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Digitization of the Integrated Supply Chain in Danish SMEs

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Preface:

Both digitization and supply chain management are components that have proved, in general, to offer increased productivity both individually and together and hereby create competitive advantage (Catherine Marinagi, Panagiotis Trivellas, Damianos P. Sakas 2014). However, through our study of 8 Danish companies, we have found that these companies have only taken advantage of such benefits through digitization to a limited extent. Through our case study of a Danish logistics SME, this paper will endeavour to show how such companies might improve their degree of digitization with a particular emphasis on their supply chain to harvest such benefits. The research in this paper is thus not only targeted at other researchers, but also aims to communicate it´s key points to the business sector, primarily CEO's of small and medium-sized companies.

Thus, the purpose of this paper is to identify the most important features that companies must attend to when implementing an integrated supply chain (ISC) by means of a literature review and primary research on 8 Danish companies, as well as a more in-depth case study. Subsequently, we will set out the tangible benefits of such implementation as well as the issues arising when such companies strive to integrate and digitize their supply chains.

Research question

How have Danish SMEs worked on digitizing their integrated supply chain and which challenges have they faced and what is the potential for further digitalization?

Definition (preliminary):

A supply chain is a network of organizations and activities that supplies a firm with goods or services (Operations Management Jay Heizer Barry Render Chuck Minson). The primary focus of our research is how small and medium-sized enterprises (SME) strive to integrate such networks and activities by exchanging data, schedules etc. in order to allow for smooth transitions between external and internal business activities when producing and transporting various good, as well at optimising attendant processes and services.

We follow the standard definitions of SMEs in use by the EU, i.e. a small company is one with less than 50 employees, an annual turnover and balance sheet each of no more than €10 million, whereas a medium-sized company employs less than 250 while having an annual turnover of no more than €50 million and a balance sheet of no more than €43 million. (OJ L 124, 20.5.2003, p. 36–41) We do not look into the EU's smallest category of companies, i.e. micro companies with less than 10 employees and no more than €2 million in annual turnover and balance sheet.

Methodology:

To shed light on relevant topics that can answer the research question, and serve as a source of information for CEO's and CTO's of small and medium-sized companies, we have collected primary data from 8 Danish companies in order to create an overview of their use of integrated supply chains (ISCs). This is supplemented by data from a more in-depth case study from an SME that has already achieved good results by working with digitization. Furthermore, secondary data from databases at Danish universities have been searched and a number of articles has been chosen.

Primary Data

The primary data underpinning this paper were collected as a series of structured interviews with the aforementioned 8 Danish companies. These interviews were conducted by students from Zealand Institute of Business and Technology in the spring of 2020. The students each had their three months' internship in the companies that participated in the interviews and followed a strict series of standardised questions composed by the authors of this paper. This format was chosen to standardize the data and allow for ease of comparison and to guide the students conducting the interviews directly towards the topics of interest to this paper in general and specifically pertaining to its research question. The use of these students as interviewers also allowed for a greater degree of familiarity and trust between interviewer and interviewees, as their roles and experience as interns, and thus as insiders (at least to some extent), allowed them to pose and present these standardized questions in a way that fitted the context of each company. This aspect allows for a greater level of rapport between interviewer and interviewee based on pre-existing relations, trust, shared experiences and knowledge, while the standardized questions impose a uniform frame of reference across the various companies. Although the questions were standardized, the data itself is mainly qualitative, though it does have a few quantitative aspects with regards to the benefits experienced by our ninth SME from its implementation of various digitization, automation and data exchange projects.

The 8 companies, with which these structured interviews were conducted, are widely distributed across the Danish region Zealand. The companies represent different industries, comprising 6 manufacturing companies, 1 service company, and 1 IT company. This allows us to at least somewhat bypass issues particularly relevant to certain sectors and look more widely at the experience of SMEs relating to integration and digitization of supply chains, as they pertain to companies of this particular size.

