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**Flexible specialization as locational advantage in the economic crisis?
Examples from the German mechanical engineering industry¹**

Martina Fuchs (co-authored with Hanno Kempermann)

Paper presented at the 50th Anniversary European Congress of the Regional Science Association International
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Abstract

'Flexible specialization' has long been considered a competitive advantage for the German mechanical engineering industry. As early as 1984, Piore/Sabel stressed that flexible specialization was important to companies in terms of the production process and also their client base. We will demonstrate that this perspective is insufficient today. Specialization can lead to disadvantages, leading to 'lock-in' if a company is too dependent on its specific market niche. The ability of a company to attain a competitive advantage depends on its capability to bring product modifications to the market, in particular innovations relating to their core competencies. In the economic recession, which first struck the German mechanical engineering industry in 2008, flexible specialization and product modifications in the core competencies played a strong role in company survival. Labour flexibility and equity capitalisation also helped companies to cope with the crisis, although the former did have consequences for the local labour markets. The investigation is based on 20 in-depth interviews in mechanical engineering companies in regions dominated by this manufacturing sector. Interviews took place in summer 2009.

¹ We thank the Hans Boeckler Foundation for the opportunity to deal with the topic "Regional Effects of the crisis in German engine building industry and local coping strategies". We also thank Kira Gee for editing the English text.

1 Introduction

German mechanical engineering is considered highly competitive on the world market on account of its flexibility. Working from the premise that flexible specialization is highly significant, Piore/Sabel (1984) stated that the ability of companies to adapt to changing environments depended on whether they were innovative and knowledge-intensive producers with a strong position in their respective market niches, or represented replaceable standard producers. Piore/Sabel considered the garment industry of Northern Italy to be an archetype for flexible specialization, but they also regarded the historical metal-working industry in the 'Bergisches Land' in North Rhine-Westphalia and the medium-sized mechanical engineering companies in Baden-Württemberg as typical examples (Piore/Sabel 1984, pp. 205ff, 216-220). The idea of flexible specialization was taken up in the discussion on the limits of mass production, 'Fordism' and flexible 'post-fordistic' production; today it is considered an important managerial strategy.

The economic recession, which first struck the German mechanical engineering industry in 2008, put the strategy of flexible specialization to the test. As part of the capital goods industry German mechanical engineering was affected later than other manufacturing sectors. Once the crisis hit, however, the decline was fast and deep. Having experienced an intensive, short upswing in 2006-2008, mechanical engineering companies now observed a decline of incoming orders of up to 80% compared to the previous year.

The paper discusses to what extent flexible production in the mechanical engineering industry still is a successful local coping strategy in the recent recession, or whether this is an assumption that has to be modified today.

2 Conceptual framework: Dimensions of flexible specialization

During the 1980s it became an accepted premise that society had largely turned 'post-fordistic' in the core economies. At a company level this was accompanied by flexible specialization, at least in some industrial sectors, companies or areas of production (Piore/Sabel 1984). Flexible specialization can thus evolve as a particular path of customer-oriented, permanent technological innovation. Leading to competitive advantages for the companies, this path is sustained by cooperative relationships and institutional support at different spatial levels. Piore/Sabel (1984) examined the 'return of economics into society' mainly at a macro-level, although the ensuing discussion largely focused on the regional level, covering regional

networks, industrial districts, or innovative milieus for example. The idea of new paths in the manufacturing industry, but also understanding the importance of regulation and institutions, leads us to approach flexible specialization from two theoretical perspectives: an evolutionary perspective and a point of view inspired by the regulation approach.

2.1 Flexible specialization from an evolutionary perspective

The enthusiastic reception of Piore/Sabel's assumptions has all but faded by now. Doubts have arisen whether the idea of flexible specialization can really be applied to different states and regions and merged at the micro and macro level, as done by Piore/Sabel (Baca 2004). Furthermore, the supposedly new and superior path of flexible-cooperative production of goods did not fit with later empirical results. Surveys of the medium-sized mechanical engineering industry in Germany in particular showed that flexible specialization, and thus the ability to deal with exceptionally high levels of complexity, can cost companies dearly. Knowledge-intensive single-part production for a particular client, and the small-series production for only some customers, are particular cases of overly expensive 'over-engineering' (Dispan/Krumm/Seibold 2009, p. 106), meaning high-priced and costly over-specialization: Carrying out complex research, development and design for just a single client or a few customers prevents the company from achieving economies of scale. Clearly, then, there are *disadvantages in too high a degree of specialization*, leading to counterproductive path dependencies and, possibly, situations of 'lock-in' (Grabher 1993, pp. 263f, Hassink 2005).

As we will show in our empirical part, mechanical engineering companies attempt to solve the problem by developing and producing incremental innovations. They make use of their technological core competencies to adapt the product and thus broaden the market at least to some degree. Partly, this corresponds to 'flexible *standardization*' (Hirsch-Kreinsen 2009, p. 5f, 9): It essentially represents modular design of product and production process, designed to reduce complexity in production planning and control and to obtain a continuous yet customer-oriented production process.

