the system.

The desired increase in closing rates is not only reflected in the bank's business results but also has the potential to positively influence the advisor's personal experience of success. This can only thrive if the right clients are approached at the right time. The assessment of objectives is further complicated by the fact that the technology use was imposed by the umbrella organizations and that the company never shared a statement with the staff formulating the system's goals.

14.4.1. Basic functional spectrum

The technical basis for the daily work of each advisor is the core banking system, which was recently supplemented by a new sales frontend. The sales front page (also *event system*) provides an overview of all the advisors' tasks. The entries under sales tasks are particularly important for the advisor's sales goals. All daily client appointments, resubmissions, reminders, campaign tasks, and, most recently, ADM events are listed (Figure 14). The ADM system is considered a supplementary proposal to an advisor's own resubmission and appointment system. On the sales front page, the ADM suggestions are listed alongside other sales tasks. The target set by sales control is that the maximum number of sales-related tasks for advisors must not exceed 50.⁵⁹ ADM events are available to the advisor for a total of two weeks, after which they are deleted, and the affinities are recalculated after a certain period of time. This two-week period is for testing purposes and is intended to provide sufficient time to work on the proposal.

Figure 14: Cutouts of sales front page and exemplary list of ADM events, Case II



Source: Provided by the case company, August 2023. Own replica.

⁵⁹ Due to the ongoing improvement efforts, the maximum number is still 100 for technical reasons.

One implicit goal of implementing the ADM system is to replace the campaign-based client selection system. At present, this approach is still being used in parallel, but only for a limited period. As the campaign system will be discussed in more detail in comparison to the ADM, the approach is only explained briefly: The data analysts in sales control select client lists based on predefined parameters, e.g., a certain age or income structure. In contrast to the ADM-supported selection, the selection criteria of a client are usually transparent, as it comprises a classic manual selection of clients for time-limited topics.

These expert selections can hardly cover the mass of clients, and, above all, it is difficult to identify new structures within the client base. The selection of topics and clients is rather based on the experience of past years. The client lists are passed on by sales control to the advisors for processing. This explanation of the campaign system is so important because some effects of the ADM system are particularly well understandable in contrast to this previous system.

The idea underlying the ADM system is not just to develop a recommendation system but to follow the principle of a client relations management system in the long term, i.e., to provide a holistic approach to client management, including contact channels, content, and recommendations specifically for each client group. So far, the case study bank has only worked with product recommendations. From the advisor's perspective, an ADM event appears as a recommendation of a match between a particular client and a specific product at a certain point in time. The advisor has this information and the invitation to act, i.e., to contact the client, but as a rule, no reason is given as to why this matching is calculated. Consequently, advisors usually research a reason for the conversation themselves before the client meeting. The conversation can hardly begin with the statement that the person in question was selected automatically. This problem will be discussed in more detail later.

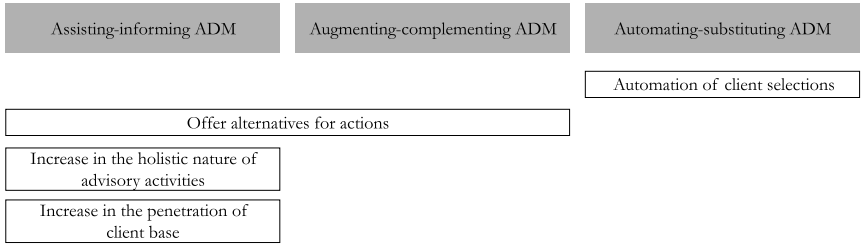
In a nutshell, the functions of the ADM system only cover one aspect (compared to four in Case I), i.e., it provides product recommendations for selected clients for a certain time period. To get more precise about the depth of the system's intervention in bank advisors' work processes, a more nuanced look at the functions is attempted. Rather, these are tasks that the system performs for advisors or in cooperation with them:

- automation of client selections,
- offer alternatives for action,
- increase the holistic nature of advisory activities (quality),
- increase penetration of client base (quantity).

Automated client selection recommends clients who are highly likely to purchase a product right now (right client, right time, right product). In this way, the system offers an alternative course of action for bank advisors. The emphasis must be, however, on the character of the system as a possibility for action, in contrast to the campaign-based system, which is more like a set of instructions for action. With the automated client selection in combination with the experience-based choice of clients from the ADM offer, it is possible to improve the holistic nature of the client consultation as well as increase client penetration. The system thus enables both qualitative and quantitative intervention in client business.

The four functions of the system are categorized differently according to the depth of their intervention in work processes (Figure 15 and fundamentally, Chap. 3.3):

Figure 15: Classification in ADM categorization, Case II



Automated client selection clearly takes on a substitutive character in the work of bank advisors. However, this remains the only function of the ADM system that frees users from a specific task, i.e., their own selection within the client base. All other functions take more of a complementing or assisting role, especially in the advisory activity. The offer of an alternative course of action is reflected in the work of advisors, with its assisting-informing elements as well as the augmenting-complementing aspects. Complementing, of course, means the complementary character of the ADM system, which supplements their own range of actions and can raise the value of the results of their work to a higher level. Assisting-informing refers to the system describing an alternative and not a compulsion to act, i.e., the system gives advisors an information basis on which they make a decision. The increase in the holistic nature of the advisory approach and the penetration of the client base are considered consequences of these new action alternatives and are counted as assisting-informing functions of the ADM system because they provide information on how these two points can be achieved but do not have a supportive effect on the implementation.

14.4.2. Elements of learning ADM

As the very existence of the test group suggests, the initial version of the recommendation system that was brought to the bank by the umbrella organizations did not prove to be fully operational. Expectations and reality have drifted far apart, much to the bank's distress. The result is a great need for additional in-house work. As the head of sales control aptly put it, "The artificial intelligence just has to be taught intelligence, and we are of course happy to assist with that". Neither the technical infrastructure nor the content of the algorithm are in the hands of the case study bank, which is why details of its design are not available.

Apart from these conceptual obstacles, the system requires some time to learn, i.e., to improve its results. The combination of this learning mechanism and the rework within the test group allowed the system results to improve considerably during the observation period. In contrast to Case I, no separation between process digitization and the learning elements of the system is necessary in this ADM example. At its core, the system consists of an ML-based recommendation system.

What data is used for the system in the first place? The answer is mostly descriptive and transaction data from both attended and unattended clients.^{60,61} However, the potential and depth of information contained in this data should not be underestimated. The bank has more than just rigid socio-economic data at its disposal. Specific life events and preferences can be read from the transactions, such as when a child was born (via a child benefit transaction) or what a person's travel or consumption preferences are. The possibilities for drawing conclusions about affinities and risk potential from this wealth of information are enormous. All this information is also fed into the ADM system, although it rarely provides a complete picture since many clients have accounts with several banks.

60 Only clients who have agreed to the General Data Protection Regulation (GDPR) are included in the ADM calculations. The bank has no legal access to the data of other clients for processing. All parties involved are extremely sensitive to compliance with basic data protection rules.

61 Interestingly, the model was not trained with data from the case study bank but with data from other banks within the bank group. The heterogeneity within the bank group thus already implies a certain flaw in the system. For example, a distinction must be made not only between institutions in urban and rural regions but also between particularly wealthy regions and corresponding changes in client demand. The basic model supplied is now being further developed with in-house data.

Figure 16: Exemplary ADM event with approach details, Case II

Approach details

Product recommendation:
consumer credit

Client

Client1

Due by

26.08.2023

What is to be done?

Description

The goal is to close a consumer credit.

Task description

Please approach the client on the subject of consumer credit.

Reasons

External financing >

Closing of instalment credit >

☆ Record reaction >

⏮ Forward >

☎ Show contact details >

✉ Write message >

📅 Schedule appointment >

👤 Client overview >

Source: Provided by the case company, August 2023. Own replica.

The recommendation system is based on two components: data analytics scores (DA scores) and a house-specific parameterization. DA scores are static affinity calculations and were used even before the ADM system was developed. These 50 DA scores are the same for all banks in the banking group. Like the basic model of the recommendation system, the DA scores originate from the umbrella organizations. However, the way in which the DA scores are calculated is largely transparent to sales control.

In contrast, the selected parameters are set specifically for each bank and provide the ADM support with a site-specific framework for its recommendations. Depending on the product, sales control can use the parameterization to manually narrow down the targeted client group according to socio-economic factors such as age, marital status, occupation, or place of residence, or, for example, more financially related factors such as income, savings capacity, creditworthiness, and assets. Sales control decides exactly which events, i.e., recommendations for which products, are played out to advisors in the case study bank. At the time of the study, four ADM events were in operation: liability insurance, loans, and two securities products (savings plan and securities account).

In the future, around 25 products are to be recommended via ADM. From the advisor's perspective, such an ADM event consists of information on the recommended product, the targeted client, and the time window for completion (Figure 16). The advisor is provided with brief descriptions of the product and task, and for certain product recommendations, short reasons for the algorithmic recommendation. For each referral, it is possible to mark a reaction in the form of a reaction code, i.e., an indication of how the advisor has dealt with the referral and what consequences have arisen (e.g., making an appointment with the client).

In comparison to the campaign approach, clients who show certain affinities according to DA scores are not simply selected, but payment flows and comparable client groups are utilized. In other words, a comparison of similar client groups, such as *other clients who also bought product X*, is mainly performed. The model therefore relies heavily on pattern recognition processes. Client behavior is compared over time and based on their complete product range, not simply based on age or income, but on the basis of all available data. The probability that a client is interested in a product is thus recalculated repeatedly, and the client profiles are sharpened over time.

14.5. Influence on job autonomy

14.5.1. Overall evaluation

Bank advisors give the ADM system a positive overall rating. Troublesome sources of error associated with the initial implementation have been minimized. In particular, the advisors consider the system's function as a provider of ideas and information to be positive, as it can also have a beneficial effect on the fulfillment of sales targets by enabling the acquisition of new/passive clients. The system enriches the work of advisors in many respects and helps to wake up *sleepier clients*. As long as the quality of results continues to increase, the advisors' attitude towards the ADM system remains predominantly positive. When there are noticeable moments of support in dealing with the system, the openness for intervention in one's own work increases. The fact that additional product recommendations are provided certainly plays a role. The quality of the ADM suggestions has increased considerably during the test phase, but further improvements will be necessary. Nevertheless, a high degree of experience on the part of the advisors and non-intervention in the actual interaction with the client are conditions for the successful use of the ADM system.

Regarding the impact of the ADM system on the job autonomy of bank advisors, i.e., bank employees who interact with clients to a high degree, predominantly affirmative trends can be identified. Positive effects include an improvement in the quality and quantity of advisory services as well as an easing of certain work steps, which have the potential to contribute to the achievement of sales targets. Autonomy-enhancing elements of the ADM system are apparent in almost all job autonomy dimensions. Compared to Case Study I, however, there are also considerably more contradictory effects. The freedom to interact with clients remains predominant, and it is difficult for the technology to intervene in this interaction. The interviewees also assume that their own self-determination will be preserved in the future, which could seemingly only be shaken by the possible pressure to use the system. Some advisors feel even more self-determined resulting from the replacement of the campaign system and the greater variety of topics that come with it. As long as the tasks set remain workable, the advisors are positive about the newly created options for action.

A slight, albeit not yet substantial, feeling of relief has emerged among some advisors. This impression, in turn, is closely linked to the

Table 11: Effects of the ADM system on employees, Case II

Autonomy Dimensions	Positive effects (+)	Negative effects (–)
Task Autonomy	<ul style="list-style-type: none"> – Supplementation of task variability – Holism of advisory service increased – Less workload in client selection 	<ul style="list-style-type: none"> – Non-transparency and missing information – Higher workload with passive/ new clients – Higher workload for advisors, not seniors
Method Autonomy	<ul style="list-style-type: none"> – Options for action expanded by recommendation – Execution of advisory work unaffected 	<ul style="list-style-type: none"> – Semi-prescriptive following of system instructions
Criteria Autonomy	<ul style="list-style-type: none"> – Support for target achievement – Replacement of campaign system 	<ul style="list-style-type: none"> – Work through an infinite to-do list – The question of control
Scheduling Autonomy	<ul style="list-style-type: none"> – Time gains – More independent prioritization, mid-term – Work speed and breaks unaffected 	<ul style="list-style-type: none"> – Sticking to the right timing, short-term – Parallelism of tasks – Dealing with unpredictability
Working Time Autonomy		<ul style="list-style-type: none"> – (Flexibility demands)
Locational Autonomy	<ul style="list-style-type: none"> – (Remote work optional) 	<ul style="list-style-type: none"> – (Decisive client demand) – (Competition with online branch)
Interactional Autonomy	<ul style="list-style-type: none"> – More individualized advisory services – (Facilitated teamwork) 	<ul style="list-style-type: none"> – Emotional demand with new clients

functional quality of the system and the critical path of the system's control potential. The topic of a *new lightness* in dealing with the ADM system as a suggestion for action will be taken up more often in this context. The greatest burdens that advisors must cope with at work remain unaffected by using the technology. This refers to the interaction work, which, although it clearly brings meaning and motivation into the daily work routine, also involves the greatest effort for bank advisors.

The following systematized description of the benefits and occasionally drawbacks of using the technical system is organized along the seven job autonomy dimensions (overview in Table 11). Some effects are not directly related to the use of the ADM system but rather to the new sales frontend and basic digitalization processes (in brackets). Similarly, the effects that are in particular due to using the ADM system, which is at its core ML-based, are highlighted to distinguish them from the impact of replacing the campaign system. At first glance, this overview suggests a large number of negative effects of ADM use, but it also simplifies the weighting of the positive effects. The fact that the system is currently perceived in a predominantly positive way and that the negative moments also partly reflect potential and expectations is revealed in detail in the following description of the individual effects.

14.5.2. Job autonomy dimensions

Task Autonomy

Task Autonomy asks about the possibility of choosing work tasks independently, task variability, changes in the amount of work, as well as the availability and holistic nature of tasks and information. Within the case study, positive changes in the dimension of Task Autonomy are expressed via three effects: the perception of complementing the variability of tasks, the associated increased holistic nature of the advisory approach, and the elimination of time-consuming selection processes to identify unattended/passive clients. These changes are countered by the lack of information on the reasoning behind the client recommendation as well as additional efforts due to follow-up research. Further restrictions can occur if technical barriers (Chap. 14.6) arise.

Supplementation of task variability (+)

As the ADM system prospectively replaces the campaign-based, i.e., monothematic, mechanism of addressing clients, employees perceive the diversity of their acquisition options as considerably increasing. Although the acquisition core remains the individual experience-based client management, the ADM events pave the way to more holistic client care that moves away from long-term thematic references. Using the system thus reinforces the idea of the availability of any product offered to clients. If the campaign-based system stood for a thematic focus, the new system offers thematic diversity and the idea of opening the tunnel vision regarding products and clients. Employees noticeably welcome this development.

However, the ADM system offers a supplement to existing acquisition possibilities. This means that advisors' own support system of resubmission, based on the assumption that it formulates the qualitatively best acquisition approaches, has priority over the ADM events issued. This understanding of prioritization is shared by advisors and sales control. The prioritization of experience-based tasks, in connection with the capping of the maximum number of acquisition approaches displayed, has the consequence that no client recommendation events are reported to the advisor if there are enough self-scheduled appointments with clients. In other words, if the calendar is full, the ADM plays no role in advisory work. The ADM-implied client proposals can therefore be more effective when appointments need to be filled or capacities are still free.

The central consequence of the ADM use is that rather passive clients and new product clients (sleeper clients) are included in the active advisory activity, i.e., those who are already clients of the bank but have never or rarely been advised directly. Previous client selections have not yet taken these individuals into account. From the advisor's perspective, they are new clients, as they are not yet part of the personally known client spectrum but are purely formally assigned to them. Advisors hardly have the capacity to research these people themselves, with a client number of up to 1.000 and corresponding ongoing advisory appointments and case processing. Advisors describe the setting in relation to the acquisition of passive clients as the proverbial search for a needle in a haystack. This pile is now being reduced by the ADM system. Especially for new or younger advisors who do not yet have a wealth of experience with their client base, this approach proves to be helpful. After all, for them, everything is new.

The use of the technical system thus offers advisors two kinds of variability: that of topics and that of clients. The phased thematic binding

(campaign) is completely dissolved, and in the best case, one also gets to know other clients. This increase in variability depends on the individual client base and the client potential-oriented performance targets.

Holism of advisory service increased (+)

Closely related to the new variability of topics and clients for advisors is the idea of a more holistic client service. The possibility of addressing clients individually by means of the system reflects the increased orientation away from the product towards clients. Products are not sold excessively but are offered considering the client's portfolio, needs, and liquidity. The goal of holistic client care reflects the bank's corporate philosophy, which wants to empower clients to make their own decisions about financial matters. The system fits into this advisory approach by not only breaking down client affinities but also adapting the approach channel and exact content. The system should therefore not only recommend action but also function as a complete client-relationship approach.

From advisors' perspectives, the increased holistic nature of the advisory work is expressed in a greater overview of the breadth of the client base. The system thus functions as a source of information and recommendations on how to achieve higher client penetration and exploit yet-untapped client potential. The target corridor of this more uniform approach is not exclusively the signing of new products but also the qualitative improvement of the advisory service, which offers new products for clients or even creates access to advisory services that were previously closed.

Less workload in client selection (+)

Permanently developing new acquisition opportunities is one of the core tasks of bank advisors. This affects active clients who have already purchased the bank's products but are often no longer sufficient to meet the set performance targets. With an average rate of 50 % of unattended/passive clients, the potential to unlock is huge. Unsystematic and time-consuming individual client selections are now automatically issued by the technical system. Ultimately, it is up to advisors to evaluate the ADM proposals, but at least they save the effort of selecting them in the first place.

Especially the search for clients with a high affinity for a certain product, for which the performance targets of an advisor have not yet been met (e.g., certain number of loan deals), is facilitated in this way.

Without technical support, this search is complex, lengthy, and demanding for advisors due to the abundance of data, as it requires understanding and the ability to interpret, for example, a client's transaction behavior. Advisors describe the change as a *new lightness* in client selection that replaces a more cumbersome campaign system. This ease is not only noticeable for advisors but also for their service partners at the front desk. Research and communication tasks are often shared in tandem, and since the effort is now reduced, collaboration between both parties is facilitated.

Non-transparency and missing information (–)

The non-transparency of the ADM-supported client recommendation describes one of the essential changes using the system. Why a certain affinity for a product is calculated for a client cannot be determined in detail. Advisors therefore lack the information to carry out certain parts of their work. From the advisors' perspective, this naturally calls the acceptance of the system into question. In practice, advisors lack arguments for addressing the client, which must first be researched (given data protection consent) and increase the demands on their ability to interact. The difficulty lies in the fact that a catch must be found as to why the client is actively approached in the first place. This also means that the advisor must create incentives for the client to engage in the conversation. The simple statement that the client has been selected by a technical system is hardly accepted by them. In any case, this reasoning does not correspond to the advisory requirements of the employees in terms of quality. The campaign-based system, in contrast, is characterized by greater transparency, as the selection criteria of the clients are known and communicated (e.g., evaluation of all clients between 18 and 25 with a regular income of a certain amount).

The missing or inadequate chain of argumentation is a major driver of additional efforts. From advisors' perspectives, the extent of the negative influence caused by the lack of transparency in acquisition events depends primarily on the functional quality of the system. If these are promising and prove to be correct, the effort required for follow-up research is considered to be less serious.

Higher workload with passive/new clients (–)

Higher workloads and efforts with passive or new clients are closely related to the non-transparency of ADM events. The additional efforts to address these clients do not necessarily have to be lengthy (e.g., change

in income), but may well result in finding a completely different pretext for the client approach (e.g., reference to the current economic situation, interest rate situation, special conditions). In this respect, advising known clients is less demanding work, especially in comparison to the initial meetings with newer clients.

However, the actual additional workload depends heavily on the client base and advisors' individualized approach to client meetings and acquisitions. The needs of advisors to either prepare extremely carefully for an appointment with an unknown client or to approach the new conversation more situationally based on experience differ greatly. In any case, there is a requirement to make the added value of a certain product or service visible to the client. The fact that this requirement is associated with additional work due to the non-transparency and lack of completeness of information through the ADM is known to sales control and is accepted as a requirement for advisors.

Higher workload for advisors, not seniors (–)

Not only the attempt to acquire passive or new clients can result in considerable additional work for bank advisors, but also the size of the client base. Since regular advisors have a much larger client base to look after compared to senior advisors, sometimes twice the number of client networks, the additional work using the ADM is also reflected disproportionately in this group, as are the associated tandem service partners. However, it is not only the sheer size of the client base that is decisive for a possible unequal distribution of the workload, but also which specific products are issued via the system. Portfolio investments, lending, or insurance appeal to quite different client groups.