As some of the companies in our sample wished to preserve their anonymity, we have thus refrained from naming any of the companies in our sample and have vetted the answers we present in this paper to exclude characteristics that might identify any of the companies in our sample. Due to such confidentiality concerns we will not comment in depth on any single

company. Instead, we summarize the answers we receive within the area covered by each question and evaluate what general patterns they evince and compare them to a more detailed case study of another (ninth) company as mentioned below.

The data from these structured interviews were subsequently supplemented by a more detailed questionnaire, posing a series of detailed, closed questions to another Danish SME that has already worked extensively on digitizing its supply chain and other internal and external processes. This allows us a more in-depth look into a company that has already worked consciously with these issues, thus contextualizing and extending the data from the structured interviews.

We thus apply the theoretical framework from our literature review to primarily this ninth company, in order to compare the general prescriptions and predictions of the theories to the actual experiences of an SME. This will allow us to situate such theoretical knowledge in a specific, practical context, including the company's organizational setup. In order to widen the scope from this single, in-depth case, we will finish our analysis by comparing the data on the 8 other companies, in order to identify potential gaps in the literature as regards the actual issues faced by SMEs. Through this process we will strive to create a framework for how such Danish SME´s work on digitizing and integrating their supply chains, along with the typical issues they face during the actual implementation of such processes.

Literature review:

Ford et al. (2011) focuses on the link between technology and managing business relations. Because the cost of technology is so high that no company can own all the technology needed, value creation lies in how technology is now and how it can be developed in collaboration with others in the network. Ford identifies four general aspects for management to observe:

1) Knowledge: beyond its own technology and into the technology of the network
2) Control: the company loses full control over the direction of its technological development
3) Change: the way technology is handled takes place in relation to others in the network

4) Bundling: A single technology has no value until it is combined with the technology of others.

One relationship to be developed is trust between the participants in the network. A major advantage is that the fields of common knowledge open up both to innovation and to complimenting resources. (Ford, 2011).

For Stevens, the purpose of integrating the supply chain is to handle customers' needs and the flow of materials. In terms of the organizational impact, Stevens offer a simple model:

1) Competitive environment evaluation - Identify customer needs.
2) Supply chain diagnostics diagnostic review – determine operational options with potential for improvement
3) Supply chain strategy development - organised options into an integrated supply chain strategy. (Stevens, 2020)

Lofti et al. gives a view on what data to share:

1) Inventory Information
2) Sales Data
3) Sales Forecasting
4) Order Information
5) Product Ability Information
6) Exploitation Information of New Products
7) Other Information.

(Lofti, Mukhtar, Sahran, & Zadeh, 2020).

Racik and Racik describe how supply chain (CH) can be a means to co create sustainable solutions with such so creators divided into three categories:

1) Focal firm stakeholders: Employees, unions, consumers, managers, owners/investors etc.
2) Supply chain stakeholders: Suppliers, distributors, consumers etc.
3) Stakeholders beyond the supply chain: Governments, communities, competitors, NGO's, the media.

While our paper does not focus on category 3 and only parts of categories 1 and 2, an important issue in this classification, as it pertains to the Danish SMEs in the study, is that they are all facing a multiplicity of challenges and pressures. In addition, the relatively small scale of an SME typically does not allow them much in the way of leverage or negotiating powers in navigating these issues.

The impact of Information Technology on the development of Supply Chain Competitive Advantage 2014
Catherine Marinagia*, Panagiotis Trivellas, Damianos P. Sakas.

This article applies a literature review to uncover how a company can gain competitive advantages by coordinating and adapting technology to the capabilities of the organisation and its business partners. The authors distinguish between supply chains as a means to create competitive advantages and performance, and IT routines as a means to promote information sharing across and between supply chain partners through integration of internal and external business practices and processes.

