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Article — Published Version

Levers of Control: Impact on Innovation

Journal of Corporate Accounting & Finance

Provided in Cooperation with:

John Wiley & Sons

Suggested Citation: Letmathe, Peter; Meyer, Christian (2025) : Levers of Control: Impact on Innovation, Journal of Corporate Accounting & Finance, ISSN 1097-0053, Wiley, Hoboken, NJ, Vol. 37, Iss. 1, pp. 113-132,
<https://doi.org/10.1002/jcaf.70000>

This Version is available at:

<https://hdl.handle.net/10419/335585>

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RESEARCH ARTICLE OPEN ACCESS

Levers of Control: Impact on Innovation

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Correspondence: Peter Letmathe (peter.letmathe@rwth-aachen.de)**Funding:** The authors received no specific funding for this work.**Keywords:** absorptive capacity | innovation performance | knowledge management | levers of control | management control systems

ABSTRACT

Using structural equation modeling, our study provides evidence for the effects of management control systems on innovation performance and knowledge acquisition within organizations. Our proposed model separates (1) dyadic management controls (“one-to-one”) from (2) polyvalent management controls (“one-to-team”). Within the presented framework, an organization’s manager can increase innovation performance on a dyadic level and can stimulate knowledge acquisition on a polyvalent team level. The analyses are based on data collected via an online questionnaire completed by 122 top managers worldwide. Our study shows that knowledge management and management control systems can complement each other. In our case, this is achieved by adapting an absorptive capacity framework. Furthermore, a manager’s action can directly affect innovation performance. Managers can make use of the levers of management controls system to steer this effect. Regulative actions by the management are more effective on the individual level with regard to improving innovation performance. Moreover, knowledge acquisition is effectively influenced due to encouraging actions on a polyvalent level. Practical implications indicate that managers need to be aware of both the direct and indirect impact of their actions on innovation performance, be it on a direct dyadic level or an indirect polyvalent level.

1 | Introduction

The following study introduces a combined concept of knowledge management and management control systems for increasing innovation performance (later also referred to as INNPERF) by providing more controls to the manager. Management control systems are essential for managers if the latter are to understand and improve their decision making (Otley 1999). Furthermore, management control systems allow managers to improve their organizational patterns that are based on different information and steering levers (Simons 1994a). There is a wide range of studies on performance (later also referred to as PERF) measures in management control systems (e.g., Ittner and Larcker (1998), Otley (1999), or Widener (2007)). However, results on how management control systems affect knowledge and innovation management are rare in the management accounting literature. Hence, this paper investigates how the use of management

control systems can influence knowledge absorption and innovation performance. This study’s contribution is to detect the relationships between knowledge management and management control systems with their respective impacts on innovation performance.

In this study, we use management control systems to understand the interactions between organizational knowledge, management and its effects on innovation in an organization. For this purpose, we apply quantitative data analysis by using structural equation modeling in the context of accounting and management, knowledge management, and performance measurement.

One well-accepted management control system, namely the levers of control, established by Simons (1994a), is based on small-scale qualitative management surveys. The system was extended

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and verified on an empirical scale by Widener (2007). Because of its richness regarding the managerial application, the levers of control system is used in our study.

Previous studies found weak direct relations between the levers of control and performance (Widener 2007; Luft and Shields 2006). Hence, more insights are necessary to more sufficiently describe drivers of innovation performance with regard to these controls and to knowledge management. Therefore, we use the broadly accepted model of “absorptive capacity” to better explain the relation between Simons’ levers of control and performance.

Cohen and Levinthal (1990) developed a basis for knowledge management and introduced the above mentioned concept of absorptive capacity. In study, we utilize a reconceptualized construct of absorptive capacity with dynamic capabilities, which was created by Zahra and George (2002). Their model distinguishes between potential and realized knowledge. The model was researched and validated empirically by Leal-Rodriguez et al. (2014). Based on our findings, the levers of control framework and the absorptive capacity model are applicable within a single framework.

The management style behind the levers of control is a mix of give-and-take. Two of the four levers (beliefs system and interactive control system) activate and enable employees on the one hand. On the other hand, with the other two levers (boundary system and diagnostic control system), a manager can constrain employees from achieving set goals. Therefore, Simons’ levers can be divided into enabling (positive controls) and constraining (negative controls) ones. Nevertheless, it has not yet been researched how the levers of control interact with knowledge management and innovation performance in a unified framework.

Management controls have been mentioned (Widener 2007) and proven to boost innovation efforts (Bisbe and Malagueño 2009; Tekavčič et al. 2011); most recently in a qualitative study by Barros and Ferreira (2022). The role of organizational knowledge components in such unified management control framework is hinted by Widener (2007). A quantitative study by Salehi (2023) confirmed the positive effects between absorptive capacity (knowledge component) and the levers of control. To summarize the context, recent research has found effects between:

- (A) knowledge management and (C) levers of control (Salehi 2023) and
- (B) innovation efforts and (C) levers of control (Barros and Ferreira 2022)

A combination of all three frameworks (A, B, and C) above is a valid approach to form a holistic view on knowledge, innovation and management controls. A combined framework can explain how managers can utilize the levers of control concept to expand absorptive capacity, thus allowing them to structure innovation efforts in a targeted manner. The term “innovation efforts” is very vast and will be outlined in a later following section. Our research approach can be added to the list above by finding the effects between:

- (A) knowledge management, (B) innovation efforts, and (C) levers of control

The specific effect of such unification is yet missing in the research landscape.

Based on recent research results (Barros and Ferreira 2022; Salehi 2023, a combination of the levers of control, absorptive capacity (knowledge components) and innovation efforts, fills the research gap regarding managerial controls in a unified and empirically researched framework of knowledge management and innovation efforts. Therefore, our research can be described as a more unified and innovation guided research approach in the levers of control context. Hence, our study addresses the following research question:

How do the levers of control affect potential and realized absorptive capacity in terms of innovation and organizational performance?

With a random sample of 122 managers, we answer our research question using a factor analysis followed by structural equation modeling to reveal correlations between the levers of control, absorptive capacity and innovation performance.

Based on our findings, we derive a mechanism to steer knowledge management and innovation performance. We show that the levers of control work on a manager-to-team and on a manager-to-one level with effects on knowledge acquisition and innovation performance. The results have implications about why innovation or knowledge transfer sometimes fails from a management perspective. Since little is known about absorptive capacity’s managerial role, our results provide new insights into the enabling of knowledge acquisition and assimilation by management.

The enabling levers of control are interactive control systems and beliefs systems (Simons 1994a). Both positively influence the potential absorptive capacity on a general non-individual level. The constraining levers are boundary systems and diagnostic control systems. They affect innovation performance via an individual level.

In our study, we adapt Simons’ levers of control framework by using new constructs that provide information about the individual perspective (we choose to refer to this as a “micronostic” control system, later also referred to as MICRO) and the organizational perspective (a “macronostic” control system, later also referred to as MACRO) on employees. The macronostic construct positively affects the potential absorptive capacity, whereas the micronostic construct shows positive influences on the innovation performance of an organization.

2 | Conceptual and Theoretical Framework

To answer the research question of how the models of levers of control and absorptive capacity interact step-by-step, we develop a model that combines the concepts of knowledge management theory and management control systems based on the existing

literature. The established and well-accepted concepts of Widener (2007) for the levers of control, Zahra and George (2002) for absorptive capacity and Mankin (2007) for innovation controls are used as the base layers of our research. As previously mentioned, the idea of these concepts is not new and has been further explored by other studies in recent years with now established underlying baseline quantitative and qualitative research. Still, to co-process these research developments and create a truly unified framework, our study needs to build on the initial and validated ideas of their most-accepted pioneers to avoid the risk of an incorrect theoretical alignment by implementing a sub-stream of these theories since the research goal is to combine the main streamlines of these theories. The academical challenge in the following study can be found in the hurdle of creating a leveled and quantifiable framework while maintaining the original idea of the concept. This is solved with the use of long-standing and validated constructs of the mentioned prominent researchers. The risk of empirically invalid constructs while connecting these can be lowered and we are able to focus on filling the gaps between the frameworks. With focusing on connecting the roots of these frameworks, the core literature used will, overall, be slightly older.