This immediately raises the question of the extent to which using the ADM system results in a downward shift in the workload for the company. This is contradicted by the fact that advisory times for seniors take longer, so the effort can be the same in the end. Overall, there is still no experience with this interaction of hierarchical levels/professional specializations and using the ADM, and therefore there is little awareness. Whether quantity balancing is necessary in the long term cannot be conclusively assessed. The danger clearly exists, but may depend on the exact client base, the regional area of work, and thus, to a certain extent, on chance.

Method Autonomy

Method Autonomy asks for the possibility of determining procedures, ways, and tools for the performance of tasks. Methodical degrees of freedom in work, especially those involving clients, are supported by the technical system. This is particularly due to the fact that the options for action of advisors are expanded, provided the system is regarded as a source of information and ideas. The fact that the direct advisory activities, i.e., the conversation with the client, remain largely unaffected in their implementation is also perceived indirectly positively. Some respondents experience slightly restrictive moments in their work, in that they consider the use of the system and compliance with the specifications as implicit obligations. Further restrictions can occur if technical barriers (Chap. 14.6) arise.

Options for action expanded by recommendation (+)

Considering the technical system as a source of information and ideas shows the central advantage for bank advisors: It offers new options for action that not only help to overcome restrictive routines but also enable individual performance goals to be achieved. The campaign system has tempted advisors to provide monothematic and assembly-line advice without discussing other products and topics with clients. This highlights a fundamental conflict between routine and a holistic approach to client support.

The ADM system supports the reopening of this tunnel vision by showing options for action without advisors having to feel directly bound to them: For example, an advisor reported a recommendation to talk to a senior client about securities trading. This product and clientele had not been thought of together before, but mathematically, there was a high affinity for the client. To the surprise of the advisor, the product was signed. The client completed the trade for the benefit of her grandchildren. This example shows how the system may function as a source of ideas for advisors. This is especially true for younger or newer colleagues who have little experience with their client base and therefore would rather accept suggestions for action.

Advisors can evaluate all ADM events relevant to them on an overview screen and select the product recommendations that they perceive as most promising. What equally speaks for the character as an option for action is that advisors do not directly adhere to the product recommendation, i.e., they also exercise the flexibility to address other topics in the client dialogue and to respond to the client's needs ac-

cording to the situation. This is where the experience-based nature of the decisions clearly comes into play. The client recommendations can initiate a conversation or even draw attention to a particular client in the first place, but who is contacted and which products and offers are discussed is up to the advisor's freedom of action. Active deviation from recommendations for action is currently practiced. However, bank advisors must make this connection themselves, which is therefore based to a considerable extent on experience and a sense of interaction.

Execution of advisory work unaffected (+)

The fact that ADM events are currently treated as an option for action and a recommendation for addressing clients implies that the core of bank advisors' work, i.e., advisory activities with clients, remains unaffected. Although technical support can be the reason for discussions with unknown clients and corresponding additional work, the way of dealing with clients, whether known or unknown, is still beyond control. It is at the advisors' discretion how to proceed with the interaction. This is absolutely necessary, as a successful client conversation requires a high degree of interaction work and situational responsiveness.

The advisors report that the client is not supposed to have the feeling that the conversation is being conducted in a technical manner. This does not correspond to the advisory approach of the bank and the individual advisors, who claim to respond to the individual needs and interests of the client. Advisors are therefore only externally controlled in the client discussion as far as they have to react to these unpredictable demands of the client. Bank advisors consider this fact to be the decisive momentum in terms of perceived job autonomy.

Semi-prescriptive following of system instructions (–)

Even if the instructions of the technical system are declared as an alternative course of action and the client interaction is not prescribed in its procedure, the actions of some advisors are still influenced. Precisely because of the time-fixed nature of the ADM instructions, some advisors feel increasingly compelled to work through them and to address clients accordingly. Some advisors experience a feeling of compulsion to act simply because of the existence of the suggested ADM advice. Whether and to what extent this feeling arises also depends on the branch, the associated leadership and communication, as well as the advisors' performance goals.

In any case, it may be perceived as a work instruction, as it is subject to the rule of sales control. Advisors describe their perception partly as

an implicit feeling of pressure to lead the ADM instructions to success, which results from the hierarchical relationship between advisors and sales control. Other advisors, however, do not perceive the technical support as a constraint but rather as a real extension of their scope for action and still try to serve the exact ADM cause. It is not so much coercion that is at work for them, but rather a more targeted and thematic approach to clients. In contrast to the former, these advisors would rather try out and experience the quality of the results themselves.

Criteria Autonomy

Criteria Autonomy asks to what extent the criteria for the evaluation of one's own work performance can be determined by oneself, which work objectives can be set and pursued, and to what extent responsibility is taken for these. Thus, Criteria Autonomy is largely influenced by personal *and* internalized corporate work objectives. If asked when exactly bank advisors feel they have done their jobs well, the answers are unanimously: The self-definition of when decent work has been done is closely linked to the presence of interaction work, i.e., when the day is filled with (preferably) pleasant client encounters. In any case, advisors do not perceive it as a good day's work if no client conversations have taken place. The feeling that clients have left the meeting satisfied, that they have been helped, and that a relationship of trust has been established between advisor and client is a great asset for their motivation and satisfaction.

Of course, advisors are also bound to sell products according to their advertised performance goals. But clients should not be *talked into* certain products. After all, advisors want to be able to "look themselves in the mirror" at the end of the day. The conscience of having empowered clients as much as possible to make their own decisions plays a key role. Not surprisingly, a particularly good day at work is described as one in which pleasant discussions with clients could also be provided with business results. Advisors consciously distinguish between *advisory* and *sales* activities, which do not necessarily coincide. Each advisor deals with this conflicting relationship, which is characterized by contradictory demands, at his or her own discretion.

Considering the specifics of Criteria Autonomy, using the ADM system is an extremely ambivalent factor regarding targeting work goals. The support in achieving personal sales targets, which for some were already apparent after a brief time, and the replacement of the campaign-based selection system are perceived as positive. In contrast, obvious signs of work intensification and the expansion of control mechanisms

are identified, the full potential of which is not yet noticeable for advisors. Further restrictions can occur if technical barriers (Chap. 14.6) arise.

Support for target achievement (+)

While the company's credo is that it is fundamentally irrelevant in which way and by which means advisors achieve their sales goals, the bank would still like to provide them with a supportive tool in line with the described operational goals of the technical system. In fact, advisors also share the perception that the system supports them in achieving their own sales objectives. Especially the possibility to address topics and products at the right time, where the achievement of sales goals is still incomplete, is shown to be valuable. With ADM support, a more precise alignment with the individual performance goals for advisors is possible. The flexibility of topics with a fixed time has a positive effect. With the quality of the system recommendations, i.e., the references to clients who also purchase a product, the probability of support and, thus, the generation of a new personal sense of achievement, naturally increases. The fact that it is often not transparent for advisors (and sales control) in detail why a certain client was selected is less important at this point if the operating results are right.

If the processing of the ADM approaches is also treated as a work objective, both in the case of success and in the negative case of client rejection, a reaction code can indicate to the sales control that the information has at least been processed. The work done is thus documented, even if no economically relevant result could be achieved. For advisors, however, there is also the possibility to control the amount of work within a limited framework by allowing an ADM event to elapse according to the two-week period.

Subsequently, the affinities of the clients are rescored, possibly resulting in a different product recommendation that better fits the advisors' target fulfillment. This can also be considered flexibility in terms of personal target achievement. However, as the system does not change the client base or their calculated potential, there are external limits to the support of target achievement.

Replacement of campaign system (+)

The replacement of the campaign-based selection system for clients is considered a separate positive factor influencing job autonomy, even though it has already been mentioned several times before when advisors

described this very change as exceedingly positive. This is due to the rigidity of the campaign approach, both in terms of content and time. The compulsion to work through the client list within the term, or the need to justify if it was not worked through completely, resulted in a noticeable and intense pressure situation. Often, these campaigns were almost impossible for bank advisors to complete and manage in their daily work. Likewise, from the advisors' perspective, there was a noticeable time-limited specialization on a certain topic, which often blocked the way for other topics in the sense of "blinkers" and thus closed off options for action.

The rigidity of the campaign system, i.e., the product focus, also leads to the fact that client meetings are more conflictual, especially when a client group absolutely must be addressed. In this respect, it might also be argued that the demands on the advisors' ability to interact are higher in the campaign-based system. In other words, the achievement of sales goals is strengthened in the ADM context, which is supposed to show higher chances of success in advising. Interestingly, using the ADM system conveys a reduced feeling of external control and work pressure in the advisors' own actions, although the technical system comes from the same level of the company, i.e., sales control. It is the same colleagues who influence which acquisition events are issued to bank advisors.

From advisors' perspectives, however, the decrease in external determination results from the aforementioned greater variety of topics in everyday working life and the possibility of a greater focus on sales goals. This finding is interesting as far as the employees of sales control themselves perceive the work of advisors as more externally determined with the ADM, presumably due to the higher technology penetration of work processes. This perception of the advisors being less externally determined can be explained by the fact that acquisition approaches can be selected individually. Additionally, there is (so far) no obligation to work through the new acquisition results until the end. Working through the entire process is not possible anyway because the ADM recommendation list is constantly being replenished, as the next section will show.

Work through an infinite to-do list (–)

A major change associated with the use of the ADM recommendations is an organizational one and less focused on the target corridor of the client meeting. For this, the following background information on the pre-ADM setting is essential: Advisors' task list for the current day or a specific period is displayed on the sales front page (Figure 14). At the

top of the list are the appointments with clients that were either made by the client or by the service partner, i.e., a self-determined number of appointments and tasks for resubmission. Further tasks could be added, for example, by the campaign system or cooperation partners. In any case, there was a time-limited number of tasks that had to be completed, a finite to-do list.

The properties of the ADM system have now been implemented in such a way that those client recommendations are filled up daily. How many ADM events there are depends on the number of other acquisition approaches, because there is currently still a cap on the number of tasks (max. 100). Currently, 50 ADM events are issued per advisor for a fortnight, i.e., five per day. This is how the amount of work is currently controlled. In any case, the task display changes for advisors, who now see an almost infinite to-do list in front of them in which new ADM events are added all the time, so that the task list reaches 100. This list of tasks can usually not be completed.

The idea of an implicit intensification and increase in the amount of work is obvious, even if the credo of non-coercion in ADM assignments continues to apply. The assessment of the extent to which the compulsory use of the system will change in the future is discussed ambivalently, even if the company has so far spoken out against it. Most bank advisors, however, are taking a relaxed approach to the infinite to-do list. They are concentrating on their self-imposed deadlines and tasks, and the feeling of pressure to work through the list at all costs has not yet arisen. It also plays a role in that client suggestions or events that cannot be dealt with within the two-week period are displayed by the system again after some time, so no client is immediately lost if action is not taken immediately.

However, the question that ultimately arises is: What happens to the advisors if they can never fully complete their tasks? Will they continue to focus exclusively on their personal sales targets, or will the never-ending to-do list take its toll eventually, with motivation and self-efficacy suffering? The answer to this question essentially depends on the degree to which there will be a compulsion to work through this list completely at some point. Thus, the potential for control that the system holds must also be discussed, since the possibly subtle means of pressure used by the management is the indirect control mechanism of self-assertion of corporate goals. This quickly turns possibilities and suggestions into implicit work directives.

The question of control (–)

Hardly any of the advisors interviewed explicitly referred to the ADM system as a control instrument, although it can be just that. Sales control is able to evaluate exactly which system events have been processed and possibly also which results have been achieved in advisory meetings. The technical possibility of tracking the general use of the system and its successes is given. As is often the case, it depends on how this information is used from an organizational perspective.

First of all, it must be mentioned that within the framework of the ADM approach, there is a concrete evaluation tool by means of so-called reaction codes. These reaction codes are supposed to be used by bank advisors after a system recommendation has been processed. They include, for example, contact attempts with/without interest, mail viewed, with appointment/without appointment, or conclusion yes/no. Even supposedly negative reactions, such as the client not being reached after several attempts, can be mirrored by advisors. If a suggestion is not processed, the system notes the occasion as having expired and recalculates the affinities. The response codes go much further than the example shown. If the advisor fills in the codes correctly, the successes or failures of the ADM recommendations can be evaluated precisely.

According to company statements, no personal data of individual advisors is evaluated in terms of use and success rate; only the direct supervisor can view this data, which, however, gives the impression of individualized evaluation possibilities. Finally, there is activity controlling, which does not refer to a client's reactions to a contact attempt but how advisors move within an ADM event: Do they at least open the event? What actions follow afterwards? The combination of activity protocols and reaction codes naturally provides a lot of data about the advisors' continuous work methods. According to the company's perspective, this data should also be utilized, but in what way remains unclear. How these technical means will affect advisors is therefore not foreseeable in concrete terms. However, the risk of increasing direct or indirect control is present.

According to the advisors, the extent to which the system functions as a control instrument depends on the consequences of not meeting the sales targets. If advisors do not meet their personal performance targets, it may be used "in control constellations". This statement does not come from the advisor but is from the company. In fact, several company representatives share a desired control mechanism behind the system, initially with the objective of determining whether it is used (perspectively, how successfully it is used). The signs are on work instructions and constraints.

Scheduling Autonomy

Scheduling Autonomy asks to what extent the sequence, prioritization, timing, and speed of completing a task can be determined, break times can be chosen, and interruptions and uncertainties can be dealt with. The effects of the system's use on Scheduling Autonomy are double-edged: Autonomy-enhancing moments are visible in relation to time gains and freer prioritization of tasks. However, the design of the system recommendation binds advisors to a certain timing when addressing the client. The parallelism of topics can have intensifying effects. The predictability of work processes is probably not supported by the system. Further restrictions can occur if technical barriers (Chap. 14.6) arise.

Time gains (+)

Time gains for bank advisors should be considered in close connection with the reduced amount of work due to the elimination of individual selections and queries. Additional work due to new clients or specific client bases may or may not occur. In any case, advisors predominantly report time gains that are reflected in more advisory time. Increasing advisory time, because only this can usually lead to operationally effective results, is also an elementary corporate objective of using the system. The more analogous variant of the individual selection of specific client groups by the advisor and service partner repeatedly proved to be extremely time-consuming and unsystematic. With this task, there was always the question of time and the chance of success. Mostly, there is no idle time at all in which these research and analysis tasks can be completed. Where should it come from? The daily routine of bank advisors, with up to five client meetings and additional follow-up paperwork, is extremely compressed. The ADM system is at least supposed to relieve them of the individual selection work. Not only advisory time but also service time can be used more intensively using the technical system. However, the time gains are limited. After all, no additional time is granted for using the system, but it does replace the campaign system.

More independent prioritization, mid-term (+)

When it comes to the possibility of organizing work tasks more freely, the comparison with the campaign-led system, which provides for topic focusing with a duration of about two months, comes into play again. In addition to the self-scheduled appointments with clients, the prioritization of topics with the aim of working through the campaign lists is

clearly predefined. Using the ADM system, this rule is broken. There is a shift from temporally focused sales campaigns to permanent sales activities to address a broader spectrum of clients. Even if only one system is replaced with a novel approach, the temporal opening of topics and products makes an essential difference in terms of prioritization. The prioritization rhythms shift from a two-month cycle to a two-week cycle (duration of an ADM event). The use of the system is much less of an interference in the daily routine of advisors (presumably because its use is not compulsory).

Overall, an advisor's task prioritization remains within the following rough framework: experience-led tasks within resubmissions, ADM-supported recommendations, and clerical work. A single working day can be planned independently as far as possible, which also means that there is a higher degree of advisors' control regarding the timing of contact with clients compared to the campaign. Whether or not ADM events are used is only decided if time resources are available, which depends on the individual work schedule. There are no further instructions on how to use the system or how to integrate it into the daily routine.

Work speed and breaks unaffected (+)

From advisors' perspectives, self-determination continues to prevail regarding work speed. According to their statements, the technical system has no influence on work speed, at least at first glance. To what extent the implicit feeling of pressure to process ADM events within the set deadline is also reflected in work speed remains open for the time being. In any case, it remains questionable to what extent work speed can be increased even further without massively intervening in the daily work processes. Furthermore, the ADM system has no influence on the setting of breaks. A fixed time window is planned for all advisors, which can be moved if necessary but is not influenced by the technical system.

Sticking to the right timing, short-term (-)

What can be treated positively in terms of job autonomy under the keywords of self-determined prioritization or individualized client advice also leaves room for time constraints in the daily work of advisors: paying attention to the right timing of the client approach in ADM events. As a reminder, the technical system not only calculates which clients are likely to show a particularly high affinity for a certain product but also couples these recommendations to a certain time window. The client will most likely purchase the product now, not in 6 months (e.g., credit card

or travel cancellation insurance in summer). An important trigger point, which also determines the system's chances of success, is time, because hardly all clients want to purchase the same product at the same time (campaign system).

For advisors, this technical peculiarity may result in a compulsion to act, which means that current events must also be processed in a timely manner. In this sense, one can certainly speak of a work intensification that is developing subliminally but is already perceived by advisors. The fact that an ADM recommendation takes into account a time component for the client may have some advantages already mentioned in terms of achieving sales goals, but it also brings with it the danger of being permanently rushed. The deadline of two weeks for completion is not a rough guideline but is linked to the event in the sales system by means of a precise expiration date and is therefore always visible to advisors. One difficulty for advisors in implementing the correct timing lies in the fact that the scheduling of client appointments can usually only be staggered and not within a two-week period. The reason for the meeting may already have passed by the time of the appointment and, in the worst case, may be irrelevant for the client, which again requires a situational reaction on the part of the advisor.

Parallelism of tasks (–)

Similar to the right timing, which has both positive and negative potentials for the job autonomy of advisors, the new variability of topics must also be viewed ambivalently. It places new flexibility demands on advisors in that there is a permanent diversity of topics, which could be interpreted as an increased parallelism of topics and products. Admittedly, this parallelism does not necessarily have an immediate negative effect on advisors. It probably also depends on the success rate of using the system. It is possible that the diversity of topics and parallelism is perceived more as an opportunity if it also produces effective business results and more as a requirement if the usefulness of the technical system is questioned. In any case, there should be sensitivity to higher flexibility requirements for advisors, who must react to new topics even more than before. The danger, in turn, lies in an increasing compression of work in terms of time, which advisors have not yet actively reported. Ultimately, in their opinion, the client sets the pace for the working day.

Dealing with unpredictability (–)

Advisors are naturally used to dealing with the partial unpredictability of their own work. Unpredictability is an elementary component of interaction work and, therefore, from an advisor's perspective, should also be linked to the emotional challenges of dealing with clients. Situational demands and reacting to client needs are part of everyday life for bank advisors. With the use of the system, the unpredictability of the content within the advisory activity is increased even more because the clients are usually unknown and experience in dealing with them cannot be relied on. Advisors explicitly report the need for situational action in connection with the ADM.

This unpredictability may subside over time, but it determines the workload, especially at the beginning of the interaction. The client's demand for a certain product can always change, and topics discussed in the consultation can take an unforeseen turn. It is often a balancing act for advisors between reacting correctly and taking ADM recommendations or legal requirements into account. In this regard, using the ADM is considered both a cause of uncertainty and a problem solver.

Working Time Autonomy

Working Time Autonomy refers to the extent to which it is possible to determine the beginning and end of working time and to influence total working time, overtime, or on-call duty. At the time of the interviews, the ADM system had no immediate influence on the self-determined working hours of bank advisors. In essence, working time is determined by advisory meetings with clients. These can also take place during off-peak hours or breaks, by arrangement. Client inquiries outside of these offers are intercepted within the bank's online services. In both cases, the use of the ADM system initially has no influence. However, the system also has the potential to incorporate more time-related components, e.g., the availability of clients or the time-related coupling of certain products, into the affinity calculation and thus also to intervene in the free working time organization of employees. This is explicitly a potential danger, not a reality.

Flexibility demands (–)

The advisors' working hours are fundamentally experience-based, for example, with regard to when exactly a client is contacted or when appointments are made. Independent of technically supported client approaches,

advisors understand that client requirements for the time availability of services have changed. The business model with broad client consultation, advisory time windows, and linking to online product offers is only appealing to a certain client profile. There are also client groups that simply cannot be reached with these offers. Standard opening times lose clients, so, for example, extended working hours in the evening and at weekends are also discussed. In this context, the ADM system should be understood as an element that has the potential to break the previous tradition of the bank. After all, one of the core functions of the system is not only to bring the right product to the right client but also to suggest it at the right time. Why should this recommendation refer to a two-week radius and not to a specific period of the day? Linking ADM events to a tighter time frame could massively interfere with the existing work rhythm of advisors and force them into atypical relationships far outside of traditional working hours.