Applying a definition from Ketchen, Rebarick, Hult & Meyer, the authors view competitive advantages as *"the extent to which an organization has the competency to create a defensible position over its competitors as a result of critical management decisions, which differentiates itself from its rivals. Although empirical research has indicated cost, quality, delivery, and flexibility as important competitive capabilities."* (Ketchen et al., 2008)

In addition, Marinagia et al. highlight the functions of time and innovation in creating competitive advantages, with the role of IT systems being to promote and support business activities, decision making and productivity. One way of doing this is to integrate with external business partners, using various IT solutions, in order to create "extended value chains". (Marinagia et al., 2014, p. 588).

This perspective on exchanging data is of particular relevance to the scope of our paper as it sets up an ideal(ized) framework as a yardstick against which we can compare our findings

from the Danish SMEs. Without completely preemtping our conclusions, it suffices to say that none of the actual SMEs in our study match the ideal(ized) scenario from Marinagia et al. in which the focal company shares and exchanges data with both suppliers and customers. We have thus structured our analysis according to whether a company shares its data with either suppliers, or customers, or both. We subsequently look at each of these three categories in detail, in order to see which kind(s) of data are shared and how digitization is incorporated into these processes and/or how (further) digitization might allow for improvements within each of the categories.

Analysis

What is the current state of technology in the SMEs in question?

It is clear from our findings, that the eight SMEs in our structured interview are busy introducing many and various types of internal technologies. Many of them have no or only limited capacity to exchange data with their partners automatically, leading to many manual processes and procedures. However, we have decided to classify such manual exchange of information as equivalent to the automatic exchange prescribed in the various theories, as both serve the same purpose: Coordination of supply chains via exchange of information. We analyze these part and manual data exchanges as it still highlights issues posed by any exchange of data, making the exact form(at) of the exchange less important by comparison. An increased degree of automatization in these exchanges may entail greater advantages, not least because they allow for faster and more uniform data exchange, but we will not delve into these topics in our analysis.

What SCM challenges do you see for the company in the coming years?

The major challenges faced by the eight SMEs in our structured interview vary considerably. They are very specific to each company, depending on their current situation and prospects. To illustrate the breadth of these topics, they run the gamut from implementing systems already purchased to optimizing various processes needed to cope with COVID-19 and its associated

challenges. However, there is one common denominator in all of these issues: The need for digitization to help deal with all of them.

What SC areas is the company currently working on?

All of the eight SMEs in our structured interview sample have several, different, ongoing IT projects that focus on optimizing the information available to the company, as well as managing the internal flow of information. These patterns are also one we recognize from not just SMEs, but also other companies we encounter through our work: All are in the process of digitizing various parts of their activities. While there is a huge variety in the degree to which companies are digitized or the scope of their digitization efforts, the importance of digitization is one that every company agrees on and sees as a crucial task. The general tendency is for the companies to focus on purchasing and implementing systems to improve the quantity, quality and flow of the data available to the company. The purpose is to improve flow of goods and services within the company, as well as optimizing various internal processes through the introduction or expanded utilization of ERP or barcode systems etc.

What new technologies do you expect to be crucial for SCM in the future (robots, IT, etc.)?

All of the SMEs in our structured interview sample agreed that further introduction and implementation of IT solutions, robotics etc. will be crucial to their future SCM efforts. As such technologies require a high degree of pre-existing digitization within a company, they present yet another reason that the SMEs in our sample emphasize the importance of and focus their efforts on digitizing their various internal processes to lay the groundwork for introducing and implementing such technologies in the future.

What IT-systems do you use in the company - ERP, CRM, WSM etc.

Ideally, we would have wished to acquire a full list of the various IT systems that the SMEs in our study employ in their supply chain management. Unfortunately, such a complete overview proved impossible to create, leading to a more fragmented and partial picture of these systems as they exist in our SMEs. Nevertheless, even from these fragmentary answers, it was clear that

none of the SMEs had a “best practice” IT solution that would define them as fully or extensively digitized companies.

Do you exchange data (EDI, Forecast, production plans VMI ect.) With your suppliers or customers?