The levers of control framework equip managers with levers that allow them to pursue strategic goals at the operational level, whereas the absorptive capacity reflects a knowledge management process (Simons 1994a; Zahra and George 2002). This chapter introduces both of the concepts and describes where they overlap. The model of Widener (2007) is applied, since her study provides empirically validated scales for measuring Simons' levers of control. Similarly, Zahra and George (2002) also adapted the concept of absorptive capacity so that it could be used empirically (Jansen et al. 2005). By including these constructs, we are able to create a model that combines both frameworks.

The levers of control are sectioned into *enabling* and *constraining* dimensions (Simons 1994a). The model consists of four levers, which the manager controls and steers (Simons 1994a). The (1) *boundary system* (BNDR) sets up limits and rules. The (2) *diagnostic control system* (DCS) is used to provide a formal feedback system and to monitor organizational outcomes. Together these systems form the *constraining* side of the system. On the *enabling* side, the (3) *interactive control system* (ICS) actively involves managers by focusing their attention, encouraging more dialog, and creating learning experiences. Lastly, the (4) *beliefs system* (BLFS) is used to establish fundamental values, direction, and purpose. Using these levers, managers can perform their daily management routines more mindfully.

We aim to research the relations between management control systems and knowledge management. Therefore, it is essential to understand how knowledge is handled within an organization and why it deserves attention in the levers of control framework.

Widener implemented the role of knowledge in the levers of control framework with the item "Diffusion of knowledge" under the construct "Strategic uncertainties" (Widener 2007, 770). This item had a high (significant) effect in the model of Widener. It highlights the importance of knowledge components when

studying management control systems. According to Simons (1994a), learning is a key purpose of interactive controls. In this context we step up from the approach of Widener (2007) and extend this model using a knowledge framework that explains the knowledge absorption process (learning) within an organization further. In this context, we use the well-accepted model of absorptive capacity based on the idea of Cohen and Levinthal (1990) since it forms a versatile concept to streamline knowledge input, throughput and output. The empirical model by Zahra and George (2002) is especially useful in our research. By using the concept of absorptive capacity for knowledge management, we gain insights into an organization's knowledge management and can derive possible connections to the levers of control for our integrated model. These knowledge components could also be called "knowledge controls" here.

As mentioned above, the widely accepted idea of absorptive capacity originated from Cohen and Levinthal (1990) and forms a foundation in the field of knowledge management (Zahra and George 2002). Absorptive capacity is defined as a framework of how an organization searches, acquires, and exploits external knowledge (Cohen and Levinthal 1990). Zahra and George (2002) found that the general concept of absorptive capacity needs more research in terms of dynamic capabilities and they offered a reconceptualization that fits the idea of researching the managerial actions in the process of knowledge management. The more detailed process of absorptive capacity by Zahra and George (2002) differentiates between *potential* (PACAP) and *realized* absorptive capacity (RACAP). The concept provides information about how an organization generates new knowledge. Therefore, external knowledge is first filtered into potential knowledge that would be useful for the organization. Following that, the potential knowledge is again refined toward its exploitability and transformability, and is then called "realized knowledge." This means that knowledge that has a potential value for the organization needs to be gathered first, then accessed, and then exploited (Zahra and George 2002). The process of their concept can be compared with a sponge that first absorbs water (potential absorptive capacity) and then releases it (realized absorptive capacity), thereby creating value.

Next, we explain how to connect the levers of control with the concept of absorptive capacity. The enabling levers stimulate the free discovery of knowledge potentials within the organization's beliefs system and promote interaction routines for the exchange and development of the knowledge base. Therefore, the enabling levers have an important function for improving potential knowledge. The constraining levers evaluate potential knowledge with respect to strategic fit and strategic goals, and thus limit its use through the implemented boundary systems. The diagnostic controls subject potential knowledge to a rigorous analysis with a view to possible performance effects. In this way, it is ensured that primarily knowledge that serves the achievement of strategic goals is exploited.

Furthermore, it is necessary to regard the general concept of absorptive capacity from two particular points of view (Jansen et al. 2005; Van den Bosch et al. 2003). In the form of an organizational, polyvalent managerial influence (macro-perspective) and an individual, dyadic influence (micro-perspective) approach. While the macro-perspective takes the view of the management

level, the micro-perspective takes the view of the “normal” employee without senior management responsibility. In this vein, we assess the knowledge management model on two levels. By creating two constructs for the organizational level (a “macronostic” control system) and the individual level (a “micronostic” control system), it is possible to gain further insights. The macronostic control system includes how *managers* deal with their employees on a one-to-team level in terms of providing support and attention, and enabling them. As a counterpart, the *micronostic control system* can be understood as a “hands-on” measure on a one-to-one level. It scales autonomy and openness. For example, it measures how the *individual* employee receives support and is granted freedom in terms of ideas, projects, and innovation research by the organization. Therefore, micronostic controls can be understood as a dyadic instrument.

Widener (2007) mentions the role of innovation performance with a finding by Bisbe and Otley (2004) who state firms under high pressure to innovate are performing better when including interaction in management controls. Similar to the “knowledge controls,” “innovation controls” are integrated under the construct “Strategic uncertainties” in the study by Widener (2007, 770). This includes the factor of innovation on the levers of control but neglects the opportunity to measure the overall effect of the levers of control on the innovation performance. Therefore, more thought must be invested into the initial term of innovation efforts and innovation performance. These are similar questions but indicate different methodological procedures, especially for the levers of control framework. Instead of asking “What effects do our innovation efforts have on our management controls?” (innovation as an input, as used by Widener), the question is “What effects will our management controls have on our innovation performance?” (innovation as an output). This trivialized comparison of innovation as an input or output effect should highlight that innovation can be measured in different meanings and controls in organizations. To take on the initial idea of Bisbe and Otley (2004), managers might be interested in their possible direct and indirect effects on the innovation outcome of their organization (innovation performance). Hence, our study will focus on innovation as an output. Measuring innovation performance presents a challenging task since innovation performance (“innovation controls”) is an intangible effect until it contributes to the organizational performance. Therefore, we rely on a study by Mankin (2007) who reviewed different options to measure and create these “innovation controls.” Additionally, we added more items into the construct of innovation performance to a give better understanding into the organizational focus on innovation overall and prevent a bias from organizations with a relative strong innovation-drive.

Lastly, we conclude with the core components of our initial model. The *levers of control* provide guidance on a controlling level. The *absorptive capacity model* measures scales from a knowledge point of view. The *micronostic* and *macronostic control systems* allow us to link the levers of control with the model of absorptive capacity. By using the micronostic and macronostic control systems to scope perspective, two lenses of management influence effects are provided: a dyadic “one-to-one” management and a “one-to-team” management.

3 | Hypothesis Development

By combining the concept of absorptive capacity with the levers of control framework, we gain a better understanding of how to influence organizational and innovation performance.

Before developing our hypotheses, it is necessary to provide a general idea of how our controlling model interacts with a concept of knowledge management. The levers of control are divided into an enabling and a constraining part (Simons 1994a). These levers can be influenced by the actions that a manager takes.

