

# Challenges in Developing Data-based Value Creation

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**Abstract:** Understanding data-based value creation helps organizations to enhance its decision-making and to renew their business operations. However, organizations aiming to use modern data analytics face several severe challenges that are not usually so evident or visible beforehand. In this paper we study a Finnish manufacturing company's data empowerment and information and knowledge management practices in order to identify the potential challenges related to modern data-based value creation within industrial context. The empirical data is consisted of group discussions, relevant data sets acquired from the case company's information systems, and lastly, 12 thematic interviews of the key actors in the company in relation to service development. The study provides valuable insights for managing service development and decision-making and creates understanding on data-based value creation. Achieved understanding provides meaningful knowledge for organizations utilizing or having plans to utilize, for example, data analytic methods in their businesses.

## 1 INTRODUCTION

Organizations seek ways to create value from data to improve their decision-making capabilities and productivity. Usually the amount of available data is not an issue anymore (Chen et al., 2012). However, the organizations need to distinguish what data is relevant, how to refine it, how to share it within the organization and if needed, to other stakeholders, and how to use it in decision-making (Kaivo-oja et al., 2015; Choo, 1998), and furthermore, in creating value for themselves, their customers and/or other stakeholders. This is referred to as data-based value creation (Xie et al., 2016).

Understanding data-based value creation helps organizations to enhance decision-making and renew business operations. However, most research focuses either on knowledge and its management (Hislop, 2013, Dalkir, 2013), or data and information quality issues (Hazen et al., 2014). Quite rarely the value chain from data to knowledge and its utilization are illustrated.

In this paper we study the information and knowledge management chain in an organization, and

the challenges faced in creating data-based value. Our case study consists a Finnish manufacturing company that seeks ways for better use of data in their service development and related decision-making. They believe that integrating different data sources and using their aggregate in decision-making would bring competitive advantage and value for them. However, similarly to many organizations using modern data analytics (Ransbotham et al., 2016) or knowledge management initiatives in general (Carlucci and Schiuma, 2006), also our case organization faced several challenges that were not evident or visible beforehand.

In this paper, we try to understand the case company's value chain from data empowerment to information and knowledge. We thus answer to question "what kind of challenges the case organization faces in data-based value creation"? Our study illustrates practical challenges in relation to research literature from several disciplines increasing our awareness of intertwined nature of issues and path dependency between details.

The structure of the paper is as following. Firstly, the theoretical premises of the study are presented,

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focusing on the process model of information management that acts as the analytical lenses for the empirical study. Before opening up the findings from the empirical study, the methodological choices and the research setting is discussed. The paper ends with conclusions and identification of future research avenues.

## 2 THEORETICAL SETTING

Knowledge-based approaches, like data-based value creation, aim to understand and explain how organizations internal and external knowledge resources contribute to organizations' competitive advantage (e.g. Grant 1996; Myllärniemi et al., 2012). In this context, knowledge refers to the outcome of human action that takes place in decision-making situations. Knowledge, furthermore, is based on information and the actor's interpretations on it according to their experiences and to a certain context. Information, in turn, is processed from data by adding some meaning to it (Choo, 2002). Data, on the other hand, is unstructured facts that have the least impact on the managers (Thierauf, 2001). Knowledge is the most valuable for decision-makers (Thierauf, 2001).

This chain from data to information to knowledge emphasizes its connectiveness. Knowledge does not emerge from nowhere but from data and information. This means that in order to make good, knowledge-based decisions, information and data needs to be of good quality, and available in decision-making situations.

Knowledge processes should be tightly connected to service provision and value creation (Myllärniemi et al., 2012). Value in business context is generally regarded as the trade-off between benefits and sacrifices (Helander and Vuori, 2017, Walter et al., 2001). In data-driven value creation, the focus is on analyzing the monetary and non-monetary benefits and sacrifices related to data, information and knowledge. Thus, value refers to the individuals' enhanced decision-making capabilities and improved productivity or performance (cf. Pirttimäki, 2007; Grönroos and Helle, 2010). In order to exploit the organization's value creation and its full potential, the company needs to focus on its capabilities to provide products and services that are of high quality, available when needed and produced cost effectively (cf. Nordgren, 2009; Lönnqvist and Laihonon, 2012). Consequently, the fluency of knowledge processes and practices is a critical success factor and driver for value creation. (cf. Kianto et al., 2014).