'Flexible *standardization*' (Hirsch-Kreinsen 2009, p. 5f, 9) stresses the technological aspect, although it is customer-oriented specialization that helps companies to attain a leading market position. Some of the small and medium sized firms are 'hidden champions' on the world markets. Flexible production combined with a superior position in the competition for innovation render them (nearly) irreplaceable to their clients. Long-term service contracts are evidence of their strong position. We therefore prefer the term *product modification* in the core

competencies, connected to a *'deepening' of the markets*. This leads to innovative paths of specialization, which is linked to a gradual diversification in the company's core competencies (Glückler 2007).

The close cooperation and *'co-evolution'* (Schamp 2009) of mechanical engineers and users in Germany dates back to the 19th century. At that time, many innovations were inspired by the clients and brought together different manufacturing sectors (Hirsch-Kreinsen/Seitz 2000, p. 47f, 63f). The road of innovation and flexible specialization therefore began to be taken by German mechanical engineering companies well before the 20th century. This turned them into providers of complete systems, which are complex and specialized and include a broad range of services. On this broad road, the particular companies then follow their specific paths of flexible specialization.

From an evolutionary perspective² flexible specialization – understood here to include our above modifications – can be seen as a general path along which the mechanical engineering industry has realized diverse, interactive *'adaptations'* to the socio-economic environment. Sometimes this has led to unforeseeable, *'non-ergodic'* developments (MacKinnon et al. 2009, p. 131f). The path that ultimately yields competitive advantages varies from company to company, depending on the market situation and market strategy (see Boschma/Frenken 2009, Essletzbichler 2009).

Evolutionary approaches stress adaptation to changing environments, but do not discuss recessions or crises. From the evolutionary point of view, the recent recession has to be understood as a vehement, sudden and unexpected new condition. Mechanical engineering companies respond to this new condition in their own time and manner, either by developing new strategies or deepening tried and tested ones.

We therefore argue that flexible specialization has to be complemented by other factors. Product modification in the core competencies, accompanied by a *'deepening'* of the markets play a strong role in reducing the dependency on a single or a few clients. As we will show

² In the broad area of evolutionary approaches (Grabher 2009, p. 129, Peck 2005) simple biological analogies are usually excluded (see Nelson/Winter 1982). For an explanatory, historical-dynamic approach we include the socio-economic settings (see March/Simon 1958, p. 136-149, today: MacKinnon et al. 2009, p. 129, 133, Pike et al. 2009).

below, technological and market flexibility also need to be complemented by flexible labour relations. Such flexibility is the result of labour market policy (mainly short-term temporary employment, i.e. leased labour) as well as in-house agreements (primarily ‘accounts’ for working hours). Last not least, the equity base of the company is relevant, too. As Piore/Sabel (1984) have suggested, the macro level and the overall changes in the institutional setting thus do need to be considered. These processes are commonly subsumed under the term ‘deregulation’.

2.2 Flexible specialization from a regulatory perspective

In contrast to the evolutionary perspective, which does not deal with crisis, the regulatory approach was designed to gain better understanding of the last large recession in the world economy. This took place in the 1970s and 1980s, when the ‘oil crisis’ and the decline in sales led to a downswing (Aglietta 1976). The initial approach was soon extended to cover the more general topic of economic and social change, considering the limits of mass production, ‘Fordism’ and the opportunities provided by flexible ‘post-fordistic’ production. In the 1980s and 1990s it was brought together with deeper analysis of political deregulation in Europe and in the USA (Boyer 1987, 1995, Lipietz 1986, 1987). In geography, the approach was primarily taken up by Harvey (1989) and later Jessop/Sum (2006). Rather than a ‘deep crisis’ which destabilizes the economic order and the social system, the regulatory approach views the recent recession as another form of economic restructuring. Looking back, it is clear that political actors had introduced specific institutional rules that prepared the shape and course of the crisis before the recession actually occurred. This institutional pre-structuring reveals itself clearly when looking at the institutions which regulate labour relations and monetary-financial relations (Boyer 1987, 1995):

In *labour relations*, German governments (with different party affiliations) introduced political instruments designed to increase the flexibility of employers on the labour market. The standard employment relationship with often life-long work contracts and 9-to-5 working hours continued to erode; at the same time the segmentation of the labour market into safe work contracts on the one hand and precarious jobs on the other deepened. Jobs of temporary staff and leased labourers became particularly precarious as they were no longer employed by the company itself, but increasingly subcontracted (or loaned) to the company by temp agencies (Meyer/Fuchs 2010). Short-time work is another important instrument for companies to survive the crisis and keep their permanent staff. This is due to the specific German situation,

which makes available state-funded short-time compensation for up to 24 months if production time has to be reduced for economic reasons or on account of another inevitable event (and if specific aspects of social legislation apply at the same time). Company-specific agreements on ‘working hour accounts’ also play an important role: working time accrued in the boom could now be used up, with ‘accounts’ sometimes becoming ‘overdrawn’.