Absorptive capacity is a four-dimensional and two-step process that starts by absorbing externally generated knowledge that could potentially be useful for the organization. In order for this to occur, the organization has to open up to new knowledge. In other words, before the process takes place, the knowledge-absorbing organization has to be enabled, and the activation pattern is similar to an opening mechanism that allows knowledge collection. The so-called potential absorptive capacity provides information about the identification and acquisition of externally generated knowledge by enabling an acquisition and assimilation process (Zahra and George 2002).

The levers of controls can play a positive role in this process, as they can influence the *enabling dimensions of the potential absorptive capacity*. While the belief system encourages organizational learning, the interactive control system is used to scan the external environment (Widener 2007).

To ensure that the effects are framed in the correct context, we introduce the macronostic control system as a management lens for approaching a team as a whole. Gathering new knowledge is a team-wide task. Thereby, the team as a whole has to be enabled to gather new knowledge. The macronostic control system includes enabling, supporting, and attention scales, and thereby aims to create a team-focused connection between potential absorptive capacity and the enabling levers of control. For our model, this results in connecting the enabling levers of control with the potential absorptive capacity. Hence, we derive our first two-part hypothesis:

Hypothesis 1A. *The interactive control system has a positive effect on the potential absorptive capacity by approaching the macronostic control system.*

Hypothesis 1B. *The beliefs system has a positive effect on the potential absorptive capacity by approaching the macronostic control system.*

The constraining levers act as a brake and a filter for the organization (Simons 1994a). In this vein, the boundary system creates explicit limits for areas of knowledge that should be avoided (Widener 2007). In addition, the diagnostic control system provides a formal feedback system and may affect consequences, suggested by the formal management (Chenhall 2006). Both levers lead to a mechanism of asking what is necessary to create value (Widener 2007) and how to increase performance. Hence, one could easily derive that the micronostic control system adapts

to the realization process of the absorptive capacity model. In this context, critical reflection between employee and manager should benefit the innovation performance, since context-specific knowledge can be applied more clearly in a one-to-one dialog. The outcome is a more goal-specific process that selects the previously realized knowledge and adjusts it to organizational contexts. Thereby, the manager is individually sharpening the innovation process (the “how”) and adjusts the relevant necessary knowledge (the “what”). Kostopoulos et al. (2011) state that the absorptive capacity links to innovation performance by being a toolbox in gathering new external knowledge but also translating the knowledge into innovation activity. However, it is essential to understand that an organization’s innovation performance is affected by far more than just its knowledge exploitation. Surprisingly, only a few studies in the field of absorptive capacity and innovation performance focus on direct effects of selecting and sharpening knowledge and then translating it into innovation activity at innovation performance from a management point of view that includes employee involvement. How and whether employees are involved in decision making can lead to substantial performance differences (Lund Vinding 2006; Rangus and Slavec 2017). As most studies do not fully include innovation performance or omit the management focus (Fosfuri and Tribó 2008; Kostopoulos et al. 2011; Chen et al. 2009; Tseng et al. 2011), none of them include the more detailed absorptive capacity model of Zahra and George (2002) to gain insights into how the process is managerially steered. However, the mentioned studies found other direct effects on the innovation process, which are not directly linked to the knowledge management process. This means there are reasons why innovation performance might improve without relating to knowledge management. In other words, managing innovation performance is a balance of managing knowledge, individuals, and other factors. These additional direct and very individual effects can be achieved by, for example, involving even employees who are not related to the research and development area and thus positively influencing innovation performance (Van de Vrande et al. 2009).

The before-mentioned individual factor of an employee’s behavior will be included by introducing a micronostic control construct. We frame these direct effects within the micronostic control system. Previous research has already studied dimensions for individualism in the context of employees and their performance (Lund Vinding 2006; Rangus and Slavec 2017). Based on the research of these authors, we take the individual factors, such as employee involvement and support for an employee’s ideas, into account. This allows the construct “micronostic control system” to act as a scope between the innovation performance and the restraining levers of control (boundary system and diagnostic control system). Thus, the better and clearer both managerial levers define boundaries for a value range and diagnostics for objectives, such as KPIs, the better the individual support and autonomy, leading to a better innovation performance (Widener 2007).

The relation between the potential and realized absorptive capacity, known as “efficiency factor” has already been empirically validated but will be hypothesized again here, since we are integrating the model in a new and unvalidated context (Leal-Rodríguez et al. 2014). First, the constraining two levers “boundary system” and “diagnostic control system” ask what

is necessary to achieve a goal. Second, individual factors (the micronostic control system) influence innovation performance directly. By connecting the levers “interactive control system” and “beliefs system” with the micronostic control system, we can manage innovation performance by affecting individual factors. Stating this, we derive our second set of hypotheses:

Hypothesis 2A. *The boundary system has a positive effect on the innovation performance by strengthening the micronostic control system.*

Hypothesis 2B. *The diagnostic control system has a positive effect on the innovation performance by strengthening the micronostic control system.*

Hypothesis 2C. *The potential absorptive capacity has a positive effect on the realized absorptive capacity (efficiency factor).*

With this set of hypotheses, it is possible to consider combinations of the levers of control and absorptive capacity. However, our focus is to gain insights into the output effects of this interrelation. Thus, we include performance measures as well. Zahra and George (2002) and Meissara (2017) state that the realized absorptive capacity positively affects the innovation performance of an organization. To measure innovation performance, we rely on Mankin’s (2007) suggestions, who condensed multiple innovation scales and who evaluated which of these scales are most commonly used by managers. This leads us to our third and final set of hypotheses:

Hypothesis 3A. *The realized absorptive capacity has a positive effect on innovation performance.*

Hypothesis 3B. *The innovation performance has a positive effect on organizational performance.*

Lastly, we check the previous finding from Widener (2007) on the levers of control influencing each other.

Summarizing our hypotheses in Table 1, our initial research model, which is presented in Figure 1, can be stated.

4 | Methodology

In our research, we collect and investigate data from a survey sent to top managers worldwide who are listed in the “Amadeus” database of Bureau van Dijk. The following inclusion criteria were used to generate the set of potential participants. All criteria had to be fulfilled for a person to be selected:

- filter 1 (company): active companies worldwide with existing public financial data
- filter 2 (company): number of employees larger than 100 and lower than 251
- filter 3 (company): must list at least one public email-address
- filter 4 (person): persons must have role as CEO or manager or any role in the leaderboard of the company

TABLE 1 | Summary of hypotheses.

Hypotheses (Correlation)		
H1a	(+)	Interactive → Macronostic → Potential AC
H1b	(+)	Beliefs → Macronostic → Potential AC
H2a	(+)	Boundary → Micronostic → Inn. Perf.
H2b	(+)	Diagnostics → Micronostic → Inn. Perf.
H2c	(+)	Potential AC → Realized AC
H3a	(+)	Realized AC → Inn. Perf.
H3b	(+)	Inn. Perf. → Perf.

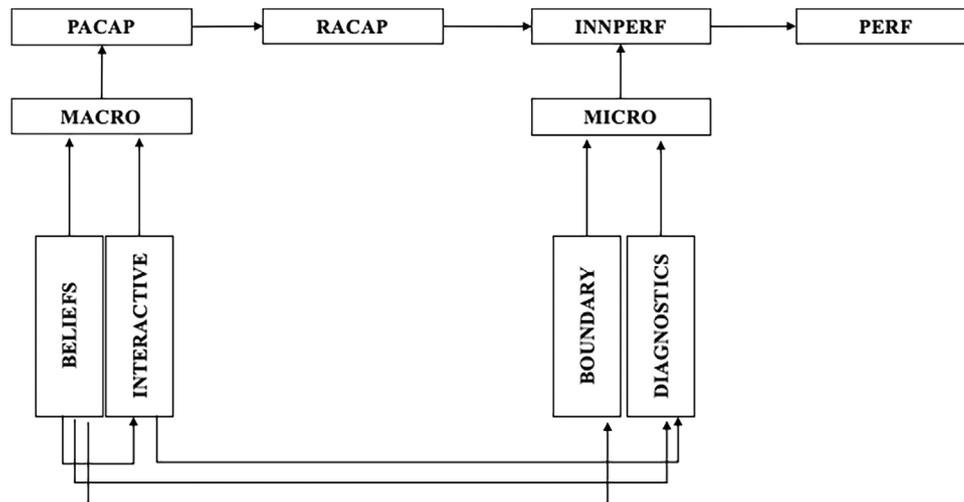


FIGURE 1 | Integrated initial model using macronostic and micronostic control systems.