Knowledge management considers the processes and activities supporting the utilization of knowledge resources (Wiig, 1997), and further, information and data. One means to structure information processing is the process model of information management (Choo, 2002). The process model is a framework of deriving knowledge and insights from data and information, but it leaves out the knowledge management layer and the connection to strategic level. In this study, we utilize Choo's model as a foundation when analysing case organization's knowledge processes, but we leverage the model according to Jääskeläinen et al., (2019) in order to include the whole value chain from data to knowledge in the analysis (see Figure 1).

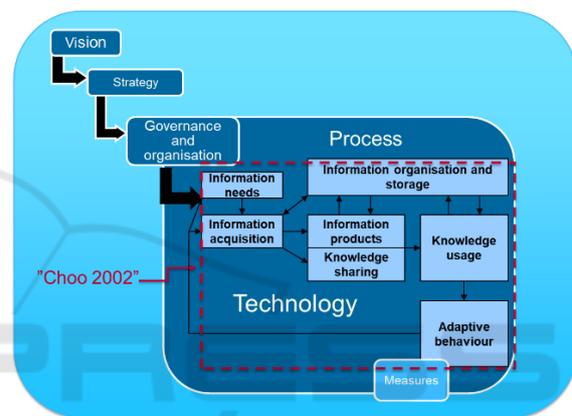


Figure 1: Framework of information and knowledge management (Jääskeläinen et al., 2019; Choo, 2002).

This information and knowledge management framework includes the more technical side of information handling and the softer side of humans related to knowledge, but it also takes into account both the viewpoints of the employees and the organization (Jääskeläinen et al., 2019). As Lake and Erwee (2005) have stated, information and knowledge management is about of finding, selecting, organising, distilling, and presenting information in a way that improves an employee's understanding within the work context. Furthermore, it also enhances organizations to gain insight and understanding from its own experience and data sources, and support utilization of knowledge in problem solving, decision making and strategic planning. (Lake & Erwee, 2005)

Within the framework there is the process of information management (Choo, 2002). The process starts with specification of information needs. The needs are first defined so that they can be later satisfied as well and efficiently as possible. Based on this definition, information is then acquired and

gathered both from external sources, such as competitors and customers, and from internal sources, such as operational databases and information systems. The collected information is stored in organization’s repositories. This means the phase of information organization and storage where the aim is to create an organizational memory. This facilitates not only latter phases such as information analysis for systematic and advanced information products/services, but also the phases of information sharing and information use. Information gets its final meaning when it is utilized for instance in decision-making, and changes in the organizational activities take place. By utilizing and adjusting organizational operations, the cycle starts over. It should be noted that the process is an iterative process and that the fluctuation between stages is not always straight-forward (Gilad and Gilad, 1985; Choo, 2002; Vitt et al., 2002).

### 3 RESEARCH METHODS AND EMPIRICAL SETTING

We have conducted a case study (Yin 1994) of a globally operating manufacturing company, located in Finland. The company has approximately 500 employees in 15 countries. The company exports approximately 90 per cent of its products. It is established in 2006.

The study was carried out in 2016, with a focus on their service development. Our empirical data is consisted of group discussions and workshops, different data sets from the company’s information systems, and 12 thematic interviews of the key actors in their service development. The list of interviewees is presented in Table 1.

Open-ended interview focused on different themes related to their service development and information usage. The themes included information needs, managerial practices, knowledge concepts, information technology and information systems, and knowledge and network dynamics. The interviews were conducted face to face in the company premises. They lasted for 30 to 90 minutes.

Kianto et al. (2014) say that “management mechanisms should be analysed to understand the key factors that impact firms’ ability to create value based on knowledge”. We analysed the interviews, group discussions and workshops, and data sets by using Choo’s (2002) process model of information management as a lens for analysis. By this analysis, we were able to point out challenges related to information needs, information acquisition, refining, sharing and utilization, i.e. all phases of Choo’s model. Afterwards we analysed what are the requirements for data and information empowerment, and summarize our lessons learned how to create value and actionable knowledge from data.

### 4 DATA-BASED VALUE CREATION IN THE CASE ORGANIZATION

Choo’s (2002) process model is a tool for organizational development. Table 2 summarizes our findings related to the model, and categorized the challenges in related to its main components. Through these challenges, the role of knowledge management in the case organization could be understood (cf. Valkokari and Helander, 2007).

Table 1: The List of Interviewees, Their Titles and Main Work Activities.