Many of the SMEs in our study do share data with suppliers and customers and have various degree of experience in doing so. Those who have such experience report that sharing data has been beneficial and thus have kept or even expanded such data exchange. As the companies were unwilling to divulge the exact nature or type of data shared, we will not elaborate further on this topic and cannot identify whether particular types of data dominate the exchange with external business partners among the SMEs in our study.

Our overall impression is that companies with higher levels of outsourcing have greater degrees of data exchange with business partners and also hold the most positive view when it comes to such exchanges. We put this pattern down to the dependency of such companies on their partners vis-à-vis the outsourced products and/or services.

By contrast, a more procurement oriented company typically has a wide selection of potential suppliers and are less dependent on any single one, leading to a more transactional relationship as opposed to the partnering we see in the companies focused on outsourcing. In such a transactional approach, there is less need to share data, as the company can easily shift between suppliers and price, as well as other contractual obligations, terms and conditions can function well enough to govern the flow of goods between the company and its suppliers.

The general pattern among the SMEs in our structured interview sample is that there is no overall digitization strategy, similar to those depicted in our theoretical framework. Instead, digitization is mainly driven by the short-term, practical challenges faced by each SME as related to resource optimization and cost savings. This pattern corresponds to Ford et al.’s concept of a loss of full control over the direction of its technological development (Ford et al., 2011). Indeed, this issue could be put even more starkly: As SMEs, the companies in our study may not have the option to fully control their own technological development, given their scale,

which may lead to external parties and trends forcing particular types of technological developments on them. These issues are further exacerbated by some of the SMEs lacking either the in-house resources (money, time, skills) to conduct the analyses and other work to develop such strategies, nor do such SMEs not possess the financial muscle required to purchase external specialists or consultants to develop strategies for them.

Do you have any plans to exchange data with suppliers / customers?

Most of the SMEs in our structured interview sample wish and/or expect to exchange data with their business partners and expect that such exchanges will be advantageous. When it comes to those of the SMEs who have already had some experience with such exchanges of data, the unanimous response is that the experience had been positive.

Our findings as they relate to our theoretical framework

From both the SMEs in our structured interview sample and from our prior experience, it is clear that there is a general consensus among such companies about the importance of and focus on digitizing various internal processes. These efforts may take many different shapes, from using Excel to calculate various offers and the consequences of their models of payment, to integrating a webshop with an ERP and WMS system in order to digitize the flow of orders from entry to shipment.

As the increased competition from the large and typically global players in the market puts ever more pressure on the SMEs to optimize their costs in order to maintain earnings and profits, digitization may hold at least some of the answers - something about which the SMEs themselves seem to agree on in general. Hence, a digitization strategy would appear to be largely a matter of which specific strategy would be appropriate, rather than whether a strategy should be developed. However, due to the mainly short term perspective for SMEs, as well as their small scale, their current ability to develop strategies in line with the prescriptions found in our theoretical framework tend to be quite limited.

As Ford et al (2011) put it, the scale of investment necessary, if a company was to purchase all of the technology it would need, would be beyond the grasp of any company. One counter example would be that, given the decreasing costs of robotics over the previous decade, even SMEs now have a realistic option to acquire and implement such technology. Similar patterns can be discerned when it comes to digitization, as the supply of IT solutions and server space are many and varied, as are the companies that supply them. This also applies to the payment structure for these systems, which tend to be based on a per use basis. An exception to this general rule is EDI systems which tend to be relatively expensive, but even here, less costly alternatives exist, e.g. PlanEven.

A more in-depth look at another SME

Here we will look more into the single SME mentioned in our methodology, i.e. one separate from the eight in the sample with which the structured interviews were conducted. This company provide a bit more practical context, in addition to the general patterns evinced by the eight other SMEs as described in the various summaries above.

An overarching strategy for digitization?