Only managers from companies with a valid personal email address have been included in this study. We were able to use 122 surveys which were fully completed by individuals. This sample size is on level with the empirical study by Widener (2007). No restrictions on industries or other company-specific limitations were applied. Also, no restrictions on the number of the company’s sales were imposed, unlike the approach of Widener (2007). No evidence has been found that sample restrictions based on a company’s sales lead to a bias in the sample (Fullerton and McWatters 2002, 717).¹ For our research, all managers were integrated into our sample regardless of their company’s sales. By loosening the sample restrictions, the generalizability could be enhanced and widened. To justify the validity of the model, we used a random selection of managers to participate in our study.

To access managers all over the world, we chose to use an online survey. Before the survey was conducted, the items had been piloted with colleagues of ours who are researching in a similar area of interest, and, additionally, the items had been mutually checked by the authors. The internal pilot study revealed necessary adjustments in the wording of items. For example, the items by Leal-Rodríguez et al. (2014) were targeted for surveying project groups. Therefore, the wording had to be changed to “organizational unit.” Overall, the quality of clarity was improved by the pilot study.

The construction of our survey can be divided into four sections: management data, knowledge data, performance data, and general and sociodemographic data. For the management and knowledge section, we used already validated scales (Widener 2007; Jansen et al. 2005; Leal-Rodríguez et al. 2014). To provide a deeper understanding of individual and organizational behavior, we introduced two new control systems: a so-called “micronostic” and a “macronostic” control system. These include dimensions like “individual autonomy,” “openness,” and “received active support.” The macronostic control system was created to deliver results on the dimensions of an “organization’s effects on idea-generation,” “creative potential,” and “management attention.” In order to provide explanatory power within each of these dimensions the constructs were validated within our research.

The performance data include scales for “organizational performance” and “innovation performance,” which were tested for validity in our study (Widener 2007; Rhee et al. 2010; Mankin 2007). Since the core and general foundation of our model are the levers of control, we followed the empirical methodology of Widener (2007).

The full questionnaire can be found in Table D1 of the Appendix.

In order to prevent bias in data reduction, we set strict rules for handling our dataset. Only answers that have been turned

in within the 2-month survey window were examined. All uncompleted answers were excluded from our analysis to avoid calculating with missing values. After cutting our dataset from incomplete answers and answers without a variance (click-throughs with exactly the same answers to each question), 122 out of 213 completed surveys were used within our research. By excluding data records with missing values, a dataset on a rigor benchmark was maintained. A construct's item with an outer loading lower than 0.4 was removed from the construct in the case where the AVE or the CR was lower than 0.5 or 0.7, respectively (Hair et al. 2014).

To test the hypothesized relationships, a structural equation model analysis with the maximum-likelihood-method was conducted. A factor analysis supported the method in advance. We also conducted a partial least squares analysis to test the fit of our model. To test the robustness level, we decided to test three alternative trimmed models where more than one path had been deleted or altered.

We also ensured the model's validity by using a variety of control variables, like the organization's country, main operating country, "primary value focus" or job experience. The scale measures possible answers overweighting others due to location and thus creating a bias in our sample.

5 | Results

For analyzing the dataset, we used the Stata16 software, including the *condisc*, *plssem*, and *collin* packages to calculate a structural equation model. Our dataset includes 122 answers from managers worldwide. Total 49.19% of the managers asked are characterized by at least 10 years or more experience in their job, as presented in Table 2. Our dataset indicates that, even though the survey has been conducted worldwide, 82 (67.2%) of the managers' organizations have their headquarters in the United Kingdom, which is one of our study's limitations.

Each construct has been evaluated for its reliability and validity. All constructs' Cronbach's alphas are above 0.81, and all composite reliability (CR) measures are above 0.86, therefore, fulfilling internal consistency reliability. Two indicators (*v_88*, *v_32*) showed outer loadings of below 0.4 and, consequently, were removed (Hair et al. 2014). After this, 11 indicators had loadings of below 0.7 and higher than 0.4. In our case, the deletion of those indicators resulted in a higher CR and average variance extracted (AVE). All other indicators are significant on a level of 1% ($\alpha = 0.01$) and therefore reliable.

The only construct with an AVE lower than 0.5 is the potential absorptive capacity with a value of 0.4899. Since our construct was validated previously and the value is very near to the suggested 0.5 threshold, we are not hard-cutting the construct from our model (Aichholzer 2017; Hair et al. 2014). It reveals that more indicators could be necessary in future for the construct "potential absorptive capacity." By testing the cross-loadings (Hair et al. 2014) and the Fornell-Larcker criterion (Fornell and Larcker 1981), we found that all constructs are distinctive.

TABLE 2 | Descriptive statistics of sample.

Scale (Average)		
Organization's focus	Focus on...	
	...services	34.43%
	...products	27.05%
	...both	38.52%
Experience	Median (St. d.)	9 (10.854) yrs
	0–9 years	50.82%
	10–19 years	27.87%
	20–29 years	10.66%
	30–39 years	7.38%
	40–49 years	2.46%
	50 or more years	0.82%
Total number of management levels (hierarchy)	0	0
	1	1.64%
	2	15.57%
	3 or more	82.79%

TABLE 3 | Evaluation of the used structural model.

Variable	VIF	VIF (Square-root)	Tolerance
BELIEFS	3.05	1.75	0.3277
BOUNDARY	1.89	1.38	0.5289
ICS	2.85	1.69	0.3506
DIAGNOSTIC	2.91	1.71	0.3435
MICRO	3.97	1.99	0.2519
MACRO	4.60	2.15	0.2173
PACAP	3.76	1.94	0.2656
RACAP	3.28	1.81	0.3051
INNPREF	3.02	1.74	0.3308
PERF	1.36	1.16	0.7378

In the next step, we evaluated the relations between our constructs. All of our hypotheses were validated. No multicollinearity has been found, since the variance inflation factors are below 5.0, and the (multicollinearity) tolerances are above 0.2, as presented in Table 3 (Hair et al. 2014).