Title	Main work activities
Business development manager	Market intelligence
Chief mechanical engineer	Product testing, quality measuring etc.
Condition monitoring engineer	Customer contacts, service data analytics
Customer service engineer	Operation planning: information management, service reports etc.
Development engineer	CRM administrator, ERP main user, sales and operation planning
Global product manager	Team manager of service products, data management
Manager conceptual design & analysis	Part of management group
PLM manager	Only inner support of PLM system
Quality engineer	Product development from quality point of view
Sales manager, Northern Europe	Head of service sales
Unit manager, Finland service	Head of field services in Finland
Vice president of product management	Head of global product management

Our case organization has significant challenges in its knowledge management. The analysis illustrates the organization's own perceptions: their data quality is poor in general, data is distributed throughout the organization and its information systems, and they have not enough resources to analyze it. This evidently creates problems especially in the management of product information and, further, data analysis.

Above mentioned challenges are quite general by nature. However, the problems and their root-causes are more profound and complex, and are only revealed after careful examination. For example, there is friction between different in-company interfaces, i.e. between departments, between information systems, and even between people. One example of friction is in customer relationship management. According one of interviewees "it is sale's duty to collect feedback from customers". However, our studies revealed the organization has many customer contact points, official as well as unofficial, across the organization to collect the information and no guidelines how to collect that information.

"It would be easy to have the conversation with customers if the poor quality of products or delays in service don't come up", said one participant in group discussions. However, during the interviews, few

interviewees were happy with the quality. Communication problems occurred because of unawareness of information collecting and sharing processes. Communication problems occurred even during our group discussions. One participant claim they had made decisions based on information collecting and coordination in a meeting day before our group discussion. The meeting's other participants were confused of this claim.

This unawareness causes cooperation break-downs between sales, operations and research and development departments. For example, the information needs about the customers are neither communicated through the organization nor unambiguously defined. The organization does not really understand the customers. One interviewee wondered "When we are developing data analytics, who is our customer? Do we develop business or are we serving one man's passion?"

The previous quote emphasizes the organization's state of knowledge management. The organization seeks ways to better utilize their data in service development. Yet they do not comprehensively understand the meaning of knowledge and for whom they are creating value. The organization, for example, used 148 emails to find out single product's product number. Like said previously, data and information is incoherent and splattered throughout

Table 2: Knowledge management challenges in the case organization.

Aspect	Challenges recognized
Information needs	<ul style="list-style-type: none"> <li>• Communications break-down between sales, operative and development functions</li> <li>• Poor understanding concerning customer requirements and their crucial meaning for other units</li> <li>• Wrong questions to define information needs</li> </ul>
Information acquisition	<ul style="list-style-type: none"> <li>• Data and information are incoherent and splattered into different information systems and silos</li> <li>• Data logging is insufficient</li> <li>• Information is not easy to use</li> <li>• Not enough ambition to store information to systems, e.g. sales information</li> </ul>
Information refinement	<ul style="list-style-type: none"> <li>• Not enough resources to refine data into information</li> <li>• Current ways of data refinement do not serve decision-making</li> <li>• Lacks in information analytics, like forecasting</li> </ul>
Information sharing	<ul style="list-style-type: none"> <li>• Communication with sales insufficient despite of weekly conversations</li> <li>• Insufficiency in communication leads overlapping in data refinement</li> <li>• Based on customer feedback, information sharing takes time</li> </ul>
Information utilizing	<ul style="list-style-type: none"> <li>• Unrealistic value propositions e.g. in sales</li> <li>• Information systems are not used comprehensively and systematically</li> <li>• Lack of tacit knowledge utilization and sharing.</li> </ul>
Measures	<ul style="list-style-type: none"> <li>• Measurement is not strongly linked to knowledge practices and processes</li> </ul>
Governance and organisation	<ul style="list-style-type: none"> <li>• Ownership of data and information is missing</li> <li>• Culture and policies are built based on products and systems</li> </ul>
Strategy & vision	<ul style="list-style-type: none"> <li>• Impulsive and non-knowledge-based decision-making</li> <li>• There is no will to develop a culture of knowledge management</li> </ul>

the organization and its information systems. Just integrating different data sources and conducting analysis on poor quality data does not bring value for them. The organization has challenges in data acquisition and refinement as well as information sharing. Based on interviews, customers have said that information sharing takes time.

We perceive this is mainly as a management problem. The organization has persons responsible of, e.g., CRM and PLM systems but owner of data-based value creation is missing. Like vice president of product management said: "We have done great things in our own personal sandboxes, now we need a mandate for someone to make changes."

