Digitizing value chains:
How SMEs can overcome their challenges

Christian Dienes

Scientific researcher
Institut für Mittelstandsforschung (IfM)
Bonn, Germany

Christian Dienes is scientific researcher at the Institut für Mittelstandsforschung (IfM) Bonn, Germany. He investigates the development and challenges of Mittelstand companies – a group of companies to which a major fraction of small and medium-sized enterprises belong to. Previously, he worked at the Schumpeter School of Business and Economics of the University of Wuppertal where he examined the behavior of firms towards resource efficiency.
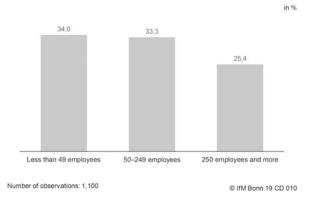
Nowadays, digitization is front and center in the media and the business world. With the advent of more powerful information technology (IT), there are new possibilities for companies to develop innovative business models and products that are based on huge amount of data. Especially in the manufacturing sector, where a high fraction of value is created through the production process, firms are increasingly confronted with the question on how to digitize their production. Also, digitization has broader implications for businesses as information technologies are expected to reshape competition (Porter and Heppelmann 2014)[1].

To successfully digitize production processes, manufacturing firms have to share their data with other companies along the value chain. However, establishing data-based connections to other firms is accompanied by severe challenges. This article examines these challenges while also paying attention to the peculiarities of small and medium-sized enterprises (SMEs). Moreover, it gives a brief overview of some important measures that have been put in place to support SMEs in digitizing their businesses in Germany.

1. Especially smaller companies overestimate their degree of digitization

SMEs can have more difficulties to digitize their business than larger companies. This typically boils down to their lack of resources. Often this applies to financial resources, personal capacity, and IT-resources (Icks et al. 2017)[2]. How does this resource scarcity translate into the company's own perception towards digitization? In a survey among 1,100 manufacturing companies in Germany, virtually every third SME estimates that it is (very) good positioned

[1] Porter M. and Heppelmann J.E. (2014): How smart, connected products are transforming competition. Harvard Business Review.
[2] Icks A., Schröder C., Brink S., Dienes C., and Schneck S. (2017): Digitalisierungsprozesse von KMU im Verarbeitenden Gewerbe, IfM Bonn: IfM-Materialien Nr. 255, Bonn.

in the digitization process. The same is true for only every fourth larger company (compare Figure 1). In other words: Owners of SMEs tend to think that their company is better positioned in the digitization process than their larger counterparts. However, the share of companies that have not yet established data-based connections between their departments or with other companies is comparatively higher for SMEs.

in %

Less than 49 employees: 34,0
50–249 employees: 33,3
250 employees and more: 25,4

Number of observations: 1,100

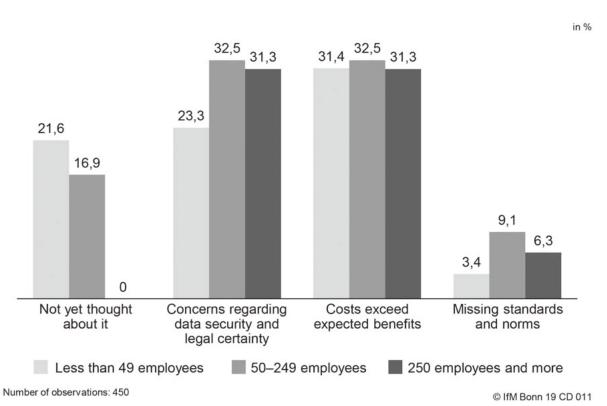© IfM Bonn 19 CD 010

Source: IfM Bonn Survey 2016
Figure 1: The perception to be (very) good positioned in the digitization process changes with firm size

2. Data security and legal certainty represent major challenges

Why is there a gap between SME's own perception and their degree of digitization from an objective perspective? Among other reasons, owners of SMEs are strongly involved in their daily business and due to that, they might have little time to inform about digital trends, like Industry 4.0 technologies. Therefore, it could be that SME owners simply do not know which digital technologies are available on the market. This interpretation is supported by results on the reasons as to why companies do not share data with companies outside their ecosystem (compare Figure 2).[3] Almost every fifth company with less than 49 employees has

Source: IfM Bonn Survey 2016

Figure 2: Obstacles preventing companies to share data with other firms

not yet thought about exchanging data with other companies. This is in sharp contrast to larger companies.