All path coefficients are significant at the 95%-level of significance with p-values lower than 0.005 or very close to zero. Their standardized coefficient (Std. coef.) values are presented in Figure 2. The endogenous construct's R-squared is only in one case lower than 0.36 for the construct "Performance" (R-squared \approx 0.12). The R-squared values are reported in Table 4. This is no surprise, due to the fact that an organization's performance is more than just an effect of its innovation performance. The effect size has been checked using a path and case sensitivity analysis depicted in

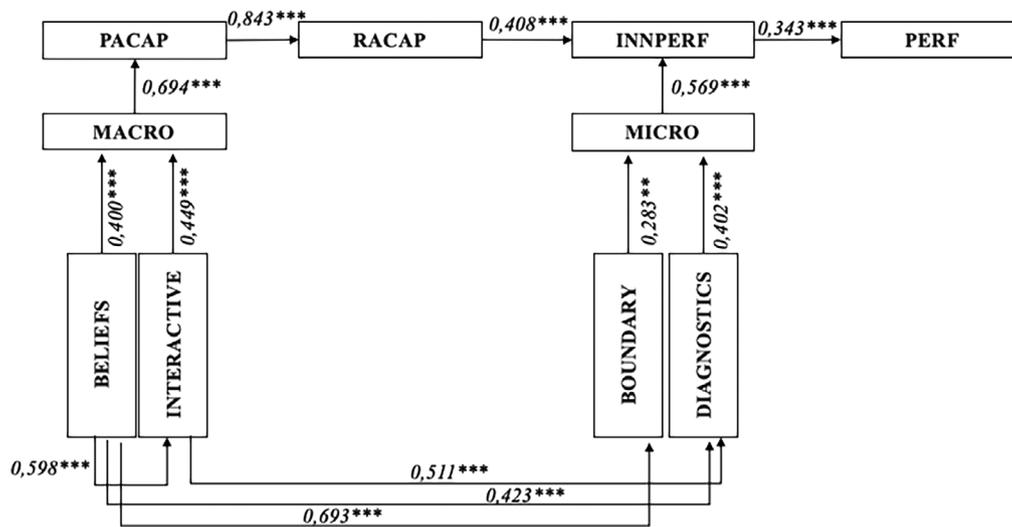


FIGURE 2 | Standardized path coefficients of the integrated model (** $p < 0.01$).

TABLE 4 | Evaluation of the used constructs.

Construct	AVE	CR	R-squared (adj.)	Cronbach's alpha
BLFS	0.7328	0.9163	[independent]	0.9168
BNDR	0.7161	0.9096	0.4807 (0.380)	0.9088
DCS	0.7260	0.9668	0.6976 (0.629)	0.9664
ICS	0.6238	0.8654	0.3570 (0.315)	0.8472
MACRO	0.7076	0.9053	0.5763 (0.485)	0.9027
MICRO	0.5665	0.8859	0.3566 (0.302)	0.8872
PACAP	0.5764	0.8628	0.4822 (0.493)	0.8181
RACAP	0.4899	0.8628	0.7102 (0.662)	0.8524
INNPERF	0.5354	0.9260	0.5957 (0.471)	0.9250
PERF	0.6675	0.8888	0.1174 (0.081)	0.8870

the Appendix (Tables B1 and C1). All constructs' paths are still significant when deleting a single path, and are thereby robust.

The analysis of the other trimmed models implies that our initially suggested model has the highest Comparative-Goodness-of-Fit-index (CFI) and the lowest Root-Mean-Square-Error-of-Approximation (RMSEA), which leads to the conclusion that it is the best alternative, as presented in Table A1 of the Appendix. The Chi-square value of 3226.266 with a p-value below 0.05 indicates that the general model is robust (Hair et al. 2014; Hooper et al. 2008). The Goodness-of-Fit value is 0.5 for the base model.

The results for the paths of the constructs ICS (Std. coef. = 0.449) and BLFS (Std. coef. = 0.400) through MACRO to PACAP (Std. coef. = 0.694) indicate a 95%-level significance. This means that the hypotheses H1a and H1b (enabling side of the model) are supported. On the restraining side of the model, BNDR (Std. coef. = 0.283) and DCS (Std. coef. = 0.402) via MICRO to INNPERF (Std. coef. = 0.569) each provide a significant path-correlation. As a result, the hypotheses H2a and H2b are supported. Given the analysis, there is a significant correlation between potential

(PACAP) and realized absorptive capacity (RACAP) with a standardized coefficient of 0.843 (efficiency score). Therefore, H2c can be accepted. Lastly, even though there is a low R-square, as explained before, the path from INNPERF to PERF (Std. coef. = 0.343) is significant and supports the hypothesis H3b.

Overall, we find two managerial paths in our general model, both confirming our initial hypotheses. The managerial enabling path, which affects the acquisition and assimilation of new knowledge within the organization, works only from a non-individual macro approach and therefore supports our hypotheses H1a and H1b. The second path is formed by the constraining levers of controls, which confirms the hypothesized effects on innovation performance, supporting our hypotheses H2a and H2b. To conclude, we observe that our presented model supports the hypotheses H2c, H3a, and H3b. Also, the presented model is stable and fits previous research findings (Widener 2007). Additionally, we found a mutual influence of the individual levers of control to each other, an influence which was stated by Widener (2007). For the hypotheses H2c, H3a, and H3b, the effects were successfully retested in the context of this study.

The levers of control take action in our model in two ways: first, the potential absorptive capacity is influenced by the enabling side of the levers of control (interactive control system and beliefs system) by having effects on the macronostic control system. The micronostic control system then has effects on the potential absorptive capacity. Second, the constraining levers of control (boundary system and diagnostic control system) have an impact on the macronostic control system, which directly affects innovation performance. Next, the managerial opportunities of these connections will be presented in the discussion.

6 | Discussion

Our results fit with the existing literature foreshadowing that relationships between knowledge management and control systems must exist. Van de Ven (1986) states that leadership is a mix of interaction and beliefs which influences how an organization considers “alternative ways of doing things” (Van de Ven 1986, 27). In our case, leadership can be compared with the managerial channel “macronostic control system,” which defines the management style.

Hence, the use of a management control system in a specific style can influence innovation performance (Kruis et al. 2016). With our findings, the managerial influence of such controls can be defined more precisely. In our model, this is done using the concept of absorptive capacity and its relation to innovation performance. The results of our research support Kahn (1996), who found a correlation between absorptive capacity and innovation performance, that is, organizations that manage and process knowledge well achieve a higher innovation performance.

The literature shows that general and unmeasured effects on innovation performance have been mentioned as being in existence before but have not yet been unified (Simons 1994b; Tekavčič et al. 2011). With our model, we show that the effects on innovation performance are likely driven by realized knowledge and the management of the individual employee’s behavior (micronostic control system).

Our findings provide new insights on how a manager can directly influence knowledge acquisition and assimilation. A short example clarifies the mechanism of the polyvalent relation from the restraining levers and innovation performance. In the given model, increased innovation performance is driven by rules, guidelines, and performance controls on an individual and one-to-one level. Although, the team is granted a credit of trust in the work, the manager sets limits individually, allowing for context-specific reactions aligned to the micronostic control system. The manager thereby gives as much freedom as possible and imposes as few limits as necessary. As a result, the overall freedom in creativity—and conclusively innovation performance—is enhanced. The levers of control mechanisms are divided into enablers and constrainers in our model and generate effects on a non-individual (polyvalent) and individual management-to-employee (dyadic) level. We can state that an enabling effect can be triggered on a macro-level, affecting a whole team or organization, which influences its knowledge acquisition ability. On the other hand, a constraining mechanism

can only be used effectively on an individual level, resulting in direct effects on innovation performance.

Three aspects limit our interpretations. The first limitation may be the construct “potential absorptive capacity,” which had several deleted items. It could be necessary for future research to rethink the choice of items of this construct. The second limitation of our study, which occurs by the fact that the received answers are mostly from managers where the organization’s headquarter is located in the United Kingdom (67.2%), followed by Germany (10.6%) and the United States (4.9%). This may result in unknown biases due to a statistical skewness in the distribution of sampled countries. Assuming that the approached manager is working in the same country as the headquarters are, a language bias could be the reason. A person might be more willing to respond to a request written in their native language. Lastly, correlation does not automatically imply causality (*cum hoc ergo propter hoc*). There may be more and currently unknown underlying reasons for the stated correlations.

7 | Conclusions

The usage of levers of control as a steering mechanism for knowledge management and innovation performance is strongly supported by our model. Their behavior differs with regard to whether an individual or a group-management approach is adopted. A manager approaching innovation performance might want to find the right balance between enabling a team holistically and constraining its members individually.