Monetary-financial relations were a cause of the crisis and shaped its appearance and course. After deregulation of the financial markets in the USA and in Great Britain, which began in the 1970s and 1980s, new legislation was introduced in Germany in the 1990s and early 2000s that allowed broad use of new financial products. This resulted in increased opaqueness of transactions and risk potential. The ensuing speculation and chain reaction were the primary causes of the recent world economic recession. Financial (de-)regulation also shaped the form of the crisis and the course it took in the companies. The new institutional setting made it easier for financial investors interested in short-term returns to take over companies, at the detriment of building a financial cushion for long-term strategies. Companies were weakened as a result. Another factor that significantly changed the situation for small and medium sized companies was ‘Basel II’. Introduced before the recession hit, this brought in regulations concerning the equity base of financial institutes. During the crisis, they now had an even stronger interest in maintaining their own equity base. As a result, credits for weak companies became expensive or were refused altogether.

From a regulatory perspective, we therefore argue that the concepts of ‘flexible specialization’ and ‘product modification in the core competencies’ need to be extended by two further important aspects: the institutions which shape labour relations, and monetary-financial relations. Both are important providers of flexibility which is necessary for companies to survive the crisis.

2.3 Analytical concept

Mechanical engineering companies react to the crisis with a range of different strategies shaped by the institutional setting in Germany (fig. 1). We modified Piore/Sabel’s (1984) idea of flexible specialization by adding the customer-oriented view on ‘product modification in the core competencies’ and labour regulation (short-time work and temporary employment) as key factors. ‘Accounts’ for working hours, i.e. internal company agreements, are important, too, as are monetary-financial relations (lending policy of financial institutions and the com-

pany's equity base) in the context of investment and innovation strategy. All these factors influence the ability of the companies to survive the crisis and also influence the local labour market.

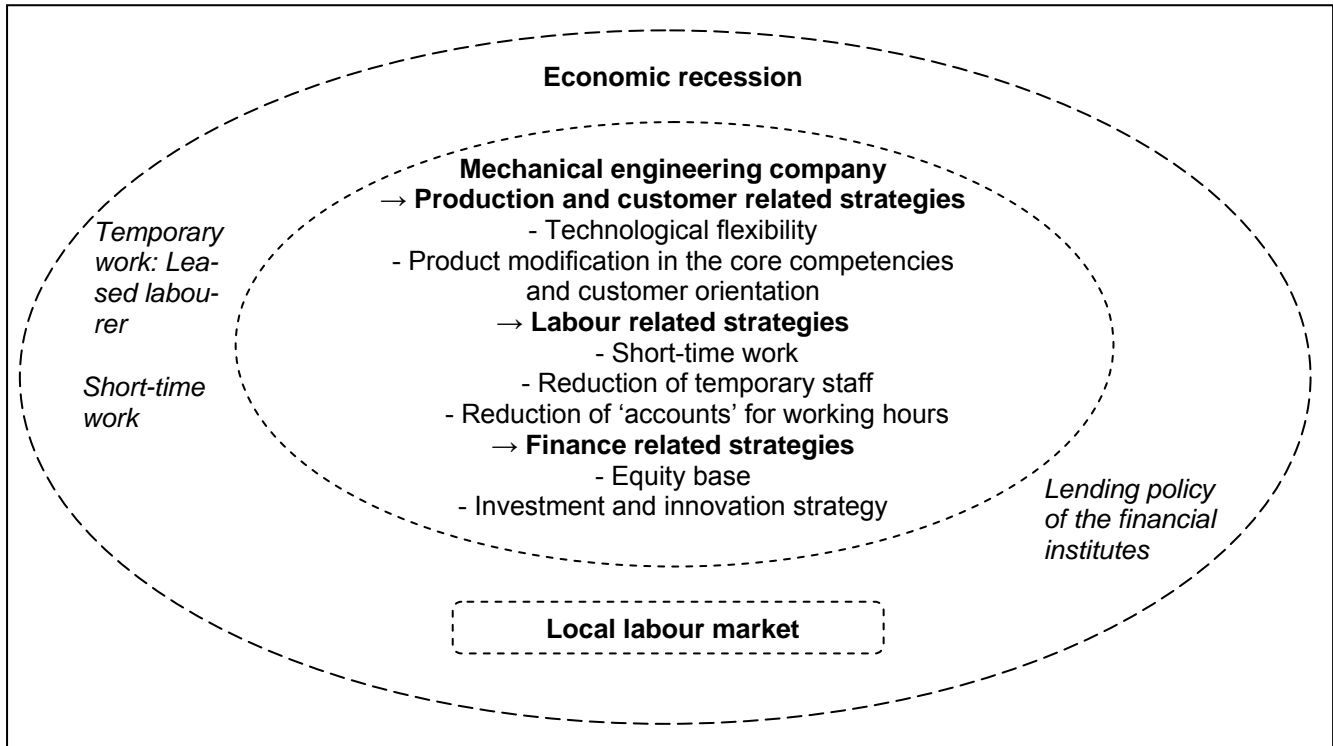


Fig. 1: Analytical concept (Source: Authors)