The results further unveil that many enterprises have concerns regarding data security and legal certainty which make them shy away from sharing data with other companies. Another related question is: How do these concerns feed into future expectations of firms that want to digitize value chains? One possible answer to this question can be seen in the results on cost-benefit expectations. Among all size classes, almost every third company estimates that costs exceed expected benefits when sharing data with other companies. On the flipside, this outcome also indicates that seven out of ten companies do not see anticipated benefits to be lower than the costs. With some caution, the results suggest that the majority of respondents value sharing data as a strategy which pays off. However, more research is needed to investigate the correlation between a cost-benefit analyses and attitudes of SME owners towards digitization. Interestingly, missing standards and norms are not yet recognized as obstacles in the digitization process. On the other hand, this does not imply that standards

and norms are less important. The more companies integrate digital technologies along their value chain, the more they have to make sure that IT-Systems are compatible with each other for which general standards and norms are necessary (Schröder and Dienes 2017)[4].

3. Competence centres 4.0: Improving the degree of digitization of the region

In Germany, policy makers have taken action to support SMEs as well as larger companies in their digitization efforts. An important measure, which has recently put in place, is the establishment of digital competence centres that are funded by the German Federal ministry of Economic Affairs and Energy through its initiative "Mittelstand Digital". The centres typically consist of universities and applied research institutes (like e.g. Fraunhofer Institutes) which are specialized in the development and use of digital technologies. The 25 centres are unique in two regards. First,

[3] In the survey, respondents had the possibility to opt for a particular kind of obstacle or not.

[4] Schröder C. and Dienes C. (2017): Datensicherheit und fehlende Standards im Mittelstand. In: Fit für die Zukunft - Herausforderungen und Trends für den deutschen Mittelstand, Dresden.

they have a thematic focus, e.g. concentrating on qualified work in a digital age, eStandards or developing smart products. Second, most of them have a regional scope, so that companies can benefit from regional proximity to the centre's activities. These include, for instance, lectures to inform business leaders and employees about the benefits of digital technologies and more practically oriented events, like workshops. Beyond that, centres also provide firm-specific support taking into account that smaller companies can have peculiarities that differ from other enterprises.

A highly digitized production site of a manufacturing company often refers to a smart factory that makes full use of Industry 4.0 technologies. However, for most of SME owners and employees, smart factories are just a vision that sounds too vague and hardly tangible. That is why many competence centres offer the possibility to have a look at a smart factory where production lines are completely digitized. What they typically do is to introduce some Industry 4.0 technologies which could be relevant in the future. E.g., with increased complexity of smart factories due to individualized customization, more dynamic allocation of capacities and shorter changeover times (McKinsey 2015)[5], there is the challenge for employees to gain the necessary qualifications to handle digitized machines. The project Appsist undertaken by several companies and state-owned institutes engaged in artificial intelligence and technical training tries to address this challenge. The aim is to develop assistance and knowledge services that use augmented and virtual reality technologies to support employees when using cyber-physical systems in a smart production site. Essentially, these services attempt to compensate a possible lack of employees' competences when using these systems. Also, smarter production is likely to increase the number of short-cycle adjustments in production planning and control. The project SOPHIE[6], undertaken by universities and companies developed a support system that enables decision makers to secure interventions in real production by simulations. Put differently, machine and other production-related data are used to run simulations of the production process so that employees can reconcile planned and actual processes.

4. 'Trusted cloud'-Labels: A way to reduce information asymmetry

Earning the benefits from digital technologies often requires high investments. Generally, this involves risks. With regard to manufacturing companies, a possible risk is the reduction of process reliability when implementing digital technologies (McKinsey 2015). And particularly for SMEs, such investment decisions are more critical due to their limited financial resources (Brink et al. 2017)[7]. However, there are possibilities for SMEs to circumvent these obstacles. Instead of investing in own digital infrastructures, SMEs could use cloud services which allow companies to get access to the newest hardware and software. More importantly, companies can access cloud-based platform solutions enabling them to exchange data with other companies, thus, realizing the digitization of value chains (Fay et al. 2016)[8].