Organizations can learn that their capability to acquire knowledge can be enabled and enhanced using the levers “interactive control systems” and “beliefs system.” The way in which management styles are applied makes a difference when it comes to knowledge management. A manager must be aware of approaching the controlling levers individually or in a group, depending on the strategic goal of the company.

Future research could repeat the study using a different management control system. Scholars may also repeat the study with qualitative in-depth interviews to investigate the underlying reasons that cause correlation. Future research can also adapt the given research toward different measures or soft performance items, since this study focuses on non-intrinsic measures. An example of soft performance items might be the individual level of job satisfaction as an intrinsic lever to organizational performance. In this vein, future studies may focus more on the employees’ perspective, since the presented research integrates answers from top managers only.

Acknowledgments

Open access funding enabled and organized by Projekt DEAL.

Ethics Statement

This study was conducted in accordance with ethical standards set by RWTH Aachen University.

Consent

This document includes research with human participants using an online survey. Informed consent was obtained from all participants at the start of their online survey with disclosure that the results would be published in a research study. No personal information was recorded during the survey.

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Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Endnotes

¹ Fullerton and McWatters (2002, 717) state that asking a manager “with annual sales in excess of \$2 billion about the overall practices in his or her company was problematic.” Thus, no further evidence is given to prove the argument, and this is likely caused by using the COMPUSTAT database. Since Widener (2007) found companies with less than \$2 million in sales to be representative, unlike Fullerton and McWatters (2002), it is worth researching whether this is the case for companies with sales that exceed \$2 billion as well.

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Appendix A: Alternative models

TABLE A1 | Testing alternative trimmed models with standardized path-coefficients.

Dependent variable (base model R-squared)	Independent variable	Base model Std. coefficient	Trimmed Model A Std. coefficient	Trimmed Model B Std. coefficient	Trimmed Model C Std. coefficient
RACAP (0.7101)					
	PACAP	0.843***	0.864***	0.831***	0.847***
INNPERF (0.5957)					
	RACAP	0.400***	0.699***	0.429***	0.698***
	MICRO	0.569***	—	0.585***	—
	BOUNDARY	—	−0.098	—	−0.102
	DCS	—	0.151*	—	0.145
PACAP (0.4822)					
	MACRO	0.694***	—	0.654***	—
	ICS	—	0.300***	—	0.367***
	BELIEFS	—	0.424***	—	0.435***
BOUNDARY (0.4806)					
	BELIEFS	0.693***	0.693***	—	—
DIAGNOSTIC (0.6976)					
	ICS	0.511***	0.511***	—	—
	BELIEFS	0.423***	0.422***	—	—
ICS (0.3570)					
	BELIEFS	0.598***	0.593***	—	—
MACRO (0.5763)					
	ICS	0.448***	—	0.468***	—
	BELIEFS	0.400***	—	0.518***	—
MICRO (0.3566)					
	BOUNDARY	0.283***	—	0.284***	—
	DIAGNOSTIC	0.402***	—	0.419***	—
PERF (0.1174)					
	INNPERF	0.343***	0.366***	0.319***	0.353***
	Model fit				
	χ^2	3226.266	3390.795	3456.722	3619.550
	RMSEA	0.089	0.094	0.096	0.100
	SRMR	0.142	0.241	0.288	0.317

(Continues)

TABLE A1 | (Continued)

Dependent variable (base model R-squared)	Independent variable	Base model Std. coefficient	Trimmed Model A Std. coefficient	Trimmed Model B Std. coefficient	Trimmed Model C Std. coefficient
	TLI	0.754	0.729	0.720	0.695
	CFI	0.764	0.740	0.731	0.707
	Model comparison indices				
	AIC	21635.954	21796.482	21858.409	22017.237
	BIC	22168.718	22323.638	22379.957	22533.177

*** $p < 0.01$; * $p < 0.10$.

Appendix B: Path-sensitivity test

TABLE B1 | Path-sensitivity test.

Deleted path (p value)	ICS→ PACAP (0.004)	BLFS→ PACAP (0.002)	MICRO→ PACAP (0.000)	BOUND→ RACAP (0.119)	PACAP→ RACAP (0.000)	DIAG→ MICRO (0.000)	DIAG→ MACRO (0.000)	MICRO→ INNP (0.000)	RACAP→ INNP (0.000)	INNP→ PERF (0.000)
ICS→ PACAP (0.004)	—	0.001	0	0.005	0.005	0.007	0.004	0.008	0.006	0
BLFS→ PACAP (0.002)	0	—	0	0.001	0.004	0.002	0.001	0.002	0.002	0.002
MACRO→ PACAP (0.000)	0	0	—	0	0	0	0	0	0	0
BOUN→ RACAP (0.119)	0.132	0.043	0.194	—	0	0.122	0.121	0.155	0.074	0.122
PACAP→ RACAP (0.000)	0	0	0	0	—	0	0	0	0	0
DIAG→ MICRO (0.000)	0	0	0	0	0	—	0	0	0	0
DIAG→ MACRO (0.000)	0	0	0	0	0	0	—	0	0	0
MICRO→ INNP (0.000)	0	0	0	0	0	0	0	—	0	0
RACAP→ INNP (0.000)	0	0	0	0	0.002	0	0.001	0	—	0.001
INNP→ PERF (0.000)	0	0	0	0	0	0	0	0	0.001	—
ICS→PACAP (0.004)	—	0.001	0	0.005	0.005	0.007	0.004	0.008	0.006	0
BELIEFS→ PACAP (0.002)	0	—	0	0.001	0.004	0.002	0.001	0.002	0.002	0.002
MACRO→ PACAP (0.000)	0	0	—	0	0	0	0	0	0	0
BOUND→ RACAP (0.119)	0.132	0.043	0.194	—	0	0.122	0.121	0.155	0.074	0.122

Appendix C: Case-sensitivity test

TABLE C1 | Case-sensitivity test.

Standardized Base Model													
Case-sensitivity p value	RACAP	INNPERF		PACAP	BOUNDARY	DIAGNOSTICS		ICS	MACRO		MICRO		PERF
	PACAP	RACAP	MICRO	MACRO	BELIEFS	ICS	BELIEFS	BELIEFS	ICS	BELIEFS	BOUN-DARY	DIAG-NOSTICS	INNPERF
RACAP	PACAP	—	0.831***	0.866***	0.817***	0.843***	0.843***	0.831***	0.841***	0.841***	0.843***	0.843***	0.842***
INNPERF	RACAP	0.361***	—	0.739***	0.416***	0.422***	0.411***	0.412***	0.410***	0.410***	0.412***	0.407***	0.399***
	MICRO	0.647***	0.785***	—	0.614***	0.559***	0.573***	0.566***	0.567***	0.574***	0.576***	0.576***	0.570***
PACAP	MACRO	0.656***	0.690***	0.712***	—	0.693***	0.695***	0.694***	0.656***	0.690***	0.686***	0.703***	0.694***
BOUNDARY	BELIEFS	0.693***	0.694***	0.694***	0.692***	—	0.691***	0.695***	0.694***	0.692***	0.693***	0.685***	0.693***
DIAG-NOSTICS	ICS	0.511***	0.511***	0.511***	0.511***	0.510***	—	0.796***	0.589***	0.501***	0.525***	0.508***	0.511***
	BELIEFS	0.423***	0.422***	0.423***	0.422***	0.425***	0.755***	—	0.511***	0.427***	0.399***	0.430***	0.423***
ICS	BELIEFS	0.598***	0.598***	0.598***	0.598***	0.598***	0.642***	0.655***	—	0.625***	0.633***	0.590***	0.598***
MACRO	ICS	0.448***	0.448***	0.449***	0.448***	0.449***	0.435***	0.459***	0.506***	—	0.717***	0.453***	0.449***
	BELIEFS	0.397***	0.401***	0.401***	0.387***	0.400***	0.409***	0.368***	0.467***	0.691***	—	0.398***	0.400***
MICRO	BOUNDARY	0.284***	0.291***	0.300***	0.283***	0.258**	0.287***	0.305***	0.294***	0.286***	0.280***	—	0.283***
	DIAGNOSTICS	0.403***	0.409***	0.393***	0.402***	0.455***	0.392***	0.392***	0.369***	0.398***	0.403***	0.547***	0.402***
PERF	INNPERF	0.330***	0.359***	0.366***	0.327***	0.333***	0.341***	0.340***	0.331***	0.341***	0.340***	0.341***	—
χ^2		3332.70	3242.93	3256.01	3209.44	3290.30 (1640)	3264.11	3252.67	3268.92	3248.06	3244.03	3225.79	3242.83
		(1640)	(1640)	(1640)	(1640)		(1640)	(1640)	(1640)	(1640)	(1640)	(1640)	(1640)
$p > \chi^2$		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix D: Survey

TABLE D1 | Survey items and descriptive statistics of survey results.