This SME does not have an explicit or clearly defined digitization strategy and whatever partial policies or strategies that relate to digitization are not strictly implemented or adhered to. Instead, the company focuses on its core competencies and processes and applies a “to be” design of its future processes. This “to be” design is not digitized either, but is drawn on a whiteboard and used as a form of stakeholder management when working with both process optimization more generally with particular digitization efforts. This is an interesting example that not only follows the pattern from the eight SMEs above, but also illustrates how a very “low tech” solution is applied to the management of a wide selection of various processes, including the company’s digitization efforts.

Digitized areas of operation, internally and externally?

The SME has implemented a wide variety of digitized solutions, internally, as well as in relation to external business partners. Examples include a transition from an analogue, paper based picking system to a mobile “pick by voice” solution. This has increased not only picking speed,

but also the quality of the product sent to the customer at one end of the process, and of the product delivered from the SME's supplier(s) due to "pick by voice" receipt of goods.

A further benefit is that such digitization allows for clearly identifiable and quantifiable benefits by making it easier to track and extract process data. The SME has also invested in an EDI software robot that automatically alerts customers when their order is ready and also invoices them, as long as a series of present criteria are fulfilled. The SME is also currently working on extending the proportion of orders that its EDI software robot can handle automatically as well as the integration with its procurement system mentioned below.

In relation to its suppliers, the SME has set up a procurement system that automatically calculates current inventory and handles communication with suppliers in the case of discrepancies. This is an example of not only the general, internal digitization seen in all of the eight SMEs mentioned above, but also a more extensive use of data exchange with external business partners, and, perhaps more importantly, of the application of automated monitoring and exchange of data, integrated with the SME's own internal operations.

Specifically, the benefits experienced by this SME included:

- The error rate on outbound orders has been reduced to less than 1%
- The company handles around 20% more product lines than before, using the same number of staffs
- The EDI software robot handles 30% of incoming EDI orders
- All company devices, internal and external, show live inventory and process status

The necessity of internal digitization as a precondition for external digitization?

As illustrated by the eight SMEs in our structured interview sample, one barrier to exchanging data with external business partners is a lack of internal digitization. This leads to SMEs being cautious in embarking on external data sharing, because they estimate that they are simply not ready, in terms of data quantity and quality, to share data with their partners and may be fearful of overpromising. Nevertheless, most of these eight companies have enough data of sufficient quality to allow for some degree of data exchange with their external business partners.

With our ninth SME there has been less hesitancy to attempt data exchange, even before all of their internal processes were fully digitized. This confirms the pattern of full, internal digitization not being a prerequisite for exchanging data with external business partners. The focus on internal digitization seems to stem more from the fact that the company fully controls these internal processes, making planning and implementation comparatively easier and keeping transaction costs low in terms of the type of negotiations, contracts and similar terms and conditions that data exchange with external business partners typically entail.

Rather than embarking on an ambitious overarching digitization strategy of an integrated supply chain, a more feasible, incremental and practical approach would be to map all of an SME's internal processes and evaluate which one(s) is most likely to free up substantial resources through digitization, as well as whether such digitization can be easily implemented. This latter point often entails fairly simple solutions, which are liable to be implemented quickly and provide a fast return on investment, whether in capital, time, or process optimization and/or standardization. One example is the "ideas box" and its attendant committee that are mentioned below.

The impetus for digitization?

As with many other companies, the ninth SME has a lot of paperwork, which requires substantial resources to run and maintain when in actual paper form. Digitization thus reduced such upkeep in both time and money, justifying the cost of transition. A further benefit is that when changes inevitably occur that necessitate the updating of the paperwork, a digitized system is more likely to handle the knock-on effects throughout the organization well, as changes do not always have to be made to each set of physical records and updated in each organisational unit or process. Instead, a digitized system allows for a greater opportunity to make a few sets of changes that are then updated throughout the company and its processes, whether they are instigated as a top-down procedure from management, or as a bottom-up initiative from the staff.