These considerations in the case study are only theories. But they are all the more important because their consequences for advisors can be extremely serious. They are potentially faced with nothing less than increased flexibility requirements in terms of time, which could add further density to a task that is already stressful from an interactional point of view. The dissolution of working time is just as much a matter of debate as the reduced predictability of the content and time of tasks. Both consequences can potentially contribute to further strain for advisors.

Locational Autonomy

Locational Autonomy asks about the possibility of determining the place of work within or outside the regular workplace. Regarding the use of the ADM system, it is difficult to identify a connection to the workplace of bank advisors. The digitality of processes opens new freedoms regarding the place of work. However, an ADM-related influence on Locational Autonomy exists only potentially. Under the dimension of Locational Autonomy, the question of the division of physical and digital tasks may be discussed. This can refer to the possibility of working remotely as well as the ambivalent relationship to the online branch or digital client service. Ultimately, client requirements have a decisive impact on the location of advisors' work, regardless of the technology used.

Remote work optional (+)

The fundamental possibility of working remotely is practically conditioned by a new sales frontend that enables technical access to sales tasks. Telephone or online consultations, which are being offered increasingly, can be performed well in the home office or remotely, as can follow-up client appointments and detailed research on individual products and clients. Basically, it is possible to work completely remotely; even crucial client support can be handled on the go. However, many of the advisors interviewed do not take advantage of this option at all. Reasons for this are the fact that they are more accustomed to working in the branch, their experiences of higher success rates in direct discussions with clients, and their willingness to interact directly with clients.

In fact, bank advisors report that they invite clients to the physical branch in particular because, in that constellation, clients have actually taken time for the advisory session and do not just casually follow the explanations of an advisor in the home setting or on the road. In other words, the clients are more focused and open to the advisory dialogue if they actively take time for it in the branch environment. Of course, the interaction work on site is also facilitated because the client's facial expressions, gestures, and body language are much more assessable than only the words spoken.

Thus, advisors are bound to the branch office with the core of their task. At least there is the possibility of mobile working for all tasks of planning, processing, or client contact, which gives advisors some new degrees of freedom. In particular, the digitalization push towards home offices is largely due to the developments within the COVID-19 pandemic.

Another game of thought regarding advisors' places of work might be the following: It is possible that affinity recommendations are linked to a certain time, similar to Working Time Autonomy, but also to a specific location where the client is likely to purchase a product or service. It is possible that the client would prefer to be advised at home. So far, the bank has not planned for this development either. Although the recommendation of clients' channel affinity is to be expanded in the future, i.e., which communication channel is most promising for a reaction depending on the client, nothing is to change regarding the primary place of work. Nevertheless, there is a need for sensitivity regarding a balanced relationship between flexibility demands and possibilities.

Decisive client demand (–)

What has already been indicated under the location-related degrees of freedom regarding remote work, namely the decisive factor of client demand, is contrasted with the flexibility options of advisors due to the bank's business model. The bank's specific clientele expects a physical location for advice and thus inevitably ties advisors to the branch, whether they want to make use of digital advisory methods or not. Ultimately, this coincides with the experience of advisors, who see a higher chance of success in their work in a face-to-face conversation. Nevertheless, the clients' desire for personal advisory services limits even the small amount of freedom that advisors can create for themselves in terms of work location. With changing clientele, which is already a result of demographic change, major changes are to be expected, which may work in favor of Locational Autonomy. So far, the flexibility opportunities of advisors can hardly be matched with client needs.

Competition with online branch (–)

From the bank's business perspective, it is irrelevant which channel is used to sell a product or service to the client: the online branch or the physical branch, i.e., the bank advisor. The revenue is the same. The advisors themselves, of course, have a different relationship to the place where a client buys a product because, for them, only the transaction in the physical branch pays into their own performance targets. The offer of the online branch thus acts as competition to direct client advice. Advisors prefer to transfer clients to the online business before they lose them completely to another bank. However, it is preferable for clients to remain in the advisors' own client base.

If the online presence of the bank is declared as a place, it is possible to identify lines of conflict between the interests of the bank and the advisors, which also affects the job autonomy of the latter. The bank has a fundamental interest in diversifying within the framework of online branches and physical branches. In practice, this means nothing other than moving more tasks and products to the online business, where processes are automated and more tasks can be assigned to the client. The ADM support can also be understood as part of this automation process as it potentially contributes to clients moving from the advisors' client base to the online branch, for example, if their time requirements simply cannot be met by advisors.

Ultimately, advisors have the great advantage that the success rates for face-to-face transactions are high, and the physical advisory business is

still very important. There is no sign of a deviation from this corporate credo or a move towards a purely digital bank. The competition with the online branch is therefore only occasional, but it may expand in the future with ADM support. So far, the system does not influence the distribution of tasks between the online branch and bank advisors, and the latter usually retain the authority to interpret the location of a client's service.

Interactional Autonomy

Interactional Autonomy asks about the dependence of one's work on other people, be they colleagues, supervisors, or clients, and how it is influenced by them. When asked to what extent cooperation and interaction with clients and colleagues are affected by the technical system, most bank advisors stated that there is no influence on interaction work. With reference to Method Autonomy, the exact procedure and the way of dealing with the client remain largely unaffected by the technical system. The client meeting can still be structured individually. It is the advisor-client relationship that is decisive, not the technical construct of the ADM tool. The conclusion is that the self-determination of advisors regarding interaction work remains intact.

Nevertheless, some tendencies regarding changed Interactional Autonomy are identified in the following, which advisors have not yet recognized for themselves, such as the possibility of more individualized advisory work or changed teamwork. Finally, a major change in the introduction of the ADM system is the increased interaction with new clients, which brings specific challenges. Finally, another question arises, even if it cannot be answered conclusively: What does using the ADM support actually do to the client? Further restrictions can occur if technical barriers (Chap. 14.6) arise.

More individualized advisory services (+)

Since one objective of using the ADM system is to better respond to clients' needs, partly to anticipate them and to open advisors' views towards new client-product matchings, one can speak of a more individualized advisory possibility. More promising counseling in terms of content may lead to a pleasant, less demanding advisory meeting, which results in a positive effect on advisors' Interactional Autonomy. Bank advisors are more detached from the rigid specifications of the campaign system and receive recommendations for more individualized advisory services due to the time-bound nature of the ADM support. The potential to address clients with the right product at the right time, sometimes with a product "that they

themselves do not yet know they need,” is noted particularly positively by them. Overall, according to the first experiences of advisors, the counseling services with the ADM supplement are closer to the needs of the clients.

The emphasis must again be on supplementation. As a reminder, advisors describe that relying exclusively on the ADM events would lead to a great deal of standardization, including in the client dialogue. However, there must always be the possibility to actively react to clients’ questions and not sell them a useless product. Individualized advisory work is therefore only possible through a combination of experience-led action and the new suggestions of the ADM system, whose greatest strength, as already mentioned, lies in its role as a source of ideas. In addition, the time freed up by the elimination of time-consuming individual selections by the advisor may also benefit the time spent on client meetings. The final evaluation of this development must remain open for the time being. On the one hand, the individualized advisory time should, of course, be maximized as much as possible because it generates relevant business results. On the other hand, the proportion of working time that advisors spend with clients is already so high that the limits of their workload have been reached for some. It is difficult to imagine accommodating even more advisory work into this scenario. If one excludes the intensity of interaction work and considers the pure time spent with service recipients, bank advisors perform even more interaction work than the caregivers from Case I, for example.

Facilitated teamwork (+)

Simplified collaboration between colleagues, between advisors and their service partners, has only been hinted at and is not so much due to the use of the ADM tool as to the new sales frontend, which facilitates the distribution of tasks. Service staff can view the sales tasks of their advisors and provide support as needed, or they are guided by advisors to contact specific clients. The ADM plays a role in that the client recommendations are often subject to a clear division of labor. Service staff contact recommended clients, and advisors conduct the meeting.

Communication about the progress of work takes place in person and via the representative system. Less effort for both sides and thus easier cooperation result from the elimination of extensive selection work, which is now taken over by the ADM system. In this way, additional efforts in the acquisition of new clients can also be partially compensated for. The joint processing of lists in the campaign management system, which is often a burden, is no longer necessary and allows for an intensified use of service times.

It is not only between advisors and service staff that the replacement of the campaign system is perceived as facilitating. Between advisors and superiors, i.e., usually branch management, fewer lines of conflict have emerged so far (which is of course also due to the fact that the use of ADM is not yet compulsory). For example, the status of processing campaign lists no longer must be reported to the supervisor. This control element is therefore omitted. However, superiors like to use the ADM approaches to give advisors recommendations for achieving their sales goals. Again, only the non-coercive use of the ADM tool implies the easing of the instructional relationship between sales management, branch supervisors, and bank advisors.

Emotional demand with new clients (-)

The setting of emotional demands in the client conversation, especially with new clients, is initially technology-independent because they are rooted in the challenges of interaction work. In this case, however, the ADM support triggers more conversations and interactions with new and unfamiliar clients, which many advisors describe as particularly challenging and for which they use more preparation time. To clarify the exact part of interaction work: It is less about actively processing, using, and influencing the clients' feelings. This belongs to the more routine activities of a bank advisor. Rather, this point is intended to illustrate the handling of bank advisors' own emotions (emotional labor) and unforeseen situations. The emotional challenges are therefore also to be considered in close connection with dealing with the unpredictability of the work under the point of Scheduling Autonomy. As already described, there are higher workloads with new clients. Even the first contact can be very time-consuming, not to mention the preparation for the meeting.

Working without ADM recommendations is more feasible since predictability is relatively high and the preparation effort is usually moderate. These two points are combined in the first meeting with new clients because the elements of the unknown are much more extensive from the advisor's perspective. Of course, experienced advisors can react to the respective needs of the client and steer the conversation in the desired direction, but especially in ADM-initiated situations, it is often a gratuitous walk between fulfilling the corporate expectations of the bank and the actual needs of the client. This conflict is constantly on the shoulders of advisors.

The objective of an advisor when talking to new and unknown clients is to build up a long-term relationship that is as intensive as possible and to lay the foundations for this in their first approach. However, the process of building trust often takes years. Advisors therefore also place the highest

demands on themselves in these situations. Some describe their preparatory work with new clients as working meticulously to minimize elements of uncertainty. It is of course impossible to predict what the client will really be like, which is why the elementary challenge of interaction work often arises via ADM events. In addition, there is the danger that the affinity calculations of the technical system may not be correct, and, in the worst case, clients may be alienated by the wrong approach.

These descriptions are not meant to suggest that advisors shy away from situations with new clients altogether. They do not. However, the interactions are made more challenging by the factors of unpredictability and unplannability, which is why advisors should strike a balance between experience-based work and these elements of unplannability, if only for their own protection. Again, this implicitly speaks against the compulsory use of the ADM system.

14.6. Technical barriers, misuse, and areas of improvement

In general, technical malfunctions and obstacles do not paralyze the work of bank advisors. Even without automated client selection, they can perform their usual work tasks. The ability of advisors to deal with malfunctions is therefore considered to be high. The technical functionality of the system is meanwhile regarded as quite positive, i.e., considerably increased compared to the beginning of the test phase. However, the accuracy of the client recommendations still has potential for improvement. Because of previous inaccurate results, the general acceptance of the system is open to debate. These sources of error and uncertainty have a partial negative impact on the job autonomy of advisors (Table 12).

Table 12: Impact of technical barriers on employees, Case II

	Task Autonomy	Method Autonomy	Criteria Autonomy	Scheduling Autonomy	Interactional Autonomy
Technical barriers (employees)					
Inaccurate results – Wrong client – Duplication with resubmission – Right client, wrong content	Higher work quantity	Missing options for action	Target achievement impeded	Additional time and unpredict- ability	Client alienation
Risk of non-acceptance	Higher work quantity	Option for action rejected		Additional time and unpredict- ability	

Inaccurate results

One difficulty that appeared, especially at the beginning of using the ADM system, is the fact that advisors perceived that the wrong results were being proposed, i.e., both the *wrong clients* and in matching with the wrong products. This applies, for example, to clients who have no real financial means at their disposal to take advantage of, such as recipients of social security benefits. For advisors, these clients are usually quickly identifiable. However, clients were also suggested who, at first glance, were not candidates for a particular product. As a rule, advisors can only judge based on experience whether a client is a suitable candidate for a given product or service. The difficulty lies in remaining open to suggestions that are less promising but that turn out to be new opportunities worth closer consideration. The fact that the technical system delivered incorrect results could be overcome relatively quickly via selected exclusion criteria by sales control. So-called KO criteria, such as the basic liquidity required by the client, are decisive. Likewise, it is important to select the right time for the affinity calculation.

Another source of error is the recommendation of products and services that have already been purchased by active clients. This also includes, for example, recommendations for clients that were already included in bank advisors' *resubmission system* or products that the client already owns. This source of error can be minimized easily by means of exclusion criteria. The advisors' knowledge and experience of their client base are required, which can identify and rectify these problems quickly. If this experience-based recognition of already known client-product matches fails to work, there is still a risk of duplicates and, in some cases, of alienating clients with false approaches.

A continuing problem is that the right clients may be recognized by the ADM system, but the *wrong product with the wrong or outdated content* may be recommended. Similar to the duplication of already-known clients, there is a risk of alienating recipients with the wrong content. Once again, the advisor must make decisions based on experience and, if necessary, resort to a recalculation if there are doubts about the recommendation. From the advisor's perspective, it is still possible to approach the client about other content despite the incorrect recommendation and thus still reach a conclusion. In any case, there are elements of uncertainty and strain on advisors' ability to interact.

The three above-mentioned malfunctions add up to the concept of inaccurate ADM results, which result in extra work (Task Autonomy) as well as additional time and uncertainty (Scheduling Autonomy) for further use by advisors. If the results are recognized as incorrect, the ADM

event is no longer available as an option for action (Method Autonomy), which disrupts the achievement of sales targets (Criteria Autonomy). An immediate danger is that the delicate relationship between the advisor and the client is shaken (Interactional Autonomy).

Risk of non-acceptance

The fact that there is a risk that advisors do not accept the ADM system and therefore refuse to use it is not a classic malfunction but rather a consequence of this in combination with the black box character of the application. Above all, the fact that there were many mistakes at the beginning of the implementation and that word quickly got around about the poor quality of the results lies like a shadow over all efforts to gain acceptance for the system. One could draw a comparison to the term “technological myopia” (Susskind & Susskind, 2015, p.44), which describes the underestimation of the perspective capacities of a technology due to current shortcomings.

According to sales control, the challenge of creating acceptance among advisors is so important because at least the quality of the results of the campaign system was high. However, this statement contradicts some of the advisors. In addition, it is possible that the advisors reject the system because they want to retain as much authority as possible over the interpretation of their work in relation to the technical system. In this context, the management and sales control teams also recognized that there was a lack of communication about the goals, capabilities, and problems of the ADM system. Objectives for using the technology were not clearly stated, and advisors were not asked for their feedback right at the beginning (or preferably before implementation). However, this is also due to the bank’s integration into the umbrella organization.

The extent to which the non-transparency of ADM events poses a problem for advisors and leads to non-acceptance is also a matter for discussion. As already described, the ADM events provide only brief reasons, or no reasons at all, for the selection of a particular client. To a certain extent, therefore, advisors’ trust in the technology is required if the system results are not to be fundamentally called into question. This trust in the technology, or as one management representative put it, “the advisors’ faith” in the system, is only achieved if the results of the ADM system are as accurate as possible.

The non-acceptance of the system and its black box character can manifest itself in additional efforts for advisors due to missing information (Task Autonomy) as well as additional time required for processing

(Scheduling Autonomy). The element of uncertainty in the use of the system may have a particular impact and lead to an active rejection of the option for action (Method Autonomy). Technology acceptance in this case study appears to depend on a combination of functional quality, communication, and transparency.

Finally, these obstacles, errors, and suggestions for improvement have occurred with decreasing frequency since the start of the test phase. The learning capabilities of the system based on the bank's own data should further minimize the occurrence of inaccuracies and improve the quality of results. Collaborative work on error reduction continues within the test group, with other pilot banks, and with the umbrella service providers.

14.7. Impact and conditions of changed job autonomy

Traditional universal banks like the case study company, which try to reach clients with a high physical presence and proximity, are largely dependent on the skills of their bank advisors. Their business model is based on the ability of bank advisors to interact with clients and the level of trust between them. This raises the question of where technology can be usefully deployed to support advisory work and to allocate scarce resources optimally. It is an increasingly delicate and conflict-laden situation in which bank advisors have to operate to satisfy the bank's corporate interests, the client's needs, and ultimately the expectations and hopes for their own work.

Interestingly, in a similar case study by Nies (2015, p.167) on the tension between content and corporate requirements for bank advisors, the respondents describe their expectations of their own work in *exactly* the same terms: They must still be able to look themselves in the mirror. Accordingly, the conflict between the demands of work content, i.e., responsibility towards clients, and sales-oriented performance management forms an irresolvable contradiction (Nies, 2015, p.241). This contradiction is also reflected in the present case study, whereby the ADM system contributes to both the quality of client advice and management control.

The influence of using the ADM system on job autonomy must be considered within this scenario. In principle, its potential is promising, as it allows advisors to address unattended/passive clients. At the same time, the system loses weight in everyday work or does not appear at all if the advisors' wealth of experience is large and sales targets are achieved anyway. The more interesting and more ambivalent consequences of sys-

tem use occur when the sales targets (from the management's point of view) are insufficiently addressed or there are temporary capacities in the advisors' calendars.

The analysis of the ADM system along the seven job autonomy dimensions has isolated specific changes and effects in the work of advisors. These are summarized along three distinct lines: the qualitative and quantitative improvement of advisory services, substantial relief tendencies, but also considerably more contradictions in the daily work routine.

The influence of the ADM system on the quality and quantity of advisory services is attributable to several components. First, the targeted approach to affine clients increases the quantity of the active client base, and they are also addressed with a broader range of products. The expansion of advisory services to include unattended and new product clients is closely related to the greater variability of tasks for advisors. But it goes beyond increasing the sheer volume of products and services; using the system also enables more specific responses to client needs. After all, the system attempts to do just that: identify clients with particularly high affinities for a product. In a qualitative sense, this represents a more individualized advisory service that attempts to implement the concept of holistic client approach and support. A possible side effect is that the ADM approach frees advisors from conflicting or non-target client interactions because these are simply not suggested. Important for implementing the improvement of qualitative and quantitative advisory performance is that the system does not influence the conduct of the actual advisory meeting with the client or the self-determined prioritization of the client interaction. The support of the advisory services with the client ultimately contributes to the achievement of sales objectives.

Supporting or even relieving elements in the handling of the ADM system result predominantly from the elimination of the campaign system and less workload in the individual selection of clients. Advisors report favorably not only on freed-up time but also on the possibility of organizing their day-to-day work more independently without having to work through campaign lists. Their daily work routine is less tense. The ADM system's ability to organize and prioritize tasks, combined with the variability of tasks and the broadening of options for action in everyday work, have a particularly supportive effect on advisors. In essence, it is the perception of fewer time constraints and more decision-making scope at the work process level that has a particularly beneficial effect on advisors. Again, if the recommendation is of a suitable quality, it is also possible to speak of a reduction in the workload by supporting the achievement of sales targets.

The perception of several positive effects associated with the ADM system is partly clouded by the fact that, under certain circumstances, a number of new contradictions arise at work. Although the elimination of the campaign system provides new prioritization options in the medium term, the pressure to adhere to the deadlines for ADM events could cancel out these opportunities in the short term. The new variability of tasks is accompanied by a higher degree of parallelism, which may have an intensifying effect on the work of advisors. The implicit obligation to use the system also stands in the way of the new options for action that have emerged for bank advisors. Furthermore, the reduced workload resulting from the elimination of individual selections is canceled if higher emotional demands, workloads, and a lack of information arise with new clients.

Elements of unpredictability are always present in the application of the system, as new possibilities are accompanied by new uncertainties. Therefore, when applying the ADM recommendations, there is the question of the situations in which using the system might have a densifying and contradictory effect on advisors. This problem is particularly evident when it comes to supporting sales target achievement. Advisors overwhelmingly report that it helps them to achieve their work goals, while at the same time, with an infinite to-do list, they are faced with a plethora of ADM-initiated tasks that are almost impossible to complete.