Survey item catalog					
Author	Variable	Section	Scaling	Descriptive results	
				Mean	Std. Dev.
1 Introduction					
Own	v_1	Number of employees in your organization	(1) Fewer than 10; (2) 10 to 49; (3) 50 to 249; (4) More than 250	<i>Descriptive results</i> • 1.64%—(1) Fewer than 10; • 10.66%—(2) 10 to 49; • 44.26%—(3) 50 to 249; • 43.44%—(4) More than 250	
Own	v_2	Number of management levels in your organization.	(1) 0; (2) 1; (3) 2; (4) 3 or more	<i>Descriptive results</i> • 0%—(1) 0; • 1.64%—(2) 1; • 15.57%—(3) 2; • 82.79%—(4) 3 or more	
Own	v_3	Your organization is focused on providing...	(1) Services; (2) Products; (3) Both	<i>Descriptive results</i> • 34.43%—(1) Services; • 27.05%—(2) Products; • 38.52%—(3) Both	

(Continues)

TABLE D1 | (Continued)

Own	v_4	How often is your organization investing resources for identifying and/or developing new ideas?	1 (never); 2 (very rarely); 3 (rarely); 4 (occasionally); 5 (often); 6 (very often); 7 (very frequently)	4.950819672	1.389764586
2 Beliefs and Boundary System					
2.1 Beliefs System					
		Please indicate the extent to which the following items describe your organization.	1 (to a small extent); 7 (to a large extent)		
Widener (2007, 785)	v_10	Our mission statement clearly communicates the firm's core values to our workforce.		5.360656	1.710761
Widener (2007, 785)	v_11	Top managers communicate core values to our workforce.		5.040984	1.618067
Widener (2007, 785)	v_12	Our workforce is aware of the firm's core value.		5	1.564059
Widener (2007, 785)	v_13	Our mission statement inspires our workforce.		4.393443	1.639176
2.2 Boundary System					
		Please rate the extent to which you agree or disagree with the following.	1 (strongly disagree); 7 (strongly agree)		
Widener (2007, 785)	v_5	Our firm relies on a code of business conduct to define appropriate behavior for our workforce.		5.606557	1.417467
Widener (2007, 785)	v_6	Our workforce is aware of the firm's code of business conduct.		5.295082	1.551797
Widener (2007, 785)	v_7	Our firm has a system that communicates to our workforce risks that should be avoided.		5.540984	1.438247
Widener (2007, 785)	v_8	Our code of business conduct informs our workforce about behaviors that are off.		5.565574	1.384613
3 Diagnostic Control System and Micronostic Control System					
3.1 Diagnostic Control System					
		Please rate the extent to which your top management team currently relies on performance measures (PM), or performance measurement system to...	1 (to a small extent); 7 (to a large extent)		
Widener (2007, 785)	v_15	... track progress towards goals.		5.221311	1.603263
Widener (2007, 785)	v_16	... monitor results.		5.434426	1.419974
Widener (2007, 785)	v_17	... compare outcomes to expectations.		5.147541	1.503011
Widener (2007, 785)	v_18	... review key measures		5.155738	1.504926
Widener (2007, 785)	v_19	... enable discussion in meetings of superiors. Subordinates and peers.		5.032787	1.563713
Widener (2007, 785)	v_20	... enable continual challenge and debate of underlying data, assumptions, and action plans.		4.680328	1.478588

(Continues)

TABLE D1 | (Continued)

Widener (2007, 785)	v_21	...provide a common view of the organization.	4.778689	1.534788
Widener (2007, 785)	v_22	...tie the organization together.	4.581967	1.604952
Widener (2007, 785)	v_23	...enable the organization to focus on common issues.	4.614754	1.566418
Widener (2007, 785)	v_24	...enable the organization to focus on critical success factors.	4.909836	1.558788
Widener (2007, 785)	v_25	...develop a common vocabulary in the organization.	4.47541	1,642479
3.2 Micronostic Control System				
		Please rate the extent to which you agree with the following statements. In your organization...	1 (to a small extent); 7 (to a large extent)	
Own (Micronostic)	v_82	...the supervisor has a sharp and deep understanding of the current innovation research.	4.401639	1.491906
Own (Micronostic)	v_83	...the organization expects the employee to work on his/her own ideas and measures the related performance.	4.565574	1.54806
Own (Micronostic)	v_84	...the employee can bring in his/her own ideas.	5.081967	1.551273
Own (Micronostic)	v_85	...the employee is free to choose own personal projects.	3.254098	1.70348
Own (Micronostic)	v_86	...the employee is actively supported when implementing his/her innovation ideas.	4.237705	1.626502
4 Interactive Control System and Macronostic Control System				
		Please indicate the extent to which you agree or disagree with the following statements.	1 (strongly disagree); 7 (strongly agree)	
Widener (2007, 785)	v_31 (RC)	Top management pays little day-to-day attention on the performance measure system.	4.901639	1.774055
Widener (2007, 785)	v_32 (RC)	Top management relies heavily on staff specialists in preparing and interpreting information from the performance measure system.	4.090164	1.799927
Widener (2007, 785)	v_33 (RC)	Operating managers are involved infrequently and on an exception basis with the performance measure system.	4.655738	1.709335
Widener (2007, 785)	v_34	Top management pays day-to-day attention to the performance measure system.	4.590164	1.619887
Widener (2007, 785)	v_35	Top management interprets information from the performance measure system.	4.762295	1.553739
Widener (2007, 785)	v_36	Operating managers are frequently involved with the performance measure system.	4.860656	1.522914
Own (Macronostic)	v_37	The organization draws the attention of employees on the management level to the organization's research.	4.213115	1.522446
Own (Macronostic)	v_38	The organization enables employees to unfold his/her creative potential.	4.188525	1.473355

(Continues)

TABLE D1 | (Continued)