3 Method

3.1 Selection of the manufacturing sector and the regions

Mechanical engineering is commonly understood to include manufacturers of durable means of production, or their pre-products and components, with the exception of electrical machines (Hirsch-Kreinsen 2009, p. 8). We selected this sector for our examination because it is a key producer of investment goods. With regard to employment, the sector is by far the most important in Germany, employing about 1 million people. It is also one of the strongest export sectors, topped only by the automobile industry. About 60% of exports are destined for European countries; about 40% go overseas, especially to USA, China and South Korea (2008, VDMA 2009a, pp. 15, 40, 52-56).

Mechanical engineering is a very heterogeneous sector. In terms of employment, the most important sub-sectors are drive technology, precision tools and the machine tool industry. The sub-sectors with the strongest drop of incoming orders – and those that are most strongly af-

ected by the crisis – are metallurgical plants and rolling mills and the machine tool industry, followed closely by companies producing food processing and packaging machines as well as producers of instrument panels and agricultural engineering (Statistisches Bundesamt 2009a, VDMA 2009a, pp. 46f, 49).

Mechanical engineering is an innovative sector; with about 12% of R&D-investments in the manufacturing industry and about 10% in the total economy, the sector is quite research-intensive in fourth place after the automobile industry, chemical production and the electrical industry/data processing/precision mechanics/optics industry (VDMA 2009b, 2009e, p. 42). As a result the mechanical engineering industry has highly qualified employees. About 80% of are technicians and skilled engineers, only 13% are unskilled or semi-skilled (7% other qualifications) (Hirsch-Kreinsen 2009, p. 11f).

To select the research regions, we calculated the coefficient of localization for different administrative districts (“Kreise”).³ We selected the top 10%, which amounted to 24 administrative districts (Fig. 2). Because of the downturn, we expected negative effects to be particularly pronounced in these. The selected regions are primarily located in Baden-Württemberg, Bavaria und North Rhine-Westphalia, where around 70% of the 1 million employees in the sector live (BA 2009).

³ The *coefficient of localization* measures the degree of regional concentration of a phenomenon, here the employees in engine building industry. The coefficient results from the positive or the negative deviations of the regional percentage of workers in the engine building industry from the corresponding regional percentage of all employees in the industry, over all regions which are relevant.