The conditions for positive effects of using the system to unfold are both technical and organizational, with the technical aspects mainly being listed under the technical hurdles in the previous chapter: In particular, the objective needs to remain improving the quality of the system's results. The support potential for the successful achievement of sales goals, the creation of positive client experiences, and ultimately the acceptance and positive impact on the job autonomy of advisors depends centrally on the quality of the ADM results. Prospectively, the quantity of the outcomes in terms of the breadth of the product range must also be expanded. It is essential to maximize the quality of the data, including its completeness, to eliminate the errors mentioned above, and to check the time frames of the data used. All these points have already been worked on by sales control. One difficulty, however, is that the quality of the ADM system's results is impossible to assess conclusively, since even an exceptionally good client recommendation still depends on the advisor's ability to successfully implement these suggestions in the client interaction.

Another technical condition is to increase the transparency of the system. This is quite possible through the further development of the ADM system with in-house client data and by building up the expe-

rience of sales control and advisors. This increase in the transparency of the reasoning behind an ADM event has the potential to eliminate a major autonomy-restricting element in using the system. However, the case study bank is still in a dependent relationship with the umbrella organization and the service providers.

From an organizational perspective, the preservation of as large a proportion of self-determined interaction work as possible is essential for the creation of positive moments of job autonomy. This is not to question the fact that maintaining interaction work is also in the interest of the bank, as it is a decisive element for operational success. Rather, it is a question of using experiential knowledge in dealing with clients. For some advisors, the shift away from experience-based work, for example, within the framework of their own resubmission system, is already foreseeable resulting from using the ADM system. For them, the question arises as to the proportionality of experience-based work and ADM recommendations in the long term.

Ultimately, the preservation of experience-based interaction work will be determined by comparing the success rates between advisors' own resubmission system and ADM recommendations. At the moment, the experience of advisors with the client base is still indispensable. But especially in view of the demographic impact on employment potential, the role of bank advisors may also change in the future. Some within the company have gone as far as to predict that these very employees with a wealth of experience will become extinct. This may present opportunities for younger and new colleagues, but ultimately, the potential loss of experience-based interaction work also erodes moments of meaning and motivation in advisory work.

The final organizational component describes the question of the control capabilities of the ADM system, or rather, how they are used by the company. As has already been emphasized several times, there is currently no obligation to process the abundance of ADM events. What happens, however, when choice becomes imperative? Using the ADM tool is accompanied by the creation of comparability between bank advisors and the reproducibility of results beyond an individual bank. The control potential inherent in the system is obvious. Whether it is also perceived as a control instrument by bank advisors ultimately depends on the consequences that arise if the system is not used and the sales targets are not achieved. The understanding of the system objectives differs to some degree between management and advisors. Advisors tend to perceive the enabling moments while using the system.

For company representatives, the potential for control is evident, while advisors are ambivalent about it. Ultimately, only the advisor who

does not fulfill his targets has a problem. This slightly exaggerated formulation is meant to illustrate how much the system can support a comparison of productivity and heat up a work system that is already permeated by competition. In concrete terms, of course, the question of the system as a means of exerting pressure to increase performance arises. Especially in the case of advisors who do not meet their performance targets and do not work with the technical system, the ADM is negotiated as leverage. A deadline for every ADM event tends to change this perception for the worse.

The critical path is clearly the negotiation of the system's recommendations as a constraint or an opportunity to act. So far, there is more of a feeling of a relieving effect. The advisors themselves, however, are at least questioning the remaining use of the system as an option for action. Some advisors actually expect that, at least in part, the system recommendations will be interpreted as a work obligation. They look forward to this development with concern.

15. Experts' views: pending issues and power imbalance

In supplementary interviews, experts from the areas of

- regulation, strategical foresight, public administration,
- occupational health and safety, standardization,
- technology development, research funding, care technologies,
- labor law, workers' participation

were requested to critically assess the case study results within the scope of their expertise. This step not only serves to validate the previous findings but also to identify the need for action and critical development stages of ADM in the future, which go beyond the boundaries of this sociological research approach. At the core of these issues is the subject of labor law and regulation. The statements refer mainly to learning ADM.

With all experts, a consensus emerged regarding the fundamental perspective on ADM and its integration into work processes: The use of ADM in its current form is considered a threat to (service) workers. ADM is rated as a key inequality amplifier at the corporate and economic level, whether these systems are used in the company merely as one digital work tool among many others or whether its controlling properties take over the pacing of work processes altogether. Well-known technology-related substitution and polarization theories are brought into play, according to which the upper pole, a small group of highly qualified employees, benefits from the complementary and upgrading consequences of ADM use; the middle pole faces increasing substitution pressure; and the lower pole of highly precarious workers only exists because their labor is cheaper than the technical implementation. The extent to which these theses apply to a specific branch or company depends on the specific rationalization logic and optimization interests of companies.

At the core of the experts' demands is that digitalization and the use of ADM systems must not be a perpetuation of the status quo, in which existing labor law is undermined, workers are simply confronted with new technologies in an overwhelming fashion, and co-determination is only a right of workers on paper. People need to be empowered to influence the way they work, regardless of skill level, profession, (and, of course, other socio-economic factors).

Job autonomy is considered a central lever to implement this empowerment. While technically possible, it is ultimately subject to power and distribution struggles between employees and employers. What is

currently being observed, however, is a redistribution of scope and power of action towards the employer.

The experts point to various approaches to countering these developments. They refer to existing rights of co-determination and occupational health and safety, i.e., opportunities to influence the structure of work that are all too rarely used and enforced. Especially regarding the introduction of new technologies, employee representatives have the right to co-determination at the workplace. In practice, however, it is known that in the service sector in particular, co-determination is virtually non-existent in some areas, and employers even actively oppose the involvement of trade unions and the establishment of work councils.

However, the mere existence of a work council is of little help to employees if the council does not make use of its co-determination rights. Ultimately, it is also a question of resources. Works councils must become capable and empowered to have a say. At this point, the legislator in particular is called upon to provide work councils with new means and knowledge so that they are able to actually help shape the use of technology. For example, a one-year pilot phase for the implementation of major new technologies is recommended, followed by a joint evaluation of the impact and effects of technology use on employees.

The results of the case studies have rudimentarily shown that participation-oriented technology implementation can succeed – or that rejection may occur if such implementation fails. In the service sector in particular, participation needs to be thought of in broader terms. Not only must the participation of employees in technical and related organizational changes become standard. Service recipients also need to be involved in the introduction of critical technology. One example of this is care work, where it seems very understandable to involve people in need of care in the deployment and selection of technology. Finally, the interactional part of service work also requires the cooperation of service recipients. Yet, the existing interaction demands between service providers and service recipients hardly play a role in technology implementation.

It is not only co-determination and participation formats in the implementation of technology that can be an effective lever for shaping work processes. From the perspective of occupational health and safety, the risk assessment provides a clear means of evaluating the potential hazards of the ADM system for employees. This is fundamentally obligatory for every company, especially when technology is used, but only about half of the companies comply with this obligation.

The scope of the risk assessment is linked to the size and structure of the company, for example, but that does not change the fact that it

is mandatory. Experts suspect that the actual enforcement of this occupational health and safety mechanism by the legislator will make a serious difference to employment conditions. This obligation must be emphasized all the more because risk assessment not only considers the physical hazards for employees but also the risks of psychological strain.

Beyond this existing legislation, the AI Act is a legislative attempt to establish a regulatory approach for ADMs at the European level that follows a risk-based approach. This means that such systems are to be classified into different risk classes, which are accompanied by corresponding compliance and information obligations. For employees, the hope is to bring transparency to the functioning of ADM systems in the workplace and, in particular, to curb massive monitoring functions. From the perspective of the experts, there is an understanding that the legislator has long stayed out of many aspects of technology regulation in favor of collective bargaining. However, because this system is increasingly working to the disadvantage of employees, attempts are underway to counteract this development by setting standards and norms within the framework of the AI Act. The focus is on increasing the transparency of ADM systems. Suppliers must be able to provide information about what a system does and what states it assumes.

In practice, however, there is an awareness that massive lobbying has eroded the sharpness and core of the intended AI Act. The irony again lies in the definition of AI: Whereas in the past, even the simplest data analysis was sold as AI for marketing purposes, now the incentive for companies is to sell their systems as anything but algorithm-based. Because the definition of the AI Act is basically broad, everything that is subject to an algorithm is counted as AI. The incentive situation from the supplier's and company's point of view is therefore clear, namely the possible non-classification of their own product as algorithm-based or intelligent. In addition, only high-risk products are potentially subject to separate testing; below that, only the self-declaration obligation applies.

Following the AI Act, a further regulatory approach is being developed in Germany with employee data protection, as there is currently no corresponding law at all. The GDPR is used for data protection at the company level. In the operational context, however, it has been confirmed several times that the GDPR requirements are not sufficient to protect employees. For example, data that is collected in violation of data protection (e.g., video recordings) may still be used by the employer in court (requirement to use evidence). Data protection is considered to be undermined in many places, and the current labor law and the Works Constitution Act are simply outdated for such cases.

In particular, an employee data protection act must be able to isolate ADM systems that exploit employee data. It is intended as a reaction to the massive increase in behavioral monitoring systems in the workplace. The problem is, how should these systems be defined? Ultimately, all digital systems have the potential to record employee data, and legislators have little influence on how they are exploited in the workplace.

Even if reference is made to the depersonalization of employee data, this does not change the holistic transparency of employee behavior, which ultimately results in a shift in power. In addition, the question of employee data protection also arises in a cross-company context. Monopolization by some large technology providers is already highly visible today. Do these external suppliers also have access to employee data and use it to develop their systems? The possible consequences of this development cannot yet be fully assessed, but the fact is that employee data can potentially be exploited not only by the employer but also by an external capitalist actor that has no relationship of responsibility to the employees.

Overall, the experts' comments paint a picture of a power imbalance between employees and employers in the implementation and application of ADM systems. This imbalance is becoming more pronounced as the use of ADM, which is critical to employment conditions, increases while existing laws and regulatory approaches are not applied and upcoming ones are eroded. Is the overall power of the employer side too strong in the end? Perhaps for now, but fighting for the ability to shape work at least helps workers keep pace.

16. Limitations

The aim of the two case studies was to establish an empirical link between job autonomy and the use of ADM systems by service workers. In addition, the organizational conditions under which job autonomy is positively utilized were documented. Most of the case studies were implemented as planned, and the results generally meet expectations in terms of scope and depth. However, there are some methodical and content-related limitations that need to be mentioned to contextualize the case study results. While the assessment of the case study contents follows in the conclusion (Chap. 17), a selection of particularly striking limits on the methodical side must be mentioned along with the research design: The selection of the qualitative design (case study) and the data collection methods (semi-structured, problem-centered interviews) are the most promising methods and have been sufficiently justified. The holistic approach of case studies as well as the degrees of freedom in the content of semi-structured interviews proved to be successful.

A possible point of criticism arises before the actual implementation and evaluation of the case studies and interviews, namely regarding the selection of branches and companies. As already described, several service branches could have been considered for the analysis. It became apparent that both case study branches have a particularly substantial number of contradictory requirements in the everyday working lives of employees, which is the main reason for the selection. Ultimately, other service branches would certainly have also opened up exciting opportunities for analysis.

The situation is more critical when it comes to selecting specific companies (and interviewees): Since the selection process is non-random, there is always an unavoidable selection bias. For example, it is likely that the company examples are particularly technology-affine representatives of the branches. However, non-random selection procedures are almost impossible to implement in qualitative research, and it is important to note that randomness cannot be equated with representativeness because even randomness has its own statistical variability. The only way to actively counter selection bias is to put the specifics of the sample company into the context of the respective branch, to uncover unique features, and to emphasize commonalities. Of course, the goal must be to achieve the greatest possible objectivity in the evaluation.

Objectivity also proved to be a challenge in conducting the interviews. In a perfect lab-like research setting, randomly selected people in a randomly selected company would be interviewed with the same objec-

tivity each time. Cynically speaking, it is unfortunate that the interviewer and author of this thesis is a human being. However, it is advantageous to make use of this subjectivity in the interview situation, which requires not only flexibility but also empathy for the interviewee.

In this context, the open design of the interviews with free response options proved to be advantageous. The interviewees were given the opportunity to reveal their very subjective perspectives and interpretations. They could develop their own connections and larger cognitive structures in the interview. Implicitly, this also makes it possible to test whether the respondents really understand the research question.

Particularly in the case of the employee interviews, the openness of the interviewees is noteworthy, as they reported willingly and, for the most part, very reflectively on their everyday working lives. One difficulty, however, was to repeatedly direct the conversation to the concrete aspects of technology use. This points to the quite subordinate role that the respective system plays regarding the core of service workers' work. It also became clear that some experience in care work and banking services, as well as reflective ability on the part of the interviewees, was necessary to do justice to the complexity of the research topic.

Content limitations ultimately ask to what extent the two case studies can contribute to answering the research question and to what extent there is transfer potential to other branches. The difficulties in conducting and analyzing company cases lie in their immanent exemplary nature, from which conclusions and implications at the branch or sector level can only be drawn with great caution, as will be shown below.

17. Summary: increasing job autonomy, interaction work at risk?

The objective of the two case studies on outpatient care and banking services involved analyzing the impact of ADM systems on the job autonomy of service workers as well as describing the conditions for creating positive job autonomy experiences with ADM examples that are in actual use. The following comparison of the two case studies focuses less on the structural differences between the branches and the content-related diversities regarding the specific services provided by the companies. The intention behind the focus on outpatient care and banking services was to compare two (alleged) opposites anyway.

However, they are united in two key aspects: (1) the high proportion and importance of interaction work that care workers and bank advisors perform. From the employees' perspective, interaction work with clients is at the core of the motivational and meaningful elements of their work. Beyond both case studies, the predominantly positive assessment of the respective technology resonates with the mostly marginal intervention of the ADM system in the work with clients. (2) In both cases, using the ADM systems has a predominantly positive effect on the job autonomy of care workers and bank advisors. Positive influences can be clearly identified and isolated on almost all job autonomy dimensions. Service employees retain the power of judgment and decision-making in areas of work that are important to them. Once again, the organizational utilization of these increased degrees of job autonomy is crucial for the interpretation of these results.

Based on selected technological or organizational aspects, a systematic comparison of the two cases is attempted in the following, which is intended to enable cross-industry conclusions to be drawn in Part IV. This comparison is conducted along the following characteristics:

- objectives of technology deployment from the employee and corporate perspective,
- functional context and application scope of the ADM system,
- impact on seven dimensions of job autonomy,
- effects and conditions of autonomy-enhancing technology use,
- interplay of technology use and interaction work.

Objectives of technology deployment from the employee and corporate perspective

Regarding the expressed or implicit goals of technology use, the first serious difference between the two case studies emerges: In the outpatient care company, the core objectives were formulated as standardization, process reliability, and quality, as well as independence of location. Employees and the manager shared this view and were able to formulate it unanimously in the interviews. It is important to emphasize that care workers also work towards efficient processes because the search for information, coordination, and planning uncertainties can take up an enormous amount of time. The creation of transparent, efficient processes is a common goal of management and care workers, because it must be assumed that despite high formal demands on care work, there are still great process inefficiencies due to certain unplannabilities.

In contrast, in the example of banking services, the management did not communicate centrally what the objectives of the ADM system were. This means that the perspectives of management and employees on the ADM system diverge. What they have in common is the understanding that the technology should support them in achieving their individual sales targets, increase the quantitative and qualitative comprehensiveness of the client approach, and, in particular, address passive and unattended clients. Consultation time must be used as effectively as possible.

However, management and bank advisors interpret the function of the ADM system differently: On the management side, the elements of performance control are implicitly emphasized, as it is stated several times that it does not matter by what means and in what way the sales targets are achieved by the bank advisors – a clearer formulation to marketization hardly exists.

Bank advisors, by contrast, see a support tool in front of them. They are more interested in advising and selling, i.e., in providing clients with a tailored overall offering. They are well aware of their high degree of freedom and make use of it. However, when it comes to making changes to their own work processes, as in the case of the ADM system, the first question is always to what extent this intervention can be used to achieve sales targets. The formulation of the target corridor was also made more difficult in the company by the fact that the introduction of the system was not initiated by the bank itself but by the umbrella organization.

With reference to the corporate strategy behind the utilization of the respective ADM system (Chap. 5.4), in the case of outpatient care, there are indications of process rationalization and optimization. In the case of

banking services, the control elements of the ADM system suggest labor power rationalization. While the former is associated with unclear effects on job autonomy in theoretical terms, the latter, keeping in mind that financial services are generally considered highly autonomous services, points to further increases in job autonomy.

Functional context and application scope of the ADM system

A review of the respective range of functions and areas of application covered by the ADM systems puts the scope of the different corporate strategies behind using technology into perspective. The technical system complex deployed in outpatient care is considerably more extensive, i.e., it covers more sections of the work processes of care workers than the counterexample in banking services: It initially takes over the digitalization of processes and provides support with learning ADM features at two core points (tour planning and care documentation). The ADM system thus intervenes in almost all administrative and planning activities of the care worker and the care manager and partly automates or at least complements them.

In contrast, at the time of the study, the ADM system in banking services intervenes in the work processes only selectively, and sometimes not at all, provided that the bank advisors' own experience-based system of client resubmission is fully utilized. The system has a completely automated effect only in the context of client selection for product recommendations and otherwise takes on the role of a complementary or even informative instrument. Thus, the client approach management system plays a smaller role in the day-to-day work of bank advisors than the holistic software solution for care workers. In this context, more elements of the ADM system, ranging from complementation to substitution, become apparent in the latter case, while the former plays a more informative and complementary role overall.

However, if the focus is placed solely on the specific learning elements of the respective systems, comparability is restored because both ADM systems introduce learning components into work processes only at certain points. What makes a serious difference between the systems is the factor of transparency. Care workers did not complain about the lack of information due to the system's intransparency. In fact, the system showed its strengths in the preparation, presentation, and consolidation of information. This is also due to the underlying data, for example, in ML-based tour planning, which can be influenced to a large extent by the care manager and care worker. In any case, there is mostly transparency about which data enters the system (e.g., employee or client data).

Intransparency of system outputs, by contrast, is a problem in banking services. There is a lack of reasoning behind the calculation of ADM events, which means that important information is missing when carrying out advisory work. Bank advisors explicitly report the need for situational action that compensates for this information gap. However, balancing mechanisms of necessary compensatory subjectification are not only required for workers in the case of missing information and system intransparency. If technical malfunctions or obstacles, even operating errors, occur (Chap. 13.6 and 14.6), the compensatory skills of care workers and bank advisors are called for.

Impact on seven dimensions of job autonomy

In terms of the influence ADM systems have on the job autonomy of care workers and bank advisors, several positive effects have been identified, although in the case of banking services there are also more contradictions: Task and Method Autonomy both emerge stronger from using the ADM systems, but for different reasons: In care, it is information centralization and standardization, with the parallel possibility of deviating from system specifications as needed. It is a prime example of how formalization and standardization of work do not necessarily have to restrict job autonomy. In banking services, the already high job autonomy is further strengthened by new options for action and higher task variability, although these options for action are also accompanied by new uncertainties regarding the lack of transparency and information in ADM recommendations.

In both case studies, Criteria Autonomy must be assessed as an ambivalent job autonomy dimension: It is evident in both cases that work results are improved and their achievement is supported. However, new control options are inherent in the systems. The quantifiability and transparency of work processes and results are selectively increased. In outpatient care, however, it appears that direct control is the primary feature, since the care workers have a work plan that is precisely described in terms of both content and time. In banking services, the signs point to a continuation of indirect control mechanisms that further specify the target expectations but leave the path to implementation open to bank advisors.

Scheduling Autonomy emerges strengthened in both cases or remains unaffected. The ability to plan one's own tasks is mostly preserved in detail, and in some situations, there is even evidence of time gains. While it remains questionable to what extent a further intensification of already very time-pressured tasks such as care work or advisory services could

succeed at all, there appears to be a tendency in banking services toward a further intensification, which is particularly justified by the time limit of the ADM recommendations.

The influence of technology on Working Time and Locational Autonomy in care work is proving to be an extremely positive development, which, although not attributable to the learning ADM properties of the system, has no less a positive effect on care workers. The remote capabilities of the technical system open up real-time gains and work facilitation in the sense of location-independent access to information. Above all, places and times are made available that were not accessible before the system was used. In this case, however, this is not perceived as intensifying or delimiting work but rather as facilitating. In banking services, no significant effects of the system's use on Working Time or Locational Autonomy could be identified.

As already mentioned at the beginning of this chapter, the impact of ADM systems on Interactional Autonomy is limited since the interaction work with clients is interfered with indirectly, if at all. As far as collaboration with colleagues is concerned, facilitation through standardization of information and communication flows is evident in both cases. In outpatient care, cooperation with clients is facilitated for the care workers as a result of decoupling certain administrative tasks from a specific location. Bank advisors benefit from using the system by being able to offer individualized products and services.