Own (Macronostic)	v_39	The organization supports intrinsically motivated employees to contribute new ideas.	4.47541	1.54392
Own (Macronostic)	v_88	The organization defines the employee's projects.	5.147541	1.340236
Own (Macronostic)	v_40	The organization creates opportunities to develop and/or work on new ideas.	4.581967	1.395626
5 Performance and Innovation Performance				
5.1 Performance				
		For each performance indicator, mark the number that best indicates the degree of conformance to your organization's goal over the past year on...	1 (very poor performance); 4 (met goals); 7 (very good performance)	
Widener (2007, 786)	v_41	... overall organizational performance.	4.729508	1.384906
Widener (2007, 786)	v_42	... overall organizational profitability.	4.688525	1.543217
Widener (2007, 786)	v_43	... relative market share for primary products.	4.754098	1.274748
Widener (2007, 786)	v_44	... overall productivity of the delivery system.	4.696721	1,389984
5.2 Innovation Performance				
		For each indicator mark the number that best indicates the degree of conformance in your organizational unit regarding...	1 (very low); 7 (very high)	
Mankin (2007, 5)	v_46	... the number of ideas funded.	3.639344	1.61125
Own	v_47	... the impact of new ideas that have been developed.	4.47541	1.612006
Mankin (2007, 5)	v_48	... the number of innovators in senior positions.	3.901639	1.58719
Own	v_49	... the ratio of innovative products to standard products in portfolio.	3.729508	1.488451
Mankin (2007, 5)	v_50	... the number of innovations that are still selling.	4.303279	1.498701
Mankin (2007, 5)	v_51	... the acceptance of the innovations by customers.	4.704918	1.418231
Rhee et al. 2010, 73); Mankin (2007, 5)	v_52	... the acceptance of technical innovation within the organization, based on research results.	4.483607	1.467182
Rhee et al. 2010, 73); Mankin (2007, 5)	v_53	... the active search for innovative ideas within the organization by the management.	4.483607	1.538667
Rhee et al. 2010, 73); Mankin (2007, 5)	v_54	... the acceptance of innovation in program/project management within the organization.	4.704918	1.551797

(Continues)

TABLE D1 | (Continued)

Rhee et al. (2010, 73); Mankin (2007, 5)	v_55	... the reward for people with new ideas that work well within the organization.	4.016393	1.537324
Rhee et al. (2010, 73); Mankin (2007, 5)	v_56	... the perception of innovation as constructive and as being actively accepted within the organization.	4.606557	1.423286
6 Absorptive Capacity (Potential)				
		In my organizational unit...	1 (strongly disagree); 7 (strongly agree)	
Leal-Rodriguez et al. (2014, 28f.)	v_57	... we have frequent interactions with top management to acquire new knowledge.	4.565574	1.71521
Leal-Rodriguez et al. (2014, 28f.)	v_58	... employees regularly visit other units or project teams.	3.713115	1.628666
Leal-Rodriguez et al. (2014, 28f.)	v_59	... we collect information through informal means (e.g., lunches with colleagues, friends. Chats with partners).	4.393443	1.572267
Leal-Rodriguez et al. (2014, 28f.)	v_60 (RC)	... members do not visit other units or project teams.	4.319672	1.890675
Leal-Rodriguez et al. (2014, 28f.)	v_61	... we periodically organize special meetings with clients, suppliers or third parties to acquire new knowledge.	4.655738	1.723779
Leal-Rodriguez et al. (2014, 28f.)	v_62	... members meet regularly with external professionals such as advisers, managers or consultants.	4.081967	1.703619
Leal-Rodriguez et al. (2014, 28f.)	v_63 (RC)	... we are slow to recognize shifts in our market (e.g., competitors, laws, demographic changes, etc.)	4.639344	1.767781
Leal-Rodriguez et al. (2014, 28f.)	v_64	... new opportunities to serve our clients are quickly understood.	4.508197	1.517098
Leal-Rodriguez et al. (2014, 28f.)	v_65	... we quickly analyze and interpret changing client demands.	4.508197	1.489611
7 Absorptive Capacity (Realized)				
		In my organizational unit...	1 (strongly disagree); 7 (strongly agree)	

(Continues)

TABLE D1 | (Continued)

Leal-Rodriguez et al. (2014, 29f.)	v_66	...we regularly consider the consequences of changing market demands in terms of new ways to provide services.	4.819672	1.437493
Leal-Rodriguez et al. (2014, 29f.)	v_67	...employees record and store newly acquired knowledge for future reference.	4.245902	1.539086
Leal-Rodriguez et al. (2014, 29f.)	v_68	...we quickly recognize the usefulness of new external knowledge for existing knowledge.	4.54918	1.590792
Leal-Rodriguez et al. (2014, 29f.)	v_69 (RC)	...employees hardly share practical experiences.	4.704918	1.644869
Leal-Rodriguez et al. (2014, 29f.)	v_70 (RC)	...we laboriously grasp the opportunities for our unit from new external knowledge.	4.106557	1.353339
Leal-Rodriguez et al. (2014, 29f.)	v_71	...we periodically meet to discuss the consequences of market trends and new services development.	4.508197	1.647668
Leal-Rodriguez et al. (2014, 29f.)	v_72	...it is clearly known how activities within our unit should be performed.	5.040984	1.344702
Leal-Rodriguez et al. (2014, 29f.)	v_73 (RC)	...client's complaints fall on deaf ears in our unit.	5.680328	1.627584
Leal-Rodriguez et al. (2014, 29f.)	v_74	...we have a clear division of roles and responsibilities.	5.098361	1.36309
Leal-Rodriguez et al. (2014, 29f.)	v_75	...we constantly consider how to better exploit knowledge.	4.737705	1.316163
Leal-Rodriguez et al. (2014, 29f.)	v_76 (RC)	...we have difficulties implementing new services.	4.245902	1.672883
Leal-Rodriguez et al. (2014, 29f.)	v_77	...employees have a common language regarding our services.	4.754098	1.416033

8 Sociodemographic

Own	v_79	Which industry is your organization in? (Mark the industry that fits your organization by clicking on it.)	Dropdown selection input field containing all NACE primary listings by the EU (maximum one can be selected).	Descriptive results <ul style="list-style-type: none"> • 36.89%—(60) Manufacturing; • 11.48%—(62) Other service activities;
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(Continues)

				<ul style="list-style-type: none"> • 10.66%—(63) Professional, scientific...; • 7.38%—(54) Construction; • 5.74%—(68) Wholesale and...; • 4.10%—(48) Accommodation and...; • 4.10%—(57) Financial and...; • 4.10%—(59) Information and...; • 3.28%—(58) Human health and...; • 2.46%—(53) Arts, entertainment...; • 2.46%—(65) Real estate activities; • 1.64%—(55) Education; • 1.64%—(66) Transportation and...; • 0.82%—(50) Activities of households...; • 0.82%—(51) Administrative and...; • 0.82%—(52) Agriculture, forestry...; • 0.82%—(61) Mining and quarrying; • 0.82%—(67) Water supply...; • 0%—(49) Activities of extraterritorial...; • 0%—(56) Electricity, gas...; • 0%—(64) Public administration...
Own	v_81	Number of years in your current position (Round up if necessary. Decimal numbers are not allowed.)	Open input field (integer values)	12.5 years 10.9 years (median = 9 years)
Own	v_87	What country is your organizations headquarter located in?	Dropdown selection input field containing all countries (maximum one can be selected).	Descriptive results <ul style="list-style-type: none"> • 67.21% UK; • 10.56% Germany; • 4.92% US; • 1.64% Belgium;

(Continues)

- 1.64% France;
- 1.64% Italy;
- 1.64% Lebanon;
- 1.64% Liechtenstein;
- 1.64% Switzerland;
- 0.08% Afghanistan;
- 0.08% Algeria;
- 0.08% British Virgin Is.;
- 0.08% Finland;
- 0.08% Ireland;
- 0.08% Japan;
- 0.08% Netherlands;
- 0.08% Nigeria;
- 0.08% Norway

Appendix E: Notation

<i>BLFS</i>	Beliefs System
<i>BNDR</i>	Boundary System
<i>DCS/DIAG</i>	Diagnostic Control System
i.e.	Id est
<i>ICS</i>	Interactive Control System
<i>INNPERF/INNP</i>	Innovation Performance
<i>MACRO</i>	Macronostic Control System
<i>MICRO</i>	Micronostic Control System
<i>PACAP</i>	Potential Absorptive Capacity
<i>PERF</i>	Performance
<i>RACAP</i>	Realized Absorptive Capacity
Std. coef.	Standardized coefficient