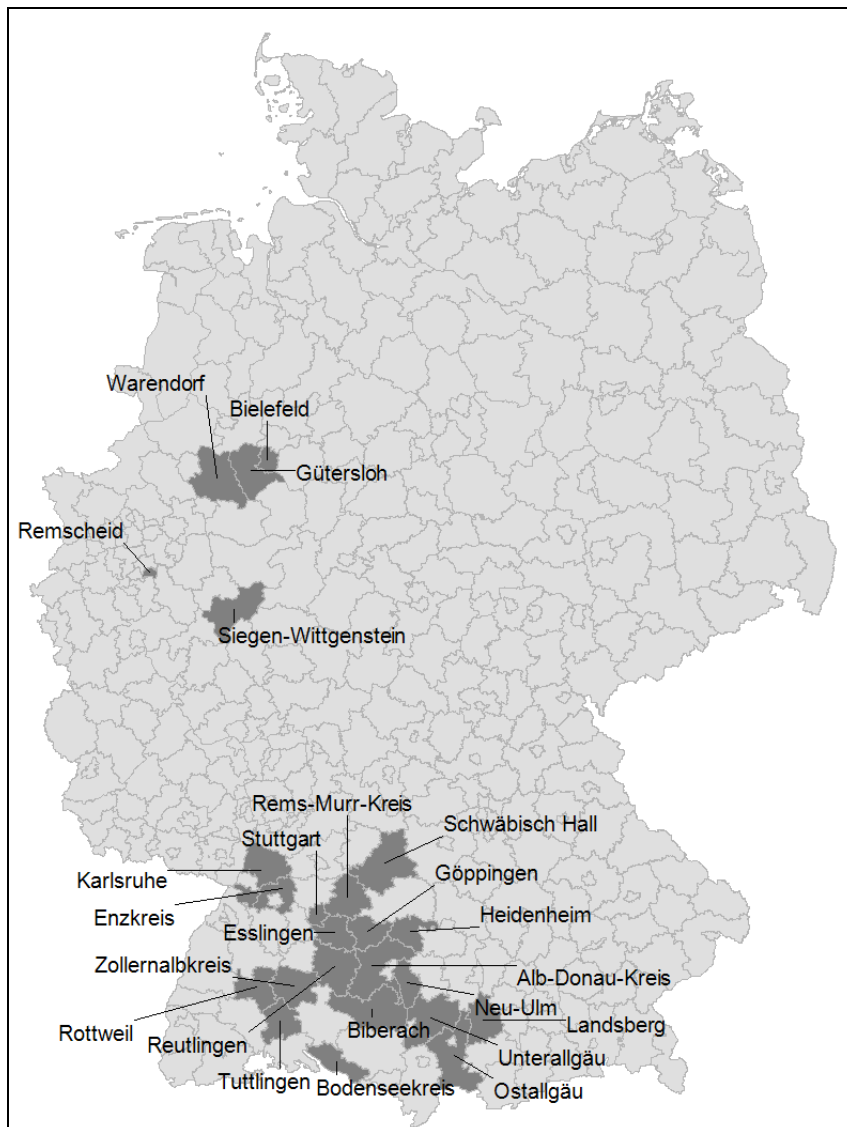


Fig. 2: The 24 selected regions in Germany (Source: Authors)

3.2 The survey

We asked the 400 companies with the highest turnover in the selected regions for interviews. Interviews with management and executives took place in 20 companies in July and August 2009. Since little is known about the subject, our method was qualitative-explorative, designed to uncover the reasons, the modus operandi and the conditions of decision-making. A qualitative approach also helps to access sensitive information. Rather than checking for known variables or terms research sought to uncover new phenomena. We drew on secondary information to complement our own data, especially from the Federal Employment Office (BA, Bundesagentur für Arbeit) and the Engine Building Industry Association (VDMA, Verband Deutscher Maschinen- und Anlagenbau). As the sector is highly heterogeneous, the companies surveyed are quite diverse. We conducted interviews in small-scale assemblers as

well as high-tech firms and world market leaders. We interviewed in family-owned companies as well as joint-stock companies, some partially owned by international corporations. The product portfolio varied between a single product (with modifications) to a broad range of products. The companies had clients in quite distinct sectors (see figure 3).

<i>Product/Subsector</i>	<i>Number of employees (in brackets: shift in the crisis)</i>	<i>Administrative district („Kreis“) and state („Bundesland“)</i>	<i>Flexible oder standardized production</i>
Material test systems	80 (-)	Biberach (Baden-Württemberg)	flexible
Insulating glass manufacturing	380 (-20)	Enzkreis (Baden-Württemberg)	flexible
Hydraulic systems	40 (-)	Bodenseekreis (Baden-Württemberg)	flexible
Manufacturing of precast concrete parts	80 (-)	Zollernalbkreis (Baden-Württemberg)	flexible
Wrapping solutions and systems	70 (-45)	Rottweil (Baden-Württemberg)	standardized
Portal milling machines	160 (-)	Esslingen (Baden-Württemberg)	flexible
Industrial robots	63 (-)	Tuttlingen (Baden-Württemberg)	flexible
Casting technology	500 (-)	Rems-Murr-Kreis (Baden-Württemberg)	flexible
Machine tool industry	140 (-)	Rems-Murr-Kreis (Baden-Württemberg)	standardized
Cooking centres	1000 (-100)	Landsberg am Lech (Bavaria)	flexible
Climate control units and leisure products	550 (-35)	Siegen-Wittgenstein (North Rhine-Westphalia)	standardized
Cranes	400 (-)	Siegen-Wittgenstein (North Rhine-Westphalia)	flexible
Oil and gas burner	44 (+1)	Rems-Murr-Kreis (Baden-Württemberg)	flexible
Sheet metal parts and units	310 (-80)	Rems-Murr-Kreis (Baden-Württemberg)	flexible
Spark erosion	140 (-)	Siegen-Wittgenstein (North Rhine-Westphalia)	flexible
Gears and gearbox parts	43 (-)	Rottweil (Baden-Württemberg)	flexible
Chipping	14 (-18)	Esslingen (Baden-Württemberg)	standardized
Mechanical and hydraulic presses	5.000 (-600)	Göppingen (Baden-Württemberg)	elements of both
Machines for books and press	31 (-29)	Schwäbisch Hall (Baden-Württemberg)	standardized
Lifts	2.400 (-)	Esslingen (Baden-Württemberg)	flexible

Fig. 3: Interviews in the mechanical engineering industry (Source: Authors)

4 Effects of the crisis in the mechanical engineering industry

4.1 Production and customer related strategies

The following illustrates that Piore/Sabel's idea of flexible specialization is still important, but needs to be modified to include the customer-oriented view on 'product modification in the core competencies', labour regulation (short-time work and temporary employment), 'accounts' for working hours, and the *monetary-financial relations* (the equity base of the company and its investment strategies). All these factors influence the ability of the mechanical engineering companies to survive the crisis, impacting also on the local labour market.