What becomes clear in the comparison of the two cases is that in the example of banking services, as already described under the goals of technology deployment, a clear orientation toward meeting individual sales targets goes hand in hand with the ADM system. The function of the system as an option for action and the partial lack of transparency in recommendations show that it is not so much a question of the path to target achievement. Job autonomy is granted to increase access to clients, both quantitatively and qualitatively. However, more options for action also result in more contradictions in the work, which bank advisors must deal with individually.

Of course, the outpatient care example also aims to support the achievement of work objectives. However, it becomes clear that it is rather the administrative and planning processes on the way to the work objective, i.e., the care work on the client, which are to be optimized by using the ADM system. Certain effects on the job autonomy of care workers and care managers seem to be only a side effect – which in a different corporate context could well have been expressed to the disadvantage of the employees.

Effects and conditions of autonomy-enhancing technology use

Despite these differences in the way ADM systems are utilized, there are overlaps in terms of the subjectively perceived impact on the working conditions of care workers and bank advisors: The quality of the respective services is improved, and employees notice the tendency toward work improvement in their everyday work. The reasons for these perceptions lie in different places: In the case of outpatient care, it is essentially the standardization and centralization of information as well as the possibility of data access regardless of location. This creates a greater sense of security about the information situation for all those involved, which has a positive effect on the quality of the services. The remote capabilities of the system have a particularly positive effect. The two learning elements of the ADM system (route planning and care documentation) play a vital role in the perception of facilitated work.

In banking services, advisors report a more holistic approach to clients. In qualitative terms, in particular, the presentation of new options for action, the possibility of individualized consultations, and the move away from more rigid campaign systems have a positive impact. However, it is the shift away from the campaign system rather than the ADM system under consideration that also has a facilitating effect on bank advisors. Interestingly, they also perceive more time freedom in their daily work, even though the use of the ADM system requires shorter processing windows in principle. Again, this perception can be explained by the use of the system as an option rather than a constraint.

In both cases, the effect of using technology as an autonomy-enhancing element in the work of care workers and bank advisors depends largely on the utilization of performance-relevant employment data as a control instrument and on the sovereignty over the evaluation of one's own work performance. In the case of outpatient care, there is an explicit obligation to use the system. It is an indispensable tool for the selected work organization in the company. This is the crux of the matter, namely that it is somewhat taken for granted as a tool in work processes and is used, if at all, more as a welcome corrective and reminder by care workers and care managers. To date, bank advisors are not obliged to use the system. The system has so far been used mainly on an on-demand basis, and bank advisors can implicitly control whether ADM recommendations are provided to them. The system is not considered to be an absolute necessity for the fulfillment of advisory work.

Both ADM systems harbor control potential. Detailed activity recording and quantification regarding the performance of certain work processes are possible. In outpatient care, these possibilities are even greater

because the system is used permanently, i.e., it covers a large number of work processes and also records location-based data. The fact that this data is currently not exploited in the care company to determine performance and increase workload is due, as already described, to the corporate strategy, which tends to provide for (jointly supported) process optimization and less for control. However, external control of care processes is another reason, because in terms of billing, health and care insurance companies pay a precise sum for working time and performance – and these lead to extremely condensed work situations anyway. Of course, there are ways of increasing the intensity of this system, but these are either finite if the quality of care is not to suffer or can only be achieved by making massive cuts in the quality of care provided.

Management's interest in control by means of the ADM system becomes clearer in banking services. Even if using the system and processing a certain number of ADM recommendations is not mandatory, this is revealed in two aspects: firstly, the constant filling of the sales task list with ADM events (infinite to-do list), and secondly, the new function of the reaction codes, which provide information about the progress of processing a client recommendation. Most advisors do not yet perceive these new control options as clearly visible in their daily work because they are not yet taking up much space alongside their own experience-based client approach. However, should this relationship shift in perspective, the control mechanisms and underlying interests should be urgently reassessed by bank advisors.

Interplay of technology use and interaction work

Both cases have demonstrated that using ADM systems can partially support interaction work, even if it does not directly intervene in it. The facilitation of planned, rational action, as required for administrative tasks, leads to relatively greater job autonomy when carrying out situationally demanding interaction work. The decisive factor lies in action support, not in its substitution. If the ADM system assists employees to act confidently and qualitatively, its positive impact potential will come to fruition. However, if the system takes on the role of an instruction provider, whether in care as a tour planner or pacesetter for care work or as a to-do list for client interactions in banking services, these positive impact mechanisms can quickly be reversed. Both cases are united by the desire for interaction with clients that is as self-determined and direct as possible, i.e., not digital. In contrast, digital communication channels are welcomed when working with colleagues, as long as there are still opportunities for personal exchange.

In this context, it is important to highlight a factor that has received little attention up until now: the different relationship between clients and the services they receive. The requirements for bank advisors are different from those in care work because they ultimately have to sell their services to their clients. However, clients have a variety of financial providers on the market to choose from. Bank advisors compete with other competitors not only within the company but also across companies. In care, this competition between care services is also quite evident, but the dependency and sheer number of people in need of care are incomparably higher.

In connection with this, the self-confidence in using technical aids in care work also appears to be different from that in banking services. At least in the case studies, the ADM system was readily accepted by care workers because the standardizing, automating, and location-independent elements of the system brought obvious advantages from the employee's perspective, but its use in everyday working life appeared to be a taken-for-granted matter that was never brought to the fore. Everything revolves around the quality of care for people in need of help, their individual needs, and how to cover these needs in a tight staffing situation. In this context, the performance of administrative tasks, which the ADM system mainly assumes, takes on the role of an accepted necessity, no more.

This is not contradicted in banking services, where professional and responsible advice to clients from the advisor's perspective is generally given priority over the fulfillment of the company's own sales targets. In this sense, both cases are united by a comprehensive client orientation, independent of the company's economic interests. Nevertheless, using technical support systems in banking services plays a more important role in that it would otherwise not be possible to handle the sheer volume of clients. Thus, using the ADM system also clearly serves the purpose of coping with the given work requirements. This partly explains why bank advisors prefer to perceive such systems as a support tool rather than a control instrument. The principle of control contradicts their everyday work, which is, in their perspective, characterized by many degrees of freedom.

Finally, the question arises of the extent to which there are nonetheless attempts to intervene in the interaction work in the two cases. This follows on from the overarching question of whether a transition from the automation of objectifying work actions, i.e., the well-formalizable, planning-administrative ones, to the attack on the client relationship, i.e., the activity of service workers that creates meaning and demands subjectification, is made possible by utilizing the ADM systems. Does this also allow for cuts in experience-based (interaction) work?

In outpatient care, this development is difficult to envision. Care work is highly dependent on experience-based work, not only because the demands of interaction are so high but also because many work situations and working hours are simply unplannable. Deep cuts in interaction work are hardly possible with the help of technology, and the potential for optimization in planning and administrative processes has yet to be fully exploited.

By contrast, some bank advisors are already questioning the future of experience-based work. The experience-based client management of advisors could increasingly be replaced by ADM systems such as those in the case study company. What consequences can be expected for the quality of services and the quality of work remains unclear. It can be assumed, however, that the holistic nature of the advisory work, which is what the case study company strives for, will be lost. Interaction work is not in jeopardy per se, but the strong emphasis on the subjective contribution of one's own skills and decisions may be diminished. However, from the striking saying, "They don't have to understand it, they just have to sell it!"⁶² (Breisig et al., 2010), the available empirical findings are still a long way off.

62 Own translation of "Sie müssen es nicht verstehen, sie müssen es nur verkaufen!" (Breisig et al., 2010, title).

PART IV

Conclusions and implications: job autonomy torn back and forth

18. Job autonomy as descriptor of change

This thesis reveals that service workers have a deep desire for job autonomy. The extent to which they are granted this autonomy is another question, the answer to which depends on the corporate strategy for realizing the potential of labor power and specific work content in the branches. ADM systems show different levels of intervention in the work processes of service workers (assisting, augmenting, automating) and may be utilized to fulfill different corporate strategies, mostly in a specific relationship between control and optimization. Employees themselves want to retain control over their work as much as possible. Using ADM systems does not fundamentally contradict this aspiration.

Has the deployment of ADM fundamentally changed work in the service sector? Is it the disruptive change that is predicted and expected for the world of work? With respect to the scope of this thesis, i.e., the extent to which using ADM systems influences the job autonomy of service employees, the answer must be no, not for the branches and tasks under consideration. This is because the systems are embedded in the existing structures of companies and work organizations, and, in many areas, learning ADM systems only intervene selectively in work processes.

The initial objective of this thesis was to gain insight into the effects of ADM on service activities. The answer to the core research question, namely, what influence ADM systems have on job autonomy for service sector employees, is, in short, a predominantly positive one. The extended question about the conditions and effects of this changed job autonomy directly involves the organizational embedding of the ADM system. A technical system does not serve the purpose of control, monitoring, support, or relief if it is not intended and embedded to do so.

The following concluding chapters reflect on the key findings of this thesis and attempt to transfer the empirical results to the service sector. First, a retrospective review is provided of specific expressions of job autonomy in the service sector, which shows a clear divide in terms of low and high autonomy values but also selective alignments (Chap. 18.1). The different levels of intervention of ADM systems in work processes are then summarized (Chap. 18.2) to highlight the special features regarding the interplay of learning ADM and job autonomy (Chap. 18.3). This distinction is intended to take account of the technical and organizational complexity of embedding ADM systems in work processes. Chap. 19 refers to these findings and supplements the consideration of specific corporate utilization strategies behind the use of ADM systems. Finally, this thesis concludes with a brief outlook and areas for action (Chap. 20).

18.1. Less and highly autonomous services: distinct yet converging

The structured quantification of all autonomy dimensions (Part II) lays the foundation for validating the basic theoretical assumptions of this work, which assume a fundamental division into less autonomous services (LAS) and highly autonomous services (HAS). The impression of a quite different job autonomy ratio between the two groups is initially confirmed in the context of the empirical analyses: LAS such as retail, logistics, accommodation and food services, or healthcare and social services show below-average job autonomy values. In contrast, HAS typically have higher average values than the service sector as a whole. The separation of the two groups is therefore empirically justified.

However, there are notable exceptions and peculiarities to this relationship. It is worth emphasizing that Criteria Autonomy not only shows mixed results for the service sector but that the differences between individual service branches are not as pronounced as might be expected. This suggests that the ability to set one's own work goals or to influence their evaluation across branch boundaries is considerably influenced by the respective control and optimization practices. Most service employees work under high pressure to perform, sometimes to their limits. The few exceptions in this sense are, for example, public administration and real estate, but also, surprisingly, wholesale and retail trade. Although other dimensions of autonomy show significant cuts, at least the pressure on employees to perform does not appear to be as pronounced as in other service branches.

What holds equally interesting implications is that Interactional Autonomy, as the component of job autonomy that has so far received little attention in other studies, is extremely homogeneous for the entire service sector. Service employees in Germany therefore not only support each other in a similar way but also have a comparable relationship of responsibility and dependency to others in their own work. Again, it is the interaction work that unites service work in its entirety. Apparently, service employees have established similar coping mechanisms with this interaction work, which allows them to work with a relatively high degree of freedom compared to other dimensions of autonomy. The view of education as well as healthcare and social services, however, reveals a sobering picture. High workloads and the most demanding interaction work are apparently also reflected in greater dependencies on the success of their work. It is particularly worrying that these two branches fall

so far behind other service branches, as the results point to particularly conflict-ridden and demanding interaction work.

These findings suggest that Interactional Autonomy eludes the development logic of the other job autonomy dimensions, i.e., LAS and HAS. It can be assumed that the other job autonomy dimensions develop along the lines of the control logics described, i.e., their access does not yet include interactional components of work. Employees with a particularly high potential for working with ADM systems, i.e., ADM knowledge, are largely in line with these findings. They are clearly among the top performers and HAS. Remarkably, however, they are even below the averages of the entire service sector for Criteria and Interactional Autonomy. Although no causality can be assumed, there are clear indications of a parallel occurrence of ADM skills and performance pressure, output control, and conflictual interactions.

Accounting for the changes in job autonomy since 2012, i.e., a period in which a considerable surge in digitalization is assumed, it is necessary to speak of solidified polarizations between LAS and HAS – but only regarding certain job autonomy dimensions. The highly autonomous branches are increasingly setting themselves apart from their counterparts, particularly in aspects relating to working hours and scheduling. This ties in with the marketization and flexibilization narratives of this group of employees: self-control and corporate target orientation.

What development gives reasons for reflection, however, are Task and Method Autonomy, i.e., the dimensions of job autonomy, which centrally concern work tasks, work quantity, task composition, and task execution. The boundaries between LAS and HAS are dissolving, as all have lost degrees of autonomy. In the less autonomous segments, the question arises as to where exactly new restrictions are being imposed, while in the highly autonomous areas, this development contradicts the existing logic of labor control and utilization. Overall, this suggests that the actual execution of work is more standardized and predetermined – possibly due to the use of ADM, which also has access to highly qualified occupations. Both trends towards devaluation and a stagnation of innovative work behavior can be formulated as consequences of these developments. However, the possibility that lower degrees of autonomy may even have a positive effect on certain groups cannot be ruled out; after all, excessive demands on self-organization and self-control can also lead to delimitation and the dissolution of boundaries.

In summary, it is important to note that the empirical analyses (especially in Part II) indicate that the service sector is characterized by significant restrictions overall. Statistically speaking, maximum values in job

autonomy could never be assumed, but the overall index values are still well below the possibilities of self-determined or at least co-determinable levels. The corresponding control logics can be easily traced based on the distinction between LAS (direct control, Taylorism, industrialization of services) and HAS (indirect control, self-optimization, internalization of the market). Comparability is established regarding performance requirements and output expectations (Criteria Autonomy) because both are controlled in this respect. Similarly, most branches resemble each other in terms of a balanced degree of Interactional Autonomy, which overall still tends to indicate self-determined interaction with clients.

18.2. Assisting, augmenting, automating ... liberating?

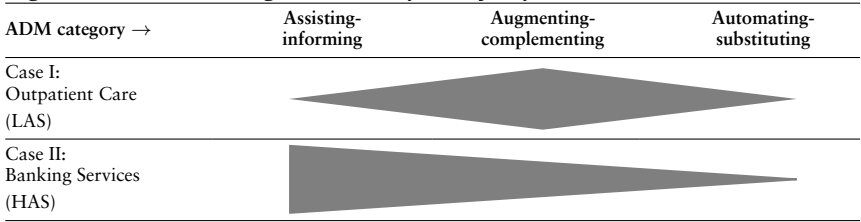
ADM systems come in a wide variety of shapes and functional scopes for companies: purely software-based and with physical components, integrated into existing systems, or part of newly set-up, networked solutions. Digital and rule-based systems are sometimes difficult to separate, and the learning components are not always clearly identifiable as such for users, as this learned output does not necessarily have to be extraordinarily complex. What unites the systems under consideration is that the various components have a broad spectrum of direct or indirect influences on the work of service employees, from assisting and augmenting to automating individual tasks.

In the two company case studies, the interplay between the depth of intervention of ADM systems in work processes and the degree of job autonomy in the branch showed what is possibly transferable to the entire service sector: LAS use ADM systems with a greater depth of intervention in service work than HAS (Figure 17). In most HAS, by contrast, the degree of digitalization is much higher than in the former, so the possibilities for the supplementary use of technology probably need to be carefully weighed up.

What should not be concluded from the above is that LAS are simply easier to automate than HAS. In both company examples, the limits of automation close to the interaction work with clients became apparent, and it is not foreseeable that, even if technically possible in parts, there will be a complete strategic move away from personal interaction work. Finally, there is still a connection between personal work with clients and the quality and individualization of services.

However, what is outlined in terms of taking over and supporting decision-making is that in the case of LAS, there may be more intervention in the decision-making process, meaning that employees must engage

Figure 17: ADM categorization by company case studies



more frequently and more deeply in negotiation processes between the machine and their own decisions. This development can be interpreted as supportive if the employees (as in the example of outpatient care) retain the authority to interpret final decisions about their work themselves.

However, should they lose this sovereignty, for example, through increased monitoring of compliance with ADM outputs, not only are massive reductions in job autonomy to be expected, but also corresponding coping mechanisms that may circumvent the ADM system through appropriation processes. In the case of HAS, by contrast, there appears to be less intervention in the decision-making practices of employees, in line with the underlying logic of self-control and optimization. Of course, there are also examples in which more complex decision-making situations are influenced. In the case of HAS, the problem lies more in the extent to which conflicts arise with the autonomy-depleting marketization mechanisms that arise from the use of ADM.

Abstracting from the case studies, a range of different effects involving the various ADM categories on work have emerged: The special feature of *assisting-informing* ADM lies in its basic information-providing character as an option. These systems are designed to process information and make it available on request. They are therefore reactive and do not actively intervene in work processes. They do not fundamentally change the form and content of work processes; they structure, centralize, and prepare information (e.g., the functions of working time and service recording in outpatient care or recommendations of unknown clients in banking services). This enables greater task variability, i.e., an information-driven expansion of the basis for decision-making, which allows tasks to be carried out more quickly and possibly more precisely. The selection and compilation of one's own task portfolio is supported based on the higher level of information. In this way, a greater density of information helps to accomplish work tasks and reduces the workload to a certain extent, especially if search processes are minimized.

Regarding the possible influence on the time and location components of job autonomy, new degrees of freedom can be created through more efficient work execution. With a high quality of information and its provision in sufficient quantity, both faster and less disruption-prone work are feasible. The informative character of these systems can influence Working Time and Locational Autonomy, in which the locally bound nature of information is partially resolved. However, the core of interaction work remains tied to specific locations, particularly in the case of LAS.

In terms of Interactional Autonomy, it has been proven that the individual employee can act more independently of team structures or other third parties due to the better quality of information provided by the ADM system. In cases of doubt, information no longer must be requested from other parties but can be obtained according to need and situation. This allows for concentration on the cooperative elements of work that are necessary for productive interaction.

The deployment of *augmenting-complementing* ADM systems can have ambivalent consequences for various dimensions of employees' job autonomy. Regarding Task Autonomy, it is evident that some routine tasks that require little autonomous decision-making are taken over by these systems, freeing up space for other, possibly more complex tasks. Whether this feature of the system is advantageous for the autonomy of employees depends very much on whether they really want to be relieved of these tasks or not, or to what extent they can retain the final decision-making authority for themselves. It is likely that some employees perceive the relief from certain simple decision-making tasks as a relief and, in a certain sense, as a strengthening of their job autonomy, while others feel deprived of their task variability and methodical freedom. The effect of changing Task Autonomy therefore depends on the extent to which the use of the system is tied to constraints or is available as an optional support tool. The use of augmenting-complementing ADM systems is a question of power and its negotiation between employees and the technical systems and thus employers – and the associated heterogeneous interests of both sides.

In augmenting-complementing ADM systems, the danger of new boundaries being drawn between workers and machines seems to be the most tangible. If ADM systems are to act in a complementary manner when performing a work task, this can quickly lead to real or perceived unwanted interference in workers' task spectrum. At what points in the work process should the technical system decide, suggest, or stay out completely? This form of demarcation, in turn, has the greatest influence on the autonomy of tasks and methods. If the system provides an alter-

native solution depending on the situation, the paths and approaches to the work objective are not predetermined but are decided based on a negotiation and coordination process between technical and non-technical elements, i.e., between workers and machines. Employees retain the right to “the last word” but must continue to bear sole responsibility for the decisions made and thus the work result (Criteria Autonomy), even though there are interventions in the individual’s own work process.

The considerations on the influences of augmenting-complementing ADM systems on the above-mentioned dimensions of job autonomy illustrate how much their positive or negative relationship can depend on the design and embedding in the work context, the application goals of the technologies, and the individual demands of the employees. Even if one assumes that the aim of the deployment (on the part of the employer) is to support employees in their decisions and to disregard the possible monitoring functions of the systems, a field of tension arises between undesirable interference in one’s own work and desired reinforcement of one’s own actions.

The *automating-substituting* elements of ADM contribute to strengthening job autonomy, as the two company case studies made clear. The decisive factor is which tasks are performed. If they are planning, administrative, or routine tasks, employees experience a new sense of freedom resulting from their omission. If they were tasks that interfered with work with clients, the outcome of this assessment might be different. The same applies to technical faults and incorrect output, which can quickly turn positive autonomy moments for service employees into negative ones. In both cases observed, the automating character of the respective ADM is perceived positively, as it creates scope for work that requires more complex, creative, and social thinking. This freedom can be expressed in terms of time and the cognitive focus being placed on more demanding tasks.