Besides this single quote, organization seems not to have willingness to develop a culture that support data-based value creation. Current situation leads to ad hoc, impulsive, and non-knowledge-based decision-making and unrealistic value propositions. Information utilizing is not as effective as it could be. However, the organization has recognised the problems and has started to discuss these issues. In the next chapter we discuss these problems more general and give some recommendations of data-based value creation to the organization as well as for more broader audience.

In overall, we can conclude the main challenges faced in the case organization as following: 1) data is of poor quality and scattered across multiple systems, 2) there are friction especially between internal interfaces, 3) lack of understanding of importance of data and information, and 4) there is no will to develop a culture of knowledge management.

## 5 DISCUSSION

Knowledge-based organization's performance differences based on firms ability to utilize its knowledge resources and knowledge management processes. Development of knowledge processes should be started by focusing on the decision-makers' and the organizations' knowledge needs (cf. Choo, 2002), and by fostering open knowledge-sharing culture and supportive processes despite of organizational boundaries (cf. Laihonon, 2012). Our analysis shows that knowledge processes must be integrated to other processes within the organization, as otherwise mundane daily operations, high quality information, and information products do not bring value to the decision-makers. The purpose should be on producing insights, visions and knowledge for them.

The case organization has some major challenges related to its knowledge practices: data is poor-quality and information systems are scattered, there are increasing friction of communication between different units, and knowledge is not the prime resource. In order to get competitive advantage and value from data the case organization must change their attitude towards knowledge and take following recommendations into account. These recommendations are general in manner and, hence, are beneficial for other organizations as well.

First, knowledge management must be organization-wide. Data and information must flow through the whole organization in order to serve its business. For example, data governance is approach that provides a more systematic way for managing information as a resource (Vilminko-Heikkinen and Pekkola, 2017). The quality of essential information has to be taken care of. This means looking after data integrity, validity, availability and accordance as well as data management issues.

Second, data-based value creation, i.e. data analytics, is possible to achieve by changing the mindset and attitude towards data. The organization acquired data warehouses and tried to integrated information systems. However, they forgot to discuss the meaning of knowledge in their decision-making and in service provision. Data was not their primary resource, after all.

Thirdly, it is all about management and leadership. Data, information and knowledge resources are key factors determining organizations value creation potential but equal factor is the management (Kianto et al., 2014). It must have a person who is responsible of it. Data needs owner like organization's other key resources have. Kianto et al. (2014) continue by saying that poor management could damage value creation although organization has the best workforce and working ICT-systems.

As a summary, the data-based value creation is the issue of the whole organization. The major problems are related to clarification of the role of knowledge and to poor management. This lead to challenges like undefined knowledge needs, insufficient knowledge practices, communication break-downs and inefficient decision-making.

## 6 CONCLUSIONS

This paper includes a case study of Finnish globally operating manufacturing company that find out competitive advantage and value by using integrated data sources and data empowerment. In this paper we

study what kind of challenges the case organization faces and what are the lessons learned from advancing such endeavour. We analysed the case organization's knowledge practices and processes by utilizing Jääskeläinen et al.'s (2019) framework of information and knowledge management. With this analysis we understand better the key factors that impact organizations' ability to create value based on their knowledge.

The organization has significant challenges in its knowledge management. The data is not quality enough, data is distributed throughout the organization, and they are lacking resources to refine it. The reasons behind these challenges are mainly result from poor management and lack of communication. To achieve the potential of knowledge management organization requires organization-wide conversations in where knowledge must be highlighted as one of the most important assets. Data-based value creation necessitates high quality data. In order for information systems are working correctly and data is acquired properly, it is crucial to define external and internal customers' information needs properly.

Most of the earlier research focuses either on knowledge and its management, or data and information quality issues. Quite rarely the value chain from data to knowledge and its utilization are illustrated. In this paper we present concrete challenges and solutions the the case organization faces and what are the key lessons for creating data-base value creation. Consequently, our study illustrates practical challenges in relation to research literature from several disciplines increasing our awareness of intertwined nature of issues and path dependency between details. This understanding and lessons learned also open up new research avenues.

The approach provides valuable insights for managing service development and decision-making and creates understanding on data-based value creation. Achieved understanding provides meaningful knowledge for organizations utilizing or having plans to utilize, for example, data analytic methods in their businesses. This understanding and lessons learned also open up new research avenues. By analysing and modelling business critical processes, i.e. product manufacturing or sales and marketing, problematics of data utilization could be highlighted.

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