Most of the companies interviewed develop and design products according to consumer requirements, some as a single product and some in small-scale series. Close contact to the clients is important for their continued ability to innovate. Often, this close relationship includes software design for the machine, as well as installation of the machine or after-sales service (maintenance, repair, updates, training). Particularly servicing contributes to strengthening customer relations. Interviews illustrated that companies able to cope with the crisis reasonably successfully were customer-oriented producers: They either represented monopolists on the world market or world market leaders sharing an oligopoly with only few other firms, sometimes with regionally divided markets. Often, products are so complex that the client is more dependent on the producer than vice versa. Pricing pressure is less strong than in the segment of standardized products. Sometimes clients are unable to cancel orders because there is no other provider and the clients lack the equipment or know-how to manufacture the machines themselves. Although this strong position helps the company to overcome the crisis, even successful companies have suffered a drop of incoming orders, leading them to introduce short-time work and sack 'loaned' temporary workers.

Because innovation and technology are important, our interviews showed that most companies with flexible specialization continued their R&D much as before. Most did not introduce short-time work in their R&D departments. Rather than delaying ongoing R&D projects by reduced working hours they were completed speedily in order to bring the new products or product modification to the markets as quickly as possible. For these companies, keeping on their permanent staff represented a means of maintaining their capacity to innovate and their customer orientation.

Many of the interviewed companies specialized in a core competency, e.g. pressure casting machines or milling. With strong focus on a specific market niche, companies are hard pressed to realize 'economies of scale'. Despite the advantages inherent in competing for innovation rather than price, there is the danger of over-engineering, possibly combined with a 'lock-in'. We found examples where competition for innovation became a struggle for low prices on account of new competitors entering the market, e.g. players from Asia. Product modification is a relatively uncomplicated and economical way of developing new markets. Rather than broadening the markets, a deepening occurred, sometimes drawing in clients in completely new customer segments.

The above demonstrates that a close relationship with the customer has always been important to flexible specialized companies even before the crisis. Many managers strive to create a customer relationship that can be characterized as a close tie but not a dependency. We often encountered long-termed strategies that had been instigated before the crisis. Back in the 1990s for example, a producer of milling machines, located near Stuttgart and with a workforce of about 160, began to employ persons who had previously worked in the clients' firms. These employees were then able to accurately anticipate any future requirements of the clients.

During the crisis, companies developed and deepened their market-oriented strategies. About half of the interviewees mentioned different customer-oriented strategies. They spoke to their existing clients about new orders, financial opportunities, sales discounts, innovations which they could need etc. By doing so they hoped that in case of an upswing, their company would be top of the list for new orders. This strategy of contacting existing customers, however, hit a limit when the client did not really need anything, or could not pay for a new order, and therefore did not respond positively to the request.

Apart from strengthening contacts to existing clients purchasing officers also tried to attract new clients. A producer of pressure casting machines for example, headquartered in the district of Rems-Murr and with a workforce of 250, knew that three clients had gone public on the Chinese stock exchange in September 2008 and had thus become quite solvent. The German company contacted the Chinese firms, which led to new orders in March 2009, right in the middle of the recession. The purchasing officers also developed a successful new strategy

for the firm and contacted clients all over Poland. Their argument was that clients would probably have more time for bargaining and testing new products in a crisis than in a boom.

The relevance of flexibility can be illustrated by contrasting it with standardized production. Standardized producers have limited elbow-room. The companies we interviewed often act in different market segments with different technologies, but none are technological market leaders with a unique selling point. Price competition is high; as a result there is high pressure on margins, resulting in a small equity base as well as limited means for R&D investment. Undersized financial cushions quickly erode in the crisis, and investments planned prior to the crisis are postponed. This applies to large innovation projects but also smaller expenditures, such as multiple sets of tools, travel costs etc.

A small assembly company with 40 employees in the district of Esslingen can serve as an example. This company experienced an upswing from 2006 to 2008. It only supplied clients on a regional level, but due to the large amount of work in these years it failed to strengthen its distribution base, e.g. by diversification. Then, in 2009, the company's most important client cancelled their order, causing the company to become insolvent. Only a single technical division was stable on account of a unique selling point, which had resulted from designing a prototype for a client. As the design competence is owned by the client, and the company was only the producer, this client-initiated innovation did not stimulate any design and innovation within the company.

4.2 Labour related strategies: Permanent and temporary staff

Apart from production and market-related strategies, labour related strategies also play a role in overcoming the crisis. As set out in chapter 2, these are determined by labour market regulation on the one hand and company-specific agreements on the other. In the mechanical engineering industry, companies tend to spend less on manpower than on material; on average, labour costs across the sector only amount to a quarter of all expenditure out of the gross production value. Costs vary between 15% (machines for agriculture and forestry), 25-27% (machine tools) and 30% (machines for paper production), compared to an average expenditure on materials of over 50% (2007, VDMA 2009a, 78f). However, orders for material can be cancelled much easier than labour contracts. From that point of view, temporary staff loaned by a temp agency is an adequate solution – at least in the short-term since temporary staff usually do not have the qualification, the ‘tacit knowledge’ and the experience of permanent

staff. In Germany, there is also an advantage in terms of the company's figures because temporary staff is not counted as 'staff' in statistics. This means that each job converted from permanent staff to temporary lent staff, leads to profits in productivity on paper (2007, VDMA 2009a, 78f).