Regarding the adoption of decisions and the decision-making process, the use of such automated ADM does not lead to a perceived reduction in task variability or the ability to select precise work steps. Although decisions and recommendations in predefined situations are made entirely without workers’ intervention, it can be assumed that job autonomy increases if, as in the present cases, the final situational authority over their transfer to the core tasks in the service is retained.

Technical hurdles and possible erroneous outputs from the highly automated functions of the ADM systems are particularly problematic. If these are known and occur regularly, employees are in a constant state of activation, as the time, location, and content of the fault cannot be predicted. Positive elements of job autonomy that are triggered by au-

tomation are thus nullified. One could even go as far as to speak of employees being overburdened if the need to react to disruptions and identify them in the first place is a permanent necessity.

What remains regarding the effect of automating-substituting ADM in services is the fundamentally beneficial and positive perception by employees, who certainly feel relieved and liberated – if the automating functions of the systems are limited to clearly defined tasks in the planning and administrative areas beyond interaction work. Overall, the effect of using ADM systems on the job autonomy of service employees is less dependent on the intervention depth of the systems in work processes. The assisting and automating elements of the systems are clearly permeated by experiences of liberating job autonomy. The use of augmenting ADM is more conflictual because a constant negotiation process between the tasks of the ADM system and workers must be conducted at the level of job autonomy.

18.3. The distinctive features of learning ADM

Both digital systems and rule-based ADM, as well as learning ADM, are capable of generating positive job autonomy experiences for employees. In the empirical examples, these positive influences on job autonomy outnumber the few negative impacts by far (Table 13), and the latter depend largely on the underlying corporate utilization strategy of the respective systems. The effects described are based on the experiences of employees in the two case study companies but also allow for further conclusions to be drawn.

What is fundamentally evident is that digital and rule-based systems have almost exclusively positive effects on the job autonomy of service employees due to their high degree of maturity and increasing accuracy. These effects become tangible if they do not interfere with the execution of the interaction work and the controlling mechanisms that are undoubtedly inherent in them are absent. In contrast, learning ADM succeeds in bringing about improvements in areas of work to which rule-based systems previously had less access. This refers in particular to the expansion of options for action, in some cases, individualization, and thus also improvements in the quality of services and the creation of new temporal freedoms. However, it is becoming increasingly apparent that learning ADM, at least in its current applied status, can lead to more contradictions at work.

Table 13: Effects of rule-based and learning ADM on job autonomy dimensions

Autonomy Dimensions	Digitality/rule-based ADM	Learning ADM
Task Autonomy	+ Information access and standardization + Transparency and holism of information + Support with selection of tasks	+ Less workload: planning-rational actions + Supplementation of task variability + Holism of services – Intransparency: missing information – Higher workload: compensatory actions
Method Autonomy	+ Execution of interaction work unaffected + Deviation from system instructions + Support in choice of methods and tools	+ Execution of interaction work unaffected + Options for action expanded – Threat to experiential knowledge – Confidence/following of system outputs
Criteria Autonomy	+ Support of work targets (quantity) + Higher sense of security – Transparency of tasks in real time	+ Support of work targets (quantity + quality) – Intransparency: questionable output – Missing indicators for evaluating performance
Scheduling Autonomy	+ Time gains + Predictability + Task prioritization/sequence unaffected	+ Time gains – Influence on task prioritization/sequence – Parallelism of tasks/intensification
Working Time Autonomy	+ Flexibility and time gains	(– Flexibility demands)
Locational Autonomy	+ Information access + Location-independence	(– Flexibility demands)
Interactional Autonomy	+ Higher quality of information + Facilitated teamwork + Administrative tasks away from client	+ Individualization and quality of service – Emotional demands – Intransparency: information asymmetries

Compared to rule-based systems, learning ADM succeeds in having a positive effect on Task Autonomy, in particular by offering a broader range of tasks, either because these systems directly recommend options or because automated tasks create new scope for other duties, thus increasing the overall holistic nature of work tasks. Less work is required due to the takeover of rational planning activities. While choices for work actions have increased in the examples mentioned, the execution, in particular the interaction work typical of service work, remains unaffected (Method Autonomy), as is also the case with rule-based systems. In the perception of the employees, the achievement of work objectives is increased not only in terms of quantity but also in terms of quality (Criteria Autonomy) – especially to the extent that information and action sequences are revealed that would either be very difficult or not available at all to employees without the output capability of the systems. This

support for achieving work targets is closely linked to the time gains made possible by using the systems (Scheduling Autonomy).

Up to now, digital and rule-based technical systems have been responsible for influencing Working Time and Locational Autonomy. Regarding learning systems, no significant impact has been identified, particularly in jobs with a high proportion of interactions. At most, changes in the flexibility requirements for employees can be expected in the future, for example, if the time and location preferences of clients are incorporated to a greater extent into system calculations.

New conflicts and contradictions in dealing with learning ADM arise in three main areas: the possible lack of traceability and transparency of system outputs, the associated intervention in interaction activities, and the automated takeover of management tasks. Both case studies unite to create even greater transparency regarding individual tasks and their execution. However, this is due to the purely digital nature rather than the learning elements of ADM. These, by contrast, tend to create intransparency for both management and employees. The intransparency of system outputs, or rather, the lack of traceability of how the results were generated, what data was included, and how the results are to be evaluated by employees, may have a negative impact on job autonomy in many ways. In particular, the lack of information at work can undermine the holistic nature of work tasks and often require time-consuming rework and follow-up research. The lack of information may imply a certain devaluation of employees' work in the sense of non-participation.

Employees try to understand why the ADM system has made a certain decision through their own research and thus nullify possible efficiency gains. Especially in combination with interaction work, a lack of information offers a high potential for conflict because employees may lose their status as experts and naturally want to minimize uncertainties when working with people to maintain service quality. The intransparency of learning ADM can therefore have a central impact on the achievement of work objectives if, in case of doubt, they do not take situational compensatory measures. How can one's own work results be assessed in the absence of transparency, anyway? Nothing less than the complete elimination of Criteria Autonomy is feasible.

An interesting contrast arises regarding Interactional Autonomy. The individualization of service activities based on the analysis of learning ADM has a positive effect on the relationship between service employees and service recipients. Learning ADM directly or indirectly improves the coordination, efficiency, and security of certain work processes, which is reflected in higher service quality overall. However, the emotional demands placed on employees are not unaffected when a lack of trans-

parency in system output and information asymmetries come up against highly situational interaction settings. If using these ADM systems also promotes these information asymmetries between colleagues, any qualitative, quantitative, or time-related benefits associated with using the system could be nullified.

The potential influence of learning ADM on interaction work has already been indicated, but it potentially goes far beyond this. What needs to be questioned is the extent to which ADM systems pose a threat to subjectivizing work actions and experiential knowledge. After all, learning ADM systems implies a fundamental change because they generate experiential knowledge themselves and apply it in a context-specific manner. This trading of experiential knowledge with the system does not necessarily have to affect job autonomy negatively if it is made available to service employees in a complementary way and the assessment of its quality remains with the workers.

However, the actual implementation of automation has often shown in practice that workers' skills are underestimated and machine capabilities are overestimated, so the replacement of experience-based interaction work must be addressed critically. The danger of transferring experience-based work to ADM systems lies not only in the devaluation of service employees and a massive loss of meaning and motivation, but also in a loss of quality for service recipients. Incidentally, there are also technical mechanisms that can create transparency in supposed black box systems. However, these are not yet legal obligations. Since these technical possibilities are not being exploited, a certain corporate interest must also be assumed behind the lack of transparency.

Overestimating the capabilities of ADM systems can be reflected in their planning and management skills. There is no doubt that learning systems in particular are better suited to processing and combining huge amounts of data than workers, but these systems also have an essential element that can have a significantly intensifying effect on the work of employees, namely the time component. This refers not only to the integration of real-time data in ADM calculations but also to the fundamental linking of system outputs to specific time periods (e.g., time-limited client preferences or traffic patterns). Learning ADM can thus influence the prioritization and planning of work tasks, may cause their parallelization, and generally has a work-compressing character.

Finally, this principle of intensification addresses the frequently mentioned issue of performance optimization. In the case of learning ADM, there are fewer signs of a shift towards direct control mechanisms but a solidification of indirect control mechanisms, which also potentially decouples middle management from decision-making processes or even

eliminates them altogether. In both case studies, these tendencies have certainly become visible, with central tasks or target achievement mechanisms being shifted to the respective ADM systems. Even if the human component has not been eliminated, mainly because the ADM results have not yet been competitive with the experience-based actions of workers and their supervisors, the replacement of management positions is a target corridor for deploying learning ADM. The result would be a further distancing of employees from company management, which may open more freedom at the working level of employees but may also result in the voice of individual employees in the company becoming increasingly quieter. If there is also a decoupling of team structures, the isolation practices of individual employees will manifest. These areas of conflict must be actively counteracted if the positive potential of learning ADM, which undoubtedly exists, is to be fully realized.

19. Corporate strategies becoming tangible

Insights into the corporate strategy behind the utilization of a certain ADM system cannot be gained from the outside, but only by examining the functioning and organization of a company in depth. This means that the corporate strategies were not clear when the case studies in outpatient care and banking services were selected. In retrospect, however, this categorization provides excellent explanations for the observations in both cases and beyond.

As an example of LAS, the organizational conditions in outpatient care are fundamentally predestined to be embedded in the logic of digital Taylorism: clearly separable and time-defined tasks fundamentally enable ADM systems to act as the pacesetter of work. The quantifiability of individual tasks in real time and the link to location-based data open huge control potential, which is also used in this way in other care companies. Comparisons with highly automated and algorithmically planned services such as logistics are obvious, at least regarding those organizational aspects of the work apart from direct interaction with clients. In this case study, however, these developments are only visible as potentials, and behind them lies a corporate strategy that does not focus on control. This perception shows that the use of ADM systems for process rationalization and optimization is even supported by employees and must not necessarily be imposed by management.

Of course, in this case, one can speak of an example of good practice in which certain particularities are present, such as the IT background of the managing director, who is the main driver of the company's affinity for technology, or the predominantly negative previous experience of the employees in other settings and companies, which leads to a common desire to do things differently. The size of the company also plays a role; although organizational and technical requirements are not proportional, they are disproportionately greater in large companies. Informal practices for coping with work can, however, be assumed regardless of the size of the company.

What remains is that both purely digital systems and learning ADM systems can be used in LAS as a tool for process optimization for the benefit of employees. This is not about full automation, but rather the optimization of tasks that lie outside the immediate core of care work. The example of care work shows that branches with a relatively low level of digitalization already benefit from fairly simple digital systems, especially if they standardize processes, centralize information, and create location independence in order to offer employees a certain degree of flexibility.

The selectively used learning elements of ADM also bring relief and are welcomed by both middle management and employees. One condition, however, is that the employees remain in control of the interpretation and evaluation of the system output. The overall conclusion is that, particularly in branches that are still less digitized, process digitization and rule-based ADM are not inferior in importance to learning ADM systems for the time being.

As an example of HAS, banking services form a clear contrast to their counterparts and are in line with other branches in this group in that there is hardly any need to discuss basic digital process optimization, such as in the care sector. Processes are already largely digital. In the case of HAS, there is a debate about the extent to which process rationalization and optimization can even be a primary corporate strategy when using ADM systems. Perhaps, from a corporate perspective, new methods must be found to access the labor power of employees. In the example of banking services, this consideration is confirmed as far as the control potential behind the analyzed ADM system can play a formative role for bank advisors in the future.

The ML-based ADM example can be understood as a targeted attempt to intervene in the interaction activities of employees by specifically suggesting clients and content. So far, it has been an area that has remained largely untouched by technology. Of course, technology has also found its way into client contact and service areas. However, when it comes to areas that focus intensively on individual advice, research, recommendations, or knowledge transfer, the strengths of workers have manifested. The case study continues to rely on these strengths, and there is no prospect of fully automating client management and contact. However, this specific example shows the attempt of a traditional universal bank to further standardize processes around and with clients, similar to pure digital banks. This also implies the devaluation of the experience and knowledge of employees, whose significance threatens to erode even further in the future. Ultimately, this attempt to remove the utilization of experiential knowledge is based on management's devaluation interests.

As has already been described in sufficient detail, the financial sector is experiencing an industrialization of service activities – a narrative that until now has tended to be associated with Tayloristic approaches to services or manufacturing industries. Marketization efforts still exist, of course, and a shift towards direct control mechanisms cannot yet be spoken of in this example. Nevertheless, the question arises as to whether a recombination of known control mechanisms can be identified for HAS in the future, which, by means of learning ADM, will provide new access possibilities to experience-led work. It must be assumed that there is

a fine line between influencing these meaningful and motivating parts of work for the purpose of control and the continued granting of job autonomy to maintain self-control and self-optimization mechanisms.

Overall, the impact of using an ADM system on job autonomy depends less on the specific technical features of the system and more on its organizational embedding. ADM can always be exploited for control mechanisms, and its learning elements even tap into the profoundly important experiential knowledge of service employees – but only if using technology and ADM take priority over the decisions of the employees. If the focus remains on decision support, the positive effects on job autonomy take center stage. If ADM results in a direct and irrevocable compulsion to act, job autonomy suffers. Both can be organizationally desirable for the company.

If using ADM in LAS, as in the case study, tends to focus on objectifying actions that can be easily formalized, a positive contribution to job autonomy is possible. This development should not be underestimated for LAS, as there is potential for job autonomy in all dimensions. Since the subjective elements at work are less affected, there are cases that break with the narrative of digital Taylorism and the utilization of technology as a control instrument. Perhaps this applies in particular to highly person-oriented tasks, which have always been in conflict with the characteristics of restricted working environments due to the need to incorporate subjective elements into the work.

As far as the deployment of ADM in HAS is concerned, the focus may not be on the automating character of the systems but initially on their assistive-complementary character. This may actually be about supporting employees – but to what end? If it is the exploitation of subjectifying action, then the focus is rather on intensification, i.e., an overall worsening of the work situation. In this case study, the potential for relief through the support and transfer of tasks in the planning/administrative area must be distinguished from opportunities to intervene in the subjective part of work, which can ultimately lead to a loss of experiential knowledge and motivation. ADM systems in HAS are embedded in existing marketization and exploitation logics to the extent that their supportive properties contribute to desired self-control and self-optimization mechanisms in objectifying work activities. However, they contradict this narrative in their attack on experience-led work, which raises the question as to the conditions of highly autonomous services anew.

Based on the empirical work of this thesis, the possibility of a consolidation of the various forms of job autonomy in the service sector emerges (and not without surprise). There are constellations in which

branches with highly oppressive, intensive conditions characterized by little job autonomy can gain degrees of freedom and thus also relief through using ADM and a corresponding corporate strategy that is based less on control. In contrast, there are also highly autonomous services based on self-control and self-optimization, which may lose degrees of freedom resulting from the expansion of control and interference in the employees' authority to interpret interaction work, which means that the intensity and stress levels in these activities will not decrease in the foreseeable future.

20. Outlook and reflections

This thesis primarily provides a structured analysis of the influence of novel ADM systems on the job autonomy of employees in the service sector. It lays the foundation for further work on the subject of negotiating job autonomy in the workplace, the success of positive autonomy experiences with the use of technology, and identifying organizational conditions and boundaries that are necessary to maintain or create appealing working conditions.

Part I of this thesis lays the theoretical and conceptual foundations for dealing systematically with the interplay between job autonomy and ADM systems. Particular emphasis was placed on presenting a comprehensive but also transferable concept of job autonomy that attempts to do justice to the modern conditions of work and will hopefully also be useful in further studies.

At the beginning of this work, the focus was quickly placed on service workers and less on the entire sector, i.e., those employees who have to work particularly close to other people. This proved to be very fruitful, as the interaction work performed by them in particular harbors potential for conflict regarding ADM systems. The theoretical and conceptual considerations in particular revealed gaps of knowledge regarding the interplay of interaction work and the use of learning ADM, which point to the need for further theory development that goes far beyond this thesis. It is not yet foreseeable what influence the learning elements of new types of ADM will have on experience-led and situational work behavior, as practiced so intensively by service employees. However, it is clear that intensive interaction work will continue to be an area of conflict between employees and employers in the future. From the company's perspective, it is one of the large remaining levels of uncertainty in which employees, even if restrictions become clear, try to maintain their sovereignty. There should be no shortage of exciting case studies in which this field of research can be observed in the future.

Part II of this thesis has revealed a clear divide within the service sector in terms of job autonomy, which speaks volumes about existing inequalities. Nevertheless, a number of similarities within the service sector have become apparent, which legitimize transferability between individual branches. Further research needs and opportunities are abundant in the context of quantifying job autonomy. It is desirable to repeat the analyses carried out with more up-to-date and in-depth data, particularly regarding technology use, and to isolate the connecting lines and dependencies between individual dimensions of job autonomy. The latter point

in particular, namely the dependencies between different autonomy dimensions, can provide enormous added value in terms of understanding patterns of stress and motivation.

Part III ultimately aimed to reflect the utilization of ADM systems in practice in as much detail as possible. Certainly, some nuances in the deployment of technology are specific to the respective company constellations. Nevertheless, patterns of impact on job autonomy from ADM systems can be clearly identified. These findings are of immense value in understanding the organization of companies as a whole. A holistic approach is an essential factor in gaining this knowledge. Far too often, the use of certain technologies, but also other interventions in work processes, is viewed in isolation and hardly embedded in the practical everyday lives of employees.

Of course, these two case studies are not sufficient to capture the complexity and diversity of even just one service branch. There is a need for far more concrete examples and cross-sector comparative studies that are brought to the public's attention and that show how the still-intangible concept of AI is being applied. This would also contribute to a more realistic assessment of the potentials and dangers for society and, in particular, reduce (or at least make assessable) fears that individual technologies and, thus, individual private companies have too great an influence on work and life. The aim of research in these areas must include not only providing this educational work but also communicating it to the public in an understandable manner. Moreover, the application of AI, its development, physical utilization, required resources, and ultimately its social impact must be viewed globally, beyond the Eurocentric perspective.

From the perspective of Germany (and Europe), the most important research and development drivers, companies, market capitalizations, and manufacturers are concentrated in the USA or China (e.g., Bryson & Malikova, 2021, pp. 4–6). This can lead to ever-new areas of conflict, e.g., regarding European data protection principles or German labor law. In this respect, AI is considered a subject of regulation for political actors.

There is no question that legislative action is needed (e.g., GI, 2018, p. 8), and this is well known to decision-makers and lawmakers. In its current form, the GDPR is too incomplete to provide comprehensive protection for employees. In the future, hopes must be pinned on the introduction of employee data protection and the AI Act to create a binding legal basis for companies. However, we should not tire of pointing out existing laws and rights, such as the right to co-determination in companies when introducing new technologies or risk assessment in the workplace.

It is well known that the difficulty lies both in enforcing existing laws and rights and in formulating new legal measures that also cover novel AI systems and their dynamic development. However, the creation of legal certainty ultimately benefits not only employees and their representatives, but also companies. Agreeing on a common basis for action must be the goal for the future, as the quality of employment conditions and the weight of employees' voices also depend on it. Hopefully, substantial regulations will be drawn up as part of the upcoming legislative changes, and these will not be undermined by excessive political influence from individual interest groups before they come into force.

In conclusion, I can only formulate a plea for needs-based approaches to the interplay between technology and work. There is far too little discussion in society about which goals are to be achieved with technology, how these can be achieved, and whether these objectives have any social benefit at all. In view of dwindling human and natural resources, the question of the sensible and socially necessary deployment of technology must come to the fore. The need for discussing the rational and socially beneficial usage of technologies is all too often subject to the supposed potential for additional capital utilization. In any case, and in view of workers' desire for job autonomy, excessive technology-based control of work performance and output, whether direct or indirect, appears to be an outdated corporate objective.