In general, companies have concerns regarding data security and legal certainty when they exchange data with IT-systems outside the company. What is typical in the German context is that business owners wish to know where their data is stored and processed (Schröder 2015)[9]. Relatedly, companies also tend to have a preference for using local cloud and storage providers, because they trust in domestic technologies (McKinsey 2015). Although SMEs are not more likely to share these concerns as compared to larger firms (compare Figure 2), data and legal concerns are expected to become more severe when SMEs digitize their value chains. The association "Kompetenznetzwerk Trusted Cloud" which has been founded in 2015 and whose members are several federal associations, applied research institutes, and companies attempts to address these concerns. Roughly speaking, it gives a seal of quality for cloud providers. Depending on the cloud service offered, companies have to meet minimal requirements to be labelled as a 'Trusted cloud' company. For example, cloud providers have to disclose their mechanisms to ensure data protection and all subcontractors

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[5] McKinsey (2015): Industry 4.0: How to navigate digitization of the manufacturing sector.

[6] SOPHIE stands for "Synchrone Produktion durch teilautonome Planung und humanzentrierte Entscheidungsunterstützung".

[7] Brink S., Dienes C., Icks A., and Schröder C. (2017): Nutzung von Cloud-Computing im Verarbeitenden Gewerbe, IfM Bonn: Denkpapier 01/17, Bonn.

[8] Fay A., Jasperneite J., and Löwen U. (2016): Aspekte der Forschungsroadmap in den Anwendungsszenarien, Ergebnispapier.

[9] Schröder C. (2015): Auf dem Weg zur vernetzten Wertschöpfung - Existiert eine Digitalisierungslücke im deutschen Mittelstand? IfM Bonn: Denkpapier 02/15, Bonn.

with which they do business. Thus, companies interested in using cloud technologies can easily access information helping them to choose a particular cloud provider. Such information include, e.g., the law that is applicable in case of legal problems and the location of the data centre.

5. "Plattform Industrie 4.0": A superordinate discussion on meeting the challenges of digitization

Besides more applied measures, companies need good framework conditions which enable them to successfully digitize their businesses. In Germany, a prominent platform is called "Plattform Industrie 4.0". Different stakeholders from science, labor unions, and business organizations discuss how to address the challenges of digitization resulting in recommendations for action. This approach takes into account the different impacts of digitization on business and society. One important topic on the agenda is the discussion about general standards and norms which are used internationally. The platform also addresses the legal framework, like data-processing laws and questions regarding data ownership. Equally important, there are also crucial societal questions for which the platform is the basis for discussion. This includes, for instance, concerns of many people that companies reduce their staff as they shift to a more capital-intensive production.[10]

6. Concluding remarks

SMEs face many headwinds when they aspire to (further) digitize their business. The most important reason as to why SMEs are often considered as digital laggards is that they typically have fewer resources as compared to their counterparts. Additionally, owners of SMEs perceive their business to be better digitized as it actually is which could reduce their digitization efforts in the future. However, the way to digitization does not necessarily have to be bumpy, because there are measures that support SMEs in their digitization efforts. As a first step, measures should aim at sensitizing SMEs with regard to which digital technologies could be appropriate for their business. A more visionary view of digitization is the realization of smart factories which completely consist of Industry 4.0 technologies. Of course, in many cases, realizing a smart factory is unrealistic to many SMEs as of today. What is more important, however, is to make owners and employees of SMEs aware of the opportunities of Industry 4.0 technologies. In Germany, this is mainly done through competence centres that use different channels through which companies can get support. Moreover, 'Trusted Cloud' initiatives can help SMEs to get more information about cloud providers and, hence, to build trust in the services offered. SMEs as well as larger companies also profit from good framework conditions. This requires a superordinate discussion on how to overcome digitization related challenges for which "Plattform Industrie 4.0" is an important forum in Germany.

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[10] For more details about the platform, compare Plattform Industrie 4.0 (2018): 2018 Progress Report, Berlin.