Official statistics do not show the number of temporary workers by manufacturing sector. Generally, however, the number of temporary workers in the crisis fell by one third to one fourth (from 800,000 temps in October 2008 to 500,000 in spring 2009; BZA 2009). In the companies surveyed the share of temporary workers was between 10% and 20%; nearly all of them were made redundant and given back to the temp agency, which was usually unable to offer them alternatives. Employing staff on short term contracts (without a temp agency) is a rare occurrence in the companies surveyed because German law is very restrictive in this respect. In most cases short-term contracts are limited to apprentices. Nevertheless, most companies attempt to take on their apprentices after their apprenticeship because trainees are considered an important future resource.

Permanent staff was visibly less reduced in the mechanical engineering industry which is predominantly knowledge-intensive. In 2008, 965,000 jobs were available in companies with more than 20 employees in this sector; 46,000 permanent jobs were cut in 2009, which is 'only' 4% (VDMA 2009a). In the companies interviewed, only half the managers sporadically dismissed employees, especially those with too few qualification and experience or mal-adapted behaviour. Only firms which were insolvent or nearly insolvent laid off a higher number of workers. Even companies with a loss of turnover of 50% and more laid off staff as late as possible, if at all.

Short-time work is another instrument that allows companies to keep their permanent staff. In all sectors the number of short-time workers grew from 35,000 in the third quarter of 2008 to 1.5 million in May 2009 (BA 2010, see also corresponding § 170 SGB III). Mechanical engineering companies particularly make use of short-time work. A fifth of all short-time workers are employed in this sector, amounting to nearly 170,000 employees (BA 2010). Most of the companies interviewed introduced short-time work, with only 4 out of 20 interview partners stressing they did not. In the other companies between 10% and 80% of staff were on short-time. Interviewees agreed that keeping permanent staff was important for the time after the crisis, when qualified engineers and workers would be needed to cope with new orders.

Another important strategy was to reduce permanent staff ‘accounts’ for working hours and to go ‘overdrawn’ wherever company agreements allowed. In the economic upswing before the recession, especially in 2007 and the first half of 2008, employees had worked on weekends and in the evening, sometimes doing shift work; these working time savings were spent now. Also, some companies stopped production in the crisis for a month, so all workers took annual leave in the same month.

4.3 Finance related strategies

Innovation, playing an important role in flexible specialization, implies high investments. An executive of a world market leader with more than 5,000 employees illustrated this as follows: *“German mechanical engineering companies are often so strong in terms of innovation that the single long-term risk for dropping out of the market is their financial situation.”* And a manager of another large company: *“Our company cannot be crowded out of the market just like that [because of the strong market position]; it can only become illiquid (...)”* [Translation: M. Fuchs].

The equity base thus becomes an important factor in the crisis. Interviewees working in firms with an equity base of more than 50% stated that they were not dependent on bank loans, and able to take independent decisions as far as investment, organisation and personal strategies were concerned. Such companies did not introduce short-time work in their R&D departments. Rather, their strategy was to keep being highly innovative throughout the crisis and to reap the competitive advantages afterwards.

An example is a family-owned company in the district of Siegen-Wittgenstein. The company has about 400 employees and has been producing cranes since the 19th century. For some years, management has pursued the goal of an equity base of “60% plus”. As a result the company grew relatively slow, but steadily, and is independent of credits and loans. In September 2009, during the recession, management started a second important step for the construction of a new hall. Although being careful with investments, and even though orders had dropped with the onset of the crisis, the owner and management decided to go ahead with the hall. An advantage of the recession was that the investment came cheaper than in an economic upswing because of lower prices.

Other companies with a large equity base were able to make similar use of lower prices during the crisis. One company bought a special machine for a very attractive price. Another – small – company employed an engineer in summer 2009 who would not have been available or affordable during an economic upturn.

The situation is different in companies with standardized production. Already struggling with fierce price competition, they had only been able to build up a small equity base before the crisis. Two of the assembly companies interviewed, each of which had 50-100 employees, became dependent on banks and consultants early in the crisis because their financial cushion dissolved quickly in the recession. This was also a problem for the surrounding regions, because in the rural areas, the companies had been relatively important employers.

Structures of decision-making and control in the companies or trusts are important factors too. Many of the small and medium sized firms as well as some large mechanical engineering companies are family-owned, but many companies whose names suggest otherwise are actually part of a national or international trust, or division of an investment firm (RWI 2006, p. 324). In general, the German mechanical engineering industry does not consist of small and medium sized firms – on the contrary: within the manufacturing industry, the mechanical engineering sector consists of more large companies than all the other sectors (Statistisches Bundesamt 2009b).

In consequence, some companies had to implement investment decisions taken in ‘external’ headquarters, decisions they could not afford in the crisis. Other companies are part of private equity firms with strong focus on shareholder value, which also leads to small financial cushions. Earnings made in good economic times could not be used for building up a financial cushion, and existing dependencies on financial institutes could not be reduced.