Appendix | Introduction | Part I

Table 14: Service branches according to WZ 2008

Branch	Code
Wholesale and retail trade; repair of motor vehicles and motorcycles	Section G
Wholesale and retail trade and repair of motor vehicles and motorcycles	Division 45
Wholesale trade, except of motor vehicles and motorcycles	Division 46
Retail trade, except of motor vehicles and motorcycles	Division 47
Transportation and storage	Section H
Land transport and transport via pipelines	Division 49
Water transport	Division 50
Air transport	Division 51
Warehousing and support activities for transportation	Division 52
Postal and courier activities	Division 53
Accommodation and food service activities	Section I
Accommodation	Division 55
Food and beverage service activities	Division 56
Information and communication	Section J
Publishing activities	Division 58
Motion picture, video and television prog. prod., sound rec. and music pub. activities	Division 59
Programming and broadcasting activities	Division 60
Telecommunications	Division 61
Computer programming, consultancy and related activities	Division 62
Information service activities	Division 63
Financial and insurance activities	Section K
Financial service activities, except insurance and pension funding	Division 64
Insurance, reinsurance and pension funding, except compulsory social security	Division 65
Activities auxiliary to financial services and insurance activities	Division 66
Real estate activities	Section L
Real estate activities	Division 68
Professional, scientific and technical activities	Section M
Legal and accounting activities	Division 69
Activities of head offices; management consultancy activities	Division 70
Architectural and engineering activities; technical testing and analysis	Division 71
Scientific research and development	Division 72
Advertising and market research	Division 73
Other professional, scientific and technical activities	Division 74
Veterinary activities	Division 75

Administrative and support service activities	Section N
Rental and leasing activities	Division 77
Employment activities	Division 78
Travel agency, tour operator and other reservation service and related activities	Division 79
Security and investigation activities	Division 80
Services to buildings and landscape activities	Division 81
Office administrative, office support and other business support activities	Division 82
Public administration and defence; compulsory social security	Section O
Public administration and defence; compulsory social security	Division 84
Education	Section P
Education	Division 85
Human health and social work activities	Section Q
Human health activities	Division 86
Residential care activities	Division 87
Social work activities without accommodation	Division 88
Arts, entertainment and recreation	Section R
Creative, arts and entertainment activities	Division 90
Libraries, archives, museums and other cultural activities	Division 91
Gambling and betting activities	Division 92
Sports activities and amusement and recreation activities	Division 93
Other service activities	Section S
Activities of membership organisations	Division 94
Repair of computers and personal and household goods	Division 95
Other personal service activities	Division 96

Source: Destatis (2008a) in German. English translation in Destatis (2008b).

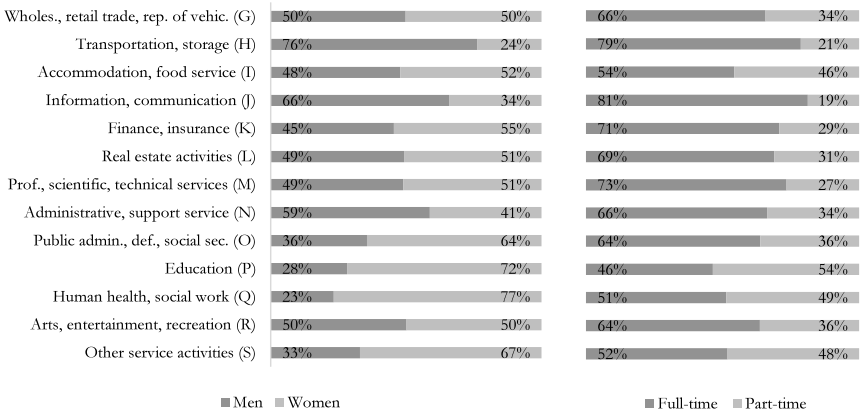
Table 15: Employment by branch, employment status, sex, working time, 2022

	Regularly employed		Marginally employed	
	Total	Share	Total	Share
Total economy	34.705.174	100 %	7.609.194	100 %
Service sector	24.997.813	72 %	6.314.924	83 %
Men	11.144.829	45 %	2.692.799	43 %
Women	13.852.984	55 %	3.622.125	57 %
Full-time	15.822.971	63 %	–	–
Part-time	9.174.842	37 %	–	–
Wholes., retail trade, rep. of vehic. (G)	4.645.666	19 %	1.271.759	20 %
Transportation, storage (H)	1.946.424	8 %	453.225	7 %
Accommodation, food service (I)	1.039.410	4 %	977.109	15 %
Information, communication (J)	1.323.226	5 %	134.256	2 %
Finance, insurance (K)	970.204	4 %	75.884	1 %
Real estate activities (L)	305.731	1 %	263.228	4 %
Prof., scientific, technical services (M)	2.510.603	10 %	432.913	7 %
Administrative, support service (N)	2.317.900	9 %	951.875	15 %
Public admin., def., social sec. (O)	2.030.677	8 %	119.093	2 %
Education (P)	1.436.345	6 %	251.920	4 %
Human health, social work (Q)	5.315.319	21 %	813.925	13 %
Arts, entertainment, recreation (R)	302.295	1 %	243.392	4 %
Other service activities (S)	854.013	3 %	326.345	5 %

Notes: Reporting date Dec 31, 2022.

Source: Statistics of the Federal Employment Agency in BA (2023b).

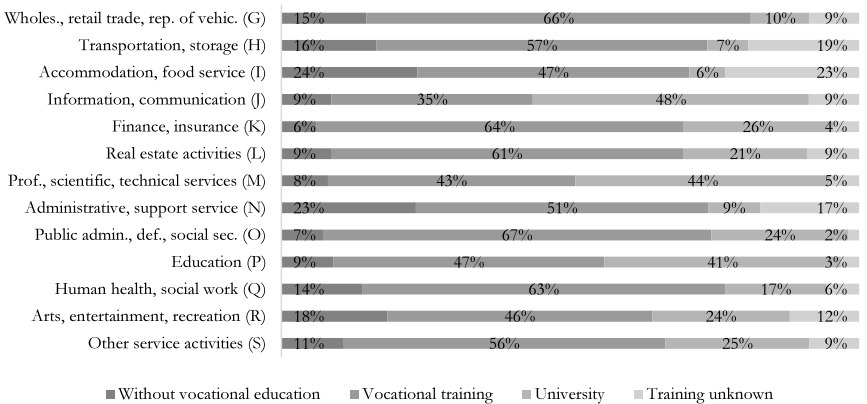
Figure 18: Employment shares by branch, sex, working time, 2022



Notes: Regularly employed. Reporting date Dec 31, 2022.

Source: Statistics of the Federal Employment Agency in BA (2023b). Own calculations.

Figure 19: Employment shares by branch, qualification, 2022



Notes: Regularly employed. Reporting date Dec 31, 2022.

Source: Statistics of the Federal Employment Agency in BA (2023b). Own calculations.

Table 16: Employment growth by branch, working time, qualification, 2018–2022

	Total	Full-time	Part-time	W/o voc. qualif.	Vocational training	University
Total economy	4 %	2 %	10 %	7 %	1 %	20 %
Service sector	6 %	4 %	10 %	11 %	3 %	22 %
Wholes., retail trade, rep. of vehic. (G)	2 %	1 %	6 %	12 %	0 %	25 %
Transportation, storage (H)	6 %	5 %	10 %	19 %	4 %	34 %
Accommodation, food service (I)	–2 %	–1 %	–4 %	6 %	–6 %	24 %
Information, communication (J)	20 %	19 %	23 %	21 %	9 %	35 %
Finance, insurance (K)	0 %	–1 %	3 %	3 %	–5 %	20 %
Real estate activities (L)	13 %	11 %	17 %	24 %	10 %	29 %
Prof., scientific, technical services (M)	11 %	8 %	18 %	12 %	5 %	21 %
Administrative, support service (N)	0 %	–1 %	1 %	9 %	–4 %	18 %
Public admin., def., social sec. (O)	11 %	9 %	15 %	3 %	8 %	26 %
Education (P)	9 %	4 %	14 %	11 %	9 %	11 %
Human health, social work (Q)	8 %	4 %	13 %	10 %	6 %	21 %
Arts, entertainment, recreation (R)	3 %	1 %	7 %	8 %	0 %	19 %
Other service activities (S)	1 %	–3 %	7 %	1 %	–2 %	17 %

Notes: Reporting dates Dec 31, 2018 and Dec 31, 2022.

Source: Statistics of the Federal Employment Agency in BA (2023b) and BA (2019). Own calculations.

Table 17: Influence of digitalization on selected job characteristics by branch, 2022

	Decision-making scope			Workload			Parallel processes			Monitoring and control		
	Increase	No change	Decrease	Increase	No change	Decrease	Increase	No change	Decrease	Increase	No change	Decrease
Wholes., retail trade; rep. of vehic.	26 %	64 %	10 %	48 %	46 %	6 %	48 %	47 %	4 %	33 %	60 %	7 %
Transportation, storage	17 %	71 %	13 %	39 %	49 %	12 %	46 %	52 %	1 %	42 %	50 %	8 %
Information, communication	28 %	65 %	7 %	41 %	56 %	3 %	52 %	46 %	2 %	24 %	70 %	6 %
Finance, insurance	17 %	69 %	14 %	55 %	44 %	1 %	50 %	50 %	0 %	34 %	63 %	3 %
Prof., scientific, technical services	25 %	65 %	10 %	54 %	38 %	8 %	46 %	47 %	7 %	32 %	64 %	4 %
Public admin., def., social sec.	18 %	74 %	8 %	48 %	46 %	5 %	41 %	56 %	3 %	38 %	58 %	4 %
Education	25 %	66 %	8 %	54 %	43 %	3 %	45 %	54 %	1 %	27 %	67 %	6 %
Health	17 %	71 %	12 %	54 %	38 %	8 %	46 %	48 %	6 %	42 %	54 %	5 %
Social Service	12 %	79 %	9 %	46 %	49 %	4 %	43 %	53 %	4 %	41 %	50 %	9 %

Source: DGB-Index (2022b). Table 18, 20, 22, 28.

Appendix | Part II

Table 18: *Decomposition of job autonomy dimensions with recoding in 2018*

Autonomy Dimension	No.	Variable	Question	Answers	Effect	Recoding
Task Autonomy	1	F411_03	How often does it happen in your work that one and the same work process is repeated down to the last detail?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
	2	F411_05	How often does it happen in your work that you improve on existing procedures or try something new?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	+	3; 2; 1; 0; missing
	3	F700_03	How often does it happen that you have influence over the amount of work assigned to you?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	+	3; 2; 1; 0; missing
	4	F700_08	How often does it happen that you are not informed in time about important decisions, changes, or plans for the future?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
	5	F503	Do you perform your tasks mainly according to instructions or mainly independently?	predominantly following instructions (1); predominantly independent (2); both equally frequent (3); not stated (9)	-	0; 2; 1; missing
Method Autonomy	1	F327_03	How often does it happen in your work that you have to identify and close your own knowledge gaps?	frequently (1); sometimes (2); never (3); not stated (9)	+	2; 1; 0; missing
	2	F411_02	In your work, how often do you find yourself being told how to perform the work down to the last detail?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
	3	F411_04	How often in your work do you find yourself faced with new tasks that you first have to think about and familiarize yourself with?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	+	3; 2; 1; 0; missing

Criteria Autonomy	1	F411_07	How common is it in your work that you are prescribed an exact number of pieces, a certain minimum output, or the time to complete a certain job?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
	2	F411_12	How often does your work require you to push yourself to the limit?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
	3	F411_01	How often does your job involve working under intense deadline or performance pressure?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
	1	F411_06	How often do you experience disruptions or interruptions in your work, e.g., due to colleagues, bad material, machine malfunctions, or telephone calls?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
	2	F411_09	How often does your work require you to keep track of different types of work or processes at the same time?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
Working Time Autonomy	3	F700_02	How often does it happen that you can plan and schedule your own work?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	+	3; 2; 1; 0; missing
	4	F700_06	How often does it happen that you can decide for yourself when to take a break?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	+	3; 2; 1; 0 (=4 or 8); missing
	1	F208*	How often do you manage to take your family and private interests into account when planning your working hours?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	+	3; 2; 1; 0; missing
	2	F209	Are your working hours normally between 7 am. and 7 pm.?	yes (1); no (2); not stated (9)	+	1; 0; missing
	3	F216_04*	Have you arranged the following in your job? (on-call duty, work on demand etc.) – not of the above	not stated (0); stated (1)	+	0; 1
	4	F220*	Do you usually work on Saturdays, at least once a month?	yes (1); no (2); not stated (9)	-	0; 1; missing
	5	F223*	Do you usually work on Sundays, at least once a month?	yes (1); no (2); not stated (9)	-	0; 1; missing

Locational Autonomy	1	F228*	Do you work for your company – even if only occasionally – from home?	yes (1); no (2); not stated (9)	+	1; 0; missing
	2	F229* &c	How often does this occur?	always (1); frequently (2); sometimes (3); rarely (4); not stated (9)	+	5 (F229=1); 4 (F229=2); 3 (F229=3); 2 (F229=4); 1 (F232=1 or F232=2); 0 (F232=3); missing (F229=9 or F232=9)
Interactional Autonomy		F232*	If your company gave you the option of working at home at times, would you accept this offer?	yes (1); no (2); not possible in my work (3); not stated (9)		
	1	F327_04	How often does your job require you to take responsibility for others?	frequently (1); sometimes (2); never (3); not stated (9)	–	0; 1; 2; missing
	2	F327_05	How often does your work involve convincing others and negotiating compromises?	frequently (1); sometimes (2); never (3); not stated (9)	–	0; 1; 2; missing
	3	F700_12	How often do you get help and support for your work from colleagues when you need it?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	+	3; 2; 1; 0; missing
	4	F700_13	And how often do you get help and support for your work from your direct supervisor when you need it?	frequently (1); sometimes (2); rarely (3); never (4); does not apply (8); not stated (9)	+	3; 2; 1; 0; missing (=8 or 9)

Notes: Own translation, collection, and item assignment.

Source: BIBB/BaA-ETB 2018.

Table 19: *Decomposition of job autonomy dimensions with recoding in 2012*

Autonomy Dimension	No.	Variable	Question	Answers	Effect	Recoding
Task Autonomy	1	F411_03	How often does it happen in your work that one and the same work process is repeated down to the last detail?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
	2	F411_05	How often does it happen in your work that you improve on existing procedures or try something new?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	+	3; 2; 1; 0; missing
	3	F700_03	How often does it happen that you have influence over the amount of work assigned to you?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	+	3; 2; 1; 0; missing
	4	F700_08	How often does it happen that you are not informed in time about important decisions, changes, or plans for the future?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
	5	F503	Do you perform your tasks mainly according to instructions or mainly independently?	predominantly following instructions (1); predominantly independent (2); both equally frequent (3); not stated (9)	-	0; 2; 1; missing
Method Autonomy	1	F327_03	How often does it happen in your work that you have to identify and close your own knowledge gaps?	frequently (1); sometimes (2); never (3); not stated (9)	+	2; 1; 0; missing
	2	F411_02	In your work, how often do you find yourself being told how to perform the work down to the last detail?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
	3	F411_04	How often in your work do you find yourself faced with new tasks that you first have to think about and familiarize yourself with?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	+	3; 2; 1; 0; missing
Criteria Autonomy	1	F411_07	How common is it in your work that you are prescribed an exact number of pieces, a certain minimum output, or the time to complete a certain job?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing

2	F411_12	How often does your work require you to push yourself to the limit?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
3	F411_01	How often does your job involve working under intense deadline or performance pressure?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	-	0; 1; 2; 3; missing
Scheduling Autonomy	1	F411_06	How often do you experience disruptions or interruptions in your work, e.g., due to colleagues, bad material, machine malfunctions, or telephone calls?	-	0; 1; 2; 3; missing
	2	F411_09	How often does your work require you to keep track of different types of work or processes at the same time?	-	0; 1; 2; 3; missing
	3	F700_02	How often does it happen that you can plan and schedule your own work?	+	3; 2; 1; 0; missing
4	F700_06	How often does it happen that you can decide for yourself when to take a break?	Frequently (1); sometimes (2); rarely (3); never (4); have no breaks (8); not stated (9)	+	3; 2; 1; 0 (=4 or 8); missing
Working Time Autonomy	1	F208*	How often do you manage to take your family and private interests into account when planning your working hours?	+	2; 1; 0; missing
	2	F209	Are your working hours normally between 7 am. and 7 pm.?	+	1; 0; missing
	3	F216*	Do you work demand or have on-call duty?	-	0; 1
	4	F218* &	Do you work – even if only occasionally – on Saturdays?	-	1 (F220=96 or F220=97 or F218=2); 0 (F220=1 or F220=2 or F220=3 or F220=4 or F220=5); missing (F218=9 or F220=99)

F220*		On how many Saturdays do you work on average per month?	1; 2; 3; 4; 5; less than once a month (96); changes, can't say (97); not stated (99)	
5	F221* &	Do you work – even if only occasionally – on Sundays?	yes (1); no (2); not stated (9)	– 1 (F223=96 or F223=97 or F221=2); 0 (F223=1 or F223=2 or F223=3 or F223=4 or F223=5); missing (F221=9 or F223=99)
F223*		On how many Sundays do you work on average per month?	1; 2; 3; 4; 5; less than once a month (96); changes, can't say (97); not stated (99)	
Interactional Autonomy				
1	F327_04	How often does your job require you to take responsibility for others?	frequently (1); sometimes (2); never (3); not stated (9)	– 0; 1; 2; missing
2	F327_05	How often does your work involve convincing others and negotiating compromises?	frequently (1); sometimes (2); never (3); not stated (9)	– 0; 1; 2; missing
3	F700_12	How often do you get help and support for your work from colleagues when you need it?	frequently (1); sometimes (2); rarely (3); never (4); not stated (9)	+ 3; 2; 1; 0; missing
4	F700_13	And how often do you get help and support for your work from your direct supervisor when you need it?	frequently (1); sometimes (2); rarely (3); never (4); does not apply (8); not stated (9)	+ 3; 2; 1; 0; missing (=8 or 9)

Notes: Own translation, collection, and item assignment.

Source: BIBB/BaA-ETB 2018.

Table 20: Observations and shares by branch, 2018 and 2012

Branch	Observations 2018	Share 2018	Observations 2012	Share 2012
Service sector	11.738	100 %	10.896	100 %
Wholes., retail trade, rep. of vehic. (G)	1.242	11 %	1.484	14 %
Transportation, storage (H)	785	7 %	686	6 %
Accommodation, food service (I)	323	3 %	317	3 %
Information, communication (J)	746	6 %	627	6 %
Finance, insurance (K)	647	6 %	724	7 %
Real estate activities (L)	113	1 %	104	1 %
Prof., scientific, technical services (M)	800	7 %	586	5 %
Administrative, support service (N)	444	4 %	432	4 %
Public admin., def., social sec. (O)	1.714	15 %	1.642	15 %
Education (P)	1.809	15 %	1.395	13 %
Human health, social work (Q)	2.583	22 %	2.328	21 %
Arts, entertainment, recreation (R)	181	2 %	159	1 %
Other service activities (S)	351	3 %	412	4 %

Source: BIBB/BAuA-ETB 2018 and 2012. Own calculations.

Table 21: Source variables, observations, shares of secondary variables, 2018 and 2012

Variable/Specification	Source variable		Share 2018	Share 2012
Task type	see Table 22	N=	11.738	10.896
Management			30 %	31 %
Information-related			38 %	38 %
Object-related			16 %	18 %
Person-related			28 %	26 %
Educational attainment	max1202/Max1202	N=	11.716	10.893
W/o voc. qualification			5 %	7 %
Vocational training			48 %	57 %
Upgrading training			6 %	6 %
University			41 %	30 %
Sex	S1	N=	11.738	10.896
Female			61 %	64 %
Male			39 %	36 %
Company size	F515	N=	11.456	10.544
Micro company			12 %	14 %
Small company			28 %	29 %
Medium company			29 %	27 %
Large company			32 %	30 %
Working hours per week	az	N=	11.738	10.896
10 to 20			12 %	14 %
21 to 30			17 %	15 %
31 to 40			39 %	39 %
More than 40			32 %	32 %
Length of employment	F510	N=	11.693	10.859
More than 10 years			54 %	58 %
Up to 10 years			19 %	16 %
Up to 5 years			17 %	17 %
Up to 2 years			10 %	9 %

ADM Knowledge	see Table 23	N=	1.811	1.421
Basic			79 %	77 %
Advanced			21 %	23 %
Knowledge intensity	TI_KI	N=	11.738	10.657
KIS			74 %	86 %
LKIS			26 %	14 %
Changes in work environment	see Table 24	N=	11.239	10.449
Low			68 %	65 %
Middle			16 %	17 %
High			16 %	18 %
Frequency of making difficult decisions	F327_02	N=	11.734	10.891
Never			12 %	12 %
Sometimes			43 %	45 %
Frequently			46 %	43 %

Notes: The generated variables are based on the listed source variables. The specifications of the variables age group, company size, and working hours are created by the author. Task type, ADM knowledge, and changes in work environment are generated variables. Differences in the number of observations are due to missing values in the responses.

Source: BIBB/BAuA-ETB 2018 and 2012. Own calculations.