Most of the ninth SME's digitization projects are thus focused on freeing up internal resources that can be spent on customer centred efforts, ultimately improving the SME's competitive advantages. In practice, this means that staff can spend more time in dialogue with the SME's

customers, as well as on customer service, allowing for better information on customer preferences and customer value. While the SME has not made any explicit ROI calculations, the general impression among staff, as well as management, is that these various digitization and automation efforts have definitely been worthwhile.

Digitization as an impetus for further innovation?

The ninth SME has an explicit focus on innovation, especially with regards to implementing new technology in its products and processes. Their own impression is that their introduction of the various digitization projects have sharpened the perception among its staff in terms of their individual role(s) not only in the implementation of new technology, but also in identifying and developing new areas of potential improvement and innovation as part of their daily work. A formal, institutionalized example of the inclusion of the employees in innovation processes, as well as a signal that the SME sees them as potential instigators of such processes is the "ideas box" and how the SME uses such input, as described below. Similarly, the SME is working on attracting students to the company as interns as well as partnering with students in developing projects and new approaches that may inspire future innovation within the company, as well as in its relation with its external business partners.

The role(s) of project and change management, employee involvement and selection of suppliers?

The ninth SME relies heavily on its "to be" design of the desired result of its processes and core competencies, as already mentioned above. The company's constant dialogue and informal exchange of knowledge with other people and companies within its sector also act as input for new "to be" designs, as well as a form of informal benchmarking, as to whether the SME is up to date with current market trends and the efforts of its business partners and competitors. In line with the earlier experience from the eight other SMEs, as well as with its own approach to digitization and supply chain integration, the ninth SME focuses particularly on practical solutions that will yield fairly quick and tangible results, rather than the grand strategizing prescribed in our theoretical framework.

Among these practical initiatives is the classic "ideas box" into which employees can deposit their ideas for improvements. Such ideas, along with the status of any ongoing improvement

projects, are discussed and tracked on a weekly basis by the "ideas committee" and all employees receive updates and feedback on both the ideas, as well as on any projects they might occasion. In terms of numbers, the SME has implemented more than 300 of the ideas that its staff has submitted on card in the "ideas box".

Challenges or barriers to digitization?

The major challenge in all of the digitization projects in the ninth SME is data quality, which stems from the need of the EDI software robot to have high quality, uniform data in order to function properly. While such problems can initially act as a barrier to digitization or as an excuse to limit it due to the initial efforts required, the need for high quality data can ultimately act as a spur for further digitization, as such data opens up new possibilities. However, the costs of high-quality data do not simply occur only as part of the initial implementation process, but also in the subsequent processes and maintenance phases due to the need for data discipline among the SME's staff. This means that errors, "noise" or miscategorization can quickly create problems for automated systems, requiring staff vigilance whenever data has to be entered or changed manually.

Particular benefits or problems?

One benefit of digitization for the ninth SME, apart from freeing up internal resources, is a significantly improved competence matrix across its entire staff. With more tasks and processes being digitized, automated and simplified, more of the employees are able to contribute to processes that once required specialized knowledge held only by a limited number of staffs. This means that employees can more easily contribute to each other's work, allowing for a more flexible system that are able to respond more quickly to sudden customer demands and to shift staff resources when demand shifts and/or peaks. All of these characteristics contribute to the competitiveness and competitive advantages of the SME, as it becomes more responsive to its customers.

General conclusion and summary of findings

SMEs have many challenges around data - this ranges from finding them to ensuring they are valid. This means that data sharing can be challenged by basic lack of data. In addition, there

are few companies that have a data basis for preparing forecasts. This makes it fundamentally difficult to benefit from data sharing. However, there are companies that have data and work with this and where there is a close relationship between the companies (Partnership) so they benefit greatly from sharing data and thus achieve a significantly higher delivery rate while they can minimize inventory. It also appears that SMEs do not have a long term strategy for digitalization, but look for short term solution when there is a need for improving their business.