Apart from being dependent on headquarters, mechanical engineering companies also suffer from dependency on the client. This is particularly the case with companies supplying the automobile industry. As it is customers that dictate investments, prices, batches etc., there was little scope for these companies to increase their financial cushion before the crisis. Capacity utilization is also highly dependent on the automobile firms. When the automobile companies changed their plans, their providers had to follow. A quarter of our interviewees said their

medium-term goal was to depend on a single client with no more than 20-25% of their returns.

However, independence in decision-making – with no influence from headquarters, clients, or banks - it no guarantee for steering out of the crisis. For some companies for example, the good economic times before the crisis were too short to build up a solid financial cushion. Others had to deal with a high number of reclamations as quality levels had suffered during the (overly) busy boom years. Furthermore, in times of high capacity utilization some companies did not use material efficiently and did not care enough about the qualification of new employees. The most important problem, however, was that some managers did not realize the dimension of the crisis early enough. Convinced that incoming orders would increase as they had in 2006-2008, they invested in capacities, bought pre-products for their stocks, and forgot the long-term limits of growth. Since many managers shared this optimistic perspective on growth, interviewees were in line with the community opinion in the sector, leading to ‘irrational’ decisions (see Scharmanski/Fuchs 2009).

4.4 Regional effects

Even though the recession did not lead to mass dismissals in the mechanical engineering industry, a number of problems were experienced on a local level. Generally, temporary workers lost their jobs. In Germany, mechanical engineering companies are often located in rural areas and small villages, where jobs once lost are hard to replace.

Regional economic networks, stressed so strongly in the discussion following Piore/Sabel (1984), only played a marginal role in overcoming the crisis. Most of the companies interviewed buy their pre-products and sell their products nationally or internationally; regional connections are incidental. There are no clusters in the strong sense, i.e. with strong internal complexity. Only in some few cases does the region play a role. The crane manufacturing company in Siegen-Wittgenstein mentioned in 4.3 invested counter-cyclically and preferred ordering from local companies wherever possible. The manager is keen to support local partners because they are considered important for the flexibility of the firm after the crisis and in the next upswing. This manager also attempts to do his part in making the rural region where the firm is located more attractive.

We found that many interviewees develop regional strategies for maintaining and increasing the level of qualification of their employees and supporting young professionals. Regional contacts were cultivated in meetings, with the chambers of commerce and industry, the mechanical engineering association, the employment office, sometimes also with research institutes. The pressure casting manufacturer, headquartered in the district of Rems-Murr (portrayed in 4.1) joined forces with the employment office to develop a job creation company where young and unemployed engineers and apprentices can work and learn. The costs are divided between the employment office and the companies taking part in the scheme. The job creation company not only benefits young people who can learn and stay in work, but also the companies which want (and have) to continue with their innovation and R&D. A similar approach was started by the metal working industry and the trade union in Bavaria in summer 2009.

5 Conclusion

The paper discussed whether flexible production in the mechanical engineering industry is still a successful local coping strategy in the recent recession, and in what way Piore/Sabel's assumptions may need to be modified today. Our survey illustrated that flexible production is important, but not the only success factor. Product modification in the core competencies, linked to a 'deepening' of the markets also plays a strong role because this reduces dependency on a single client or a few customers.

Apart from technological and market flexibility, flexible labour relations are also important. This is a result of labour market policy (mainly short-time work and temporary employment, i.e. leased labour) as well as in-house agreements within the company (primarily 'accounts' for working hours). In consequence, local labour markets are (further) divided into permanent and temporary staff, with growing gaps between the segments.

The equity base of the company is another important factor in providing flexibility. Companies with a large equity base even were able to profit from the crisis, e.g. to make similar use of lower prices during the crisis. Structures of decision-making and control in the companies or trusts play an important role too. Many of the small and medium sized firms as well as some large mechanical engineering companies are family-owned, but many companies are in fact part of a national or international trust, or division of an investment firm. Thus, some companies had to implement investment decisions taken in 'external' headquarters, decisions

they could not afford in the crisis. Other companies are part of private equity firms with strong focus on shareholder value. Earnings made in the upswing could not be used for building up a financial cushion and existing dependencies on financial institutes continued. Apart from being dependent on headquarters, mechanical engineering companies also suffer from dependency on the client. This is particularly the case with companies supplying the automobile industry.

Regional economic networks rarely play a role in coping with the crisis. There are no clusters in the strong sense, i.e. with strong internal complexity of supply-networks and coherence. At the same time, regional cooperation is important with regard to training and apprentices, especially since many mechanical engineering companies are located in rural areas with small villages, where lost jobs cannot be substituted easily. Regional contacts were cultivated in meetings, with the chambers of commerce and industry, the mechanical engineering association, the employment office, sometimes also with research institutes. We found that many firms develop regional strategies for maintaining and increasing the level of qualification of their employees and supporting young professionals.

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