Table 22: *Decomposition of variable task type*

Task type	Variable	Question	Inclusion criterion	Operator (Inclusion)	Exclusion criterion	Operator (Exclusion)
Management	F301	Do you have employees for whom you are <thes> direct supervisor?	F301=1			
	Please tell me how often these activities occur in your work, whether frequently (1), sometimes (2), or never (3):					
Information-related	F304	Measure, test, control quality	F304=1	OR	F301=1	OR
	F310	Organizing, planning, and preparing work processes.	F310=1	OR	F312=1	OR
	F311	Develop, research, construct	F311=1	OR	F315=1	OR
	F313	Collecting information, researching, documenting	F313=1	OR	F316=1	OR
	F314	Advise and inform	F314=1	OR		
	F318	Working with computers	F318=1	OR		
Object-related	F319	Use of the Internet or edit e-mails	F319=1	OR		
	F303	Manufacture, production of goods and commodities	F303=1	OR	F301=1	OR
	F305	Monitoring, control of machines, equipment, technical process	F305=1	OR	F312=1	OR
	F306	Repair, Recondition	F306=1	OR	F315=1	OR
	F308	Transport, storage, shipping	F308=1	OR	F316=1	OR
	F320	Cleaning, waste removal, recycling	F320=1	OR		
Person-related	F312	Train, teach, instruct, educate	F312=1	OR	F301=1	
	F315	Hosting, accommodating, preparing meals	F315=1	OR		
	F316	Care, nurture, heal	F316=1	OR		

Notes: Own translation. The classification of a respondent to a certain task type is based on the assigned variables listed. This means that the assignment is made as soon as one (reference to operator OR) of these variables has been answered with “frequently” (=1) or yes (=1) and the inclusion criterion has thus been met. The assignment is excluded as soon as an exclusion criterion is fulfilled.

Source: BIBB/BAuA-ETB 2018 and 2012. Own calculations.

Table 23: *Decomposition of variable ADM knowledge*

ADM knowledge	Variable	Question	Inclusion criterion	Operator (Inclusion)
Basic		Please tell me how often these activities occur in your work, whether frequently (1), sometimes (2), or never (3):		
	F313	Collecting information, researching, documenting	F313=1	AND
	F318	Working with computers	F318=1	AND
		For each area, please say whether you need this knowledge in your current job as <...> and, if so, whether basic (2) or advanced (3).		
	F403_04	Knowledge in the field of mathematics, specialized arithmetic, statistics	F403_04=3	AND
Advanced				
	F403_06	Knowledge of PC application programs	F403_06=3	AND
		Please tell me how often these activities occur in your work, whether frequently (1), sometimes (2), or never (3):		
	F313	Collecting information, researching, documenting	F313=1	AND
	F318	Working with computers	F318=1	AND
		For each area, please say whether you need this knowledge in your current job as <...> and, if so, whether basic (2) or advanced (3).		
	F403_04	Knowledge in the field of mathematics, specialized arithmetic, statistics	F403_04=3	AND
	F403_06	Knowledge of PC application programs	F403_06=3	AND
	F324	Do you use computers exclusively as a user (1) or does your usage go beyond simple application (2)?	F324=2	AND

Notes: Own translation. The classification of a respondent to a certain ADM knowledge type is based on the assigned variables listed. This means that the assignment is made if all (reference to operator AND) of these variables have been answered with the inclusion criterion listed above. The only difference between Basic and Advanced is the additional inclusion of the variable F324 in the latter.

Source: BIBB/BAuA-ETB 2018 and 2012. Own calculations.

Table 24: *Decomposition of variable changes in work environment*

Variable	Question
	Now please tell me if the following changes have been made in your <immediate work environment> in the last two years.
F1001_01	New manufacturing or process technologies
F1001_02	New computer programs
F1001_03	New machinery or equipment
F1001_04	New or considerably modified products or materials
F1001_05	New or considerably changed services
F1001_06	Has there been any considerable restructuring or reorganization that affected your immediate work environment?

Notes: Own translation. The variable changes in work environments are based on six selected variables, which assign an index value of 0 to 100 to the observations depending on their characteristics. The assigned variables are all answered with yes, no, do not know, or not stated. The latter two are omitted from the analysis. Consequently, the index value 100 (or 0) is assigned if all questions are answered with yes (or no). The specification of the variable describes three levels: low (index value 0–33), middle (34–66), and high (67–100).

Source: BIBB/BAuA-ETB 2018 and 2012. Own calculations.

Table 25: Detailed summary statistics of Autonomy Index, 2018

Service Sector	Autonomy Index		Task Autonomy		Method Autonomy		Criteria Autonomy		Scheduling Autonomy		Working Time Autonomy		Locational Autonomy		Interactional Autonomy																									
	Min	p25	p50	75	Max	Min	p25	p50	75	Max	Min	p25	p50	75	Max	Min	p25	p50	75	Max																				
12	42	50	57	80	6	39	50	61	87	3	33	47	64	87	12	34	47	67	94	13	40	48	60	86	4	36	59	73	73	19	19	28	74	94	9	45	53	65	84	
Branch																																								
G)	17	41	47	53	78	6	37	46	58	87	3	31	40	53	87	12	36	54	75	94	13	38	48	59	86	5	45	50	59	73	19	19	28	94	9	45	57	70	84	
	12	37	44	51	78	6	32	43	53	84	3	25	34	52	87	12	30	47	67	94	13	40	49	62	86	4	31	46	59	73	19	19	28	94	9	45	57	67	84	
	21	37	49	64	63	8	35	47	56	87	3	25	34	53	87	12	28	47	67	94	13	35	48	59	86	4	23	32	46	73	19	19	28	94	9	41	57	70	84	
	23	52	59	64	79	8	45	57	66	87	13	45	59	79	87	12	34	47	66	94	14	48	59	66	85	5	58	63	73	73	19	28	74	91	94	9	45	57	70	84
	25	47	54	60	80	11	40	51	61	87	11	33	47	59	87	12	30	47	62	94	13	48	49	65	86	9	59	73	73	73	19	28	28	85	94	9	45	57	70	84
L)	38	47	55	61	78	11	40	51	61	87	14	40	53	68	87	12	39	56	75	94	23	48	49	60	85	9	58	63	73	73	19	28	28	85	94	11	45	57	67	84
	19	51	56	62	78	8	45	55	65	87	3	45	59	68	87	12	30	47	66	94	14	50	60	86	4	59	73	73	73	19	28	74	85	94	9	45	57	70	84	
	20	42	47	54	72	6	36	46	55	87	3	25	34	53	87	12	38	57	77	94	13	48	52	66	86	4	56	58	63	73	19	19	28	94	9	45	57	67	84	
	22	44	51	56	80	6	38	48	58	87	3	34	47	64	87	12	36	49	67	94	13	48	48	60	86	4	58	73	73	73	19	19	28	28	94	9	45	57	66	84
	23	50	56	61	80	6	40	50	59	69	87	5	45	59	68	87	12	34	49	67	94	13	40	48	59	86	5	46	63	73	73	19	28	91	91	94	9	35	45	59
Q)	13	37	44	51	79	6	39	48	59	87	3	33	45	59	87	12	28	43	62	94	13	33	48	59	86	4	23	46	63	73	19	19	28	94	9	35	45	59	84	
	26	41	47	55	75	11	38	47	64	82	3	33	47	67	87	12	38	56	75	94	13	42	49	62	86	4	23	32	58	73	19	19	28	85	94	9	45	57	67	84
	26	45	53	59	79	6	40	53	65	87	3	34	47	64	87	12	38	52	68	94	13	48	56	60	85	5	46	59	73	73	19	19	28	74	94	9	45	57	67	84
	Task type																																							
	Management	13	42	49	56	80	6	43	53	64	87	3	34	52	67	87	12	28	43	62	94	13	41	48	59	86	4	32	50	73	73	19	19	28	85	94	9	35	45	59
Information-related		12	45	52	59	80	6	37	47	59	87	3	33	45	59	87	12	38	54	74	94	13	48	50	65	86	4	46	63	73	73	19	19	28	74	94	9	46	60	70
	Object-related	12	41	48	55	79	6	34	45	54	87	3	25	40	53	87	12	36	54	74	94	13	41	50	66	86	4	45	58	73	73	19	19	28	94	9	46	60	70	84
Person-related		18	40	47	55	80	8	40	51	63	87	3	34	47	64	87	12	28	45	64	94	13	33	48	59	86	4	32	50	73	73	19	19	28	85	94	9	39	45	59
	Educational attainment																																							
Who voc. qualif.	22	38	46	53	77	6	35	46	54	84	3	25	34	53	87	12	34	54	75	94	13	38	49	65	86	4	32	46	59	73	19	19	28	94	9	45	59	70	84	
	Vocational training	12	40	47	54	78	6	36	47	58	87	3	33	45	59	87	12	34	49	67	94	13	40	48	60	86	4	32	58	73	73	19	19	28	94	9	45	57	67	84
Upgrading training		19	43	49	56	79	8	39	51	61	87	3	33	47	60	87	12	28	47	62	94	13	42	48	60	86	4	45	59	73	73	19	19	28	74	94	9	39	47	59
	University	18	48	55	61	80	6	47	58	67	87	3	45	59	73	87	12	34	47	64	94	13	48	48	60	86	4	46	63	73	73	19	28	7	91	94	9	39	46	59

Frequency of making difficult decisions																																								
Never	18	41	49	57	80	6	43	53	64	87	3	45	59	68	87	12	28	41	60	94	13	40	48	59	86	4	32	58	73	73	19	19	28	85	94	9	35	45	57	84
Sometimes	12	43	50	57	79	6	38	50	59	87	3	33	45	59	87	12	36	53	67	94	13	41	49	60	86	4	45	59	73	73	19	19	28	85	94	9	45	57	70	84
Frequently	17	42	49	56	80	6	33	42	53	87	3	23	33	45	87	12	43	64	83	94	13	41	52	66	86	4	45	59	73	73	19	19	28	28	94	9	57	67	78	84

Source: BIBB/BAuA-ETB 2018 and 2012. Own calculations.

Table 26: Detailed summary statistics of Autonomy Index (w/o Loc), 2018 and 2012

	Autonomy Index (w/o Loc)		Task Autonomy		Method Autonomy		Criteria Autonomy		Scheduling Autonomy		Working Time Autonomy		Interactional Autonomy																						
	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max	Min/p25/p50/p75/Max																						
2018	11	44	51	58	84	6	39	50	61	87	3	33	47	64	87	12	34	47	67	94	13	40	48	60	86	4	36	59	73	73	9	45	53	65	84
2012	17	45	51	58	82	7	40	51	61	87	4	37	49	63	90	12	30	47	67	94	12	40	48	59	86	4	35	60	74	74	8	44	53	65	84

Source: BIBB/BAuA-ETB 2018 and 2012. Own calculations.

Appendix | Part III

Figure 20: Translated interview guideline for context interviews

Guideline for context interviews

Central question of the interview:

The overarching question of this interview is to what extent workers' job autonomy is affected by the use of technical systems of algorithmic decision-making and execution.

What does "job autonomy" mean?

The term "job autonomy" describes all the scope for action and decision-making that workers have in carrying out their work. Exemplary questions are: Can you decide for yourself how a task is to be performed? Can you decide for yourself how quickly these tasks are completed?

Why is it important to deal with job autonomy?

Descriptions of the scope for action and decision-making at work can help to assess what consequences the use of technical systems has for workers. The focus is on the subjective perception of workers' job autonomy. Different forms of job autonomy can provide information about how stressful and intensive work is perceived to be or which motivating and meaningful moments may be released at work.

What are "context interviews"?

The context interviews with executives, IT managers, and work councils serve the purpose of assessing the organizational and technical embedding of algorithmic systems in companies. They form the basic prerequisite for the downstream employee interviews and are intended to map the employee-, employer-, and IT-related perspectives on the technical system to obtain as holistic a picture as possible of how it is perceived in the company. The interviews thus also serve to contextualize the content of the employee interviews.

Block I: Functions of the technical system in the company

- Please describe the functions and places of use of the system in your company.
- What technical support did you use before the introduction of the system, and/or can you describe the non-technical work setting?
- From your point of view, with what objectives was the system introduced in the company?
- What are the advantages (disadvantages) of using the system for the company from your perspective?

Block II: Efforts caused by the system

- What efforts were involved in the implementation and maintenance of the system for your company?
- What technical and organizational hurdles (simplifications) does the system entail?
- With which other technical systems is the algorithmic system networked in your company?
- What data is necessary for the system to function?
- How and by whom is the collected data used?
- How do you assess the functioning of the system?

Block III: Work organization

- Can you describe how the system influences the distribution and planning of work tasks?
- To what extent does the system influence information, communication flows, and cooperation in the company?
- In what way does the system influence the organization of working time and place?
- Does the system set specific work and performance targets? What are they, and who sets them in advance?

Block IV: Influence on employees

- In your view, to what extent has the work of employees changed as a result of using the system?
- Which aspects of employees' work do you consider to be more self-determined (limited) as a result of using the system?
- To what extent do you consider the system to be a relief (burden) for employees?
- What other organizational, social, or economic aspects have an influence on the company apart from the use of technology/digitalization?

Personal information (optional)

- In which year were you born?
- What educational/vocational training have you completed?
- What is your position in the company? / What is your relationship to the company?

- How many hours a week do you work on average?
- How long have you been working in this profession and for this company?

Figure 21: Translated interview guideline for employee interviews

Guideline for employee interviews

Central question of the interview:

The overarching question of this interview is to what extent workers' job autonomy is affected by the use of technical systems of algorithmic decision-making and execution.

What does "job autonomy" mean?

The term "job autonomy" describes all the scope for action and decision-making that workers have in carrying out their work. Exemplary questions are: Can you decide for yourself how a task is to be performed? Can you decide for yourself how quickly these tasks are completed?

Why is it important to deal with job autonomy?

Descriptions of the scope for action and decision-making at work can help to assess what consequences the use of technical systems has for workers. The focus is on the subjective perception of workers' job autonomy. Different forms of job autonomy can provide information about how stressful and intensive work is perceived to be or which motivating and meaningful moments may be released at work.

Block I: Subjective perception of the technical system in everyday work

First of all, it is important for me to learn more about your everyday working routine and how you deal with the system.

- Can you describe your "typical" working day? Situations in which you deal with the system are important here.
- Please explain in a "before and after" view how your work has changed overall since the introduction of the system?
- How do you evaluate the functioning of the system in your everyday work?
- In your opinion, what goals are being pursued with the use of the system?

Block II: Influence on autonomy dimensions

I would now like to know more about how your work has changed in detail through the use of the system. This concerns particular areas in which you

yourself determine the planning and execution of your work and situations in which the system influences your work. The following questions, therefore, always refer to situations in which the system influences your work. We start by looking at what tasks you carry out and how you carry them out.

[Task Autonomy]:

- Can you describe the ways in which the use of the system influences exactly what tasks you perform?
- Does the system influence whether you have all the information you need to do your job?
- To what extent does the use of the system change the amount of work you do?

[Method Autonomy]:

- Can you describe the extent to which you can determine the way (i.e., procedure, method) in which your tasks are performed?
- In which situations does the system give you advice or recommendations on how to do your work?
- Also, can you describe situations where you deviate from the guidance you are given?
- Do you learn anything new when using the system?

Now it is a question of how your work results are evaluated and to what extent you can set and pursue your work goals yourself. It is particularly important what influence the system has on your work goals and assessment of work results.

[Criteria Autonomy]:

- What criteria do you use to evaluate whether you have done your own work well?
- In what way does the system influence these “criteria”?
- To what extent does the system give you certain work or performance goals?
- Are there also situations in which you rely on the system? What are they?

The next questions refer to time- and place-related components of your work, for example, to what extent you determine when, how fast, or where you work. Again, this is about whether the system influences your freedom of choice.

[Scheduling Autonomy]:

- In which situations does the system influence the order or priority in which you complete tasks?
- To what extent can you determine for yourself how quickly you work?
- Can you decide for yourself when to take breaks?
- In what ways does the system influence how you deal with unpredictable situations or interruptions at work?

[Working Time Autonomy]:

- To what extent does the system influence when you start and finish work, and how many hours do you work in total?
- Has there been any change in the need to cover for colleagues and in general in the way you can plan your working hours? Can you describe the aspects in more detail?

[Locational Autonomy]:

- Please describe how the system influences where you do your work. This can include work commutes, time spent at the company site, work travel, or client/client premises.
- Has the use of the system changed anything in the relationship between time spent at work, on the road, or at home?

Now the question is to what extent the cooperation with or relationships with other people in your work environment have changed. These people can be your colleagues and supervisors in the company or the service recipients.

[Interactional Autonomy]:

- Can you describe what aspects of your cooperation with your colleagues or supervisors have changed since you started using the system?
- Can you describe situations where the system influences who you work with, either within the organization or in relation to your clients?
- From your perspective, does your relationship with your clients change as a result of using the systems? In what way?

Block III: Overall assessment

The last questions are about your overall impression of working with the system.

- Do you perceive your work with the system as more self-determined (more restricted) overall?

- Which aspects of your work do you perceive as generally facilitated (more burdened)?
- Apart from the use of technology, which other organizational, economic, or private aspects have an impact on your work and sense of autonomy, i.e., your freedom of action and decision-making?

Personal information (optional)

Finally, I would like to ask you for some personal information. This information will, of course, be treated confidentially.

- In which year were you born?
- What schooling/vocational training have you completed?
- What is your position in the company?
- How many hours a week do you work on average?
- How long have you been working in this profession and for this company?

Figure 22: Translated interview guideline for expert interviews

Brainstorming template for expert interviews

“Algorithmic Decision-Making in Service Work.

An Analysis of Changing Job Autonomy”

= How does the autonomy of employees change as a result of AI use?

Why expert interviews?

Situate selected empirical study results in your field of expertise: From your perspective, what should be considered when using AI in the workplace?

Bottom line:

- Does it contribute to increasing social inequalities? To what extent?
- Can the use of tech contribute to reducing the workload of employees?

RESULTS

Case I | Outpatient care: “We all know how it shouldn’t be.”

The company example uses a hardware and software solution that moves administration, billing tasks, and work planning into the digital space. Tour planning is algorithm-driven. On tour, care documentation is recorded by means of voice input, handovers, and performance and time recording on

networked tablets, via which there is also access to the tour plan and care-relevant information on the clients.

- +/- Accurate recording of working hours/services
- + Requirements of interaction work alleviated
- + Flexibilization of place/time
- + Time savings/reduction of admin. Efforts
- + Standardization/information access

Case II | Banking: “AI just needs to be taught intelligence.”

The company example uses a software solution that largely automates client selection and approaches for advisory activities. This recommendation system suggests clients to bank advisors who would be most likely to purchase a certain product. The probability calculation is based, in particular, on the clients’ transaction data and is intended to replace campaign-based approaches with more needs-oriented approaches.

- +/- Increasing the chances of success/pressure
- + Preservation of adaptable interaction work
- - Higher flexibility demands on advisors
- - Increase in the amount of work
- - Devaluation of experiential knowledge

Conditions for autonomy-promoting tech use:

- The objective of tech-use as a critical path (realization of economic efficiency, control, rationalization, or support?).
- Technical prerequisite: quality of results and functionality are decisive
- Use of technology/reliance on functionality only in combination with experiential knowledge
- (Non-)exploitation of performance-related employee data as an instrument of control
- Interaction work as the core of service work can still be individually shaped

Table 27: *Specification of interviews conducted*

No.	Interview type	Interviewee/field of expertise	Day	Recording
#1	Context	Executive, company I	14.10.22	1:31:14
#2	Context	Care manager, company I	14.10.22	1:39:00
#3	Context	Technology provider, company I <i>[online]</i>	21.10.22	0:55:21
#4	Employee	Care manager, company I <i>[online]</i>	28.10.22	0:50:17
#5	Employee	Care professional, company I	09.11.22	1:18:45
#6	Employee	Care assistant, company I	09.11.22	0:37:11
#7	Employee	Care professional, company I	10.11.22	0:57:31
#8	Employee	Care professional, company I	10.11.22	1:01:32
#9	Context	Employee representative, company II	20.04.23	1:42:31
#10	Context	Middle management, company II	20.04.23	1:05:21
#11	Context	Middle management, sales, company II	25.05.23	1:20:32
#12	Employee	Branch manager, bank advisor, company II	23.06.23	1:07:16
#13	Context	Technology expert, sales, company II	23.06.23	1:08:22
#14	Employee	Bank advisor, company II	11.07.23	1:13:32
#15	Employee	Bank advisor, company II <i>[online]</i>	18.07.23	0:47:30
#16	Employee	Bank advisor, company II <i>[online]</i>	24.07.23	0:53:35
#17	Expert	Public policy, regulation <i>[online]</i>	22.06.23	0:48:09
#18	Expert	Occupational safety, standardization <i>[online]</i>	26.06.23	0:55:39
#19	Expert	Research funding, care technologies <i>[online]</i>	27.06.23	0:54:44
#20	Expert	Labor law, employee participation <i>[online]</i>	10.07.23	0:54:33
				∅ 1:05:08
				Σ 21:42:35

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