Risk vulnerability mapping while innovating a business model - summary

A case study exploring the risks while innovating a business model from product selling to a consignment stock agreement with a subscription model in the metal processing industry.

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Abstract

A qualitative study was carried out to investigate the risks involved in implementing consignment stock as a business model innovation in a three-tier operation. The research was carried out based on a single case study involving interviews with a company specialised in steel processing machines and their network. During ten semi-structured in-depth interviews, a broadening and deepening of the current theory was created based on the following research question: "How can steel processing companies implement BMI? - the example of CS" and three sub-questions. "What are the consequences of implementing BMI in steel processing companies? - The example of CS" (1). "How can steel processing companies minimize risk vulnerability through stakeholder interaction?" (2). "How can a steel processing company assure the level of quality of their operations?" (3). This resulted in a list of 41 codes that are connected to risks that arise when implementing consignment stock at a company in the steel processing industry. This paper describes the need for data and a solid information structure for the implementation of consignment stock. In addition, responsibilities must be documented in a contract between the network partners that participate. The vendor acts as a mediator between supplier and customer. During the research, it became clear that in the most favourable scenario, the supplier acts as the financing party. The customer is liable for the consumables that are on consignment. The customer is not the owner of the consumables that should be paid for after usage. The vendor provides a system that helps register and predict usage. The study reveals various risks related to scenarios such as bankruptcy of the customer, consumables going missing, and aspects required for long term maintenance of consignment stock. The vendor should consider that in case of non-fulfilment of responsibilities, in most cases they assume final responsibility. The vendor can limit risks by making contractual agreements with network partners regarding financing and responsibility for consumables. Risks can also be eliminated by ruling out manual actions.

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1 Introduction

1.1 Situation and Background

Companies are increasingly being encouraged to be innovative and adjust strategically to stay in business and make a profit in a world that is constantly changing and demanding more and more. Changing environmental factors require a business structure that is flexible and offers internal differentiation. This means that a company must apply different strategies within its structure. Regularly critically observing the business model (BM) and changing it to meet future market demands is one of such strategies. This popular strategy approach is called Business Model Innovation (BMI) (Hossain, 2016). BMI is applied in many sectors and affects the way of operating, the revenue model and network partners (Teece, 2010). According to Lindgard et al. (2009), BMI is said to occur when two or more aspects of the BM change. BMI is not only characterised by operational change. The goal of a BMI is a change in the delivery of value that a company contributes. Branca et al. (2019) state that this is especially true for energy-consuming industries such as the steel industry. Junior et al. (2012) add that industry-specific innovation relates to both process and strategy. The need to survive through BMI lies in the high degree of competition in the steel industry.

1.2 Aim and Research Question

The goal is to gain insight into the risks that occur with this BMI, and to minimise and spread the risks. This is done using a main question which is divided into sub-questions. First, we look at the changes on company level that take place during this BMI. Secondly, the research looks at the financial risks of a steel processing company that decides to work with a CS agreement. Thirdly, the research aims at operational excellence of the BM, how it can be achieved and maintained. The research is executed based on the following research question and sub-questions.

How can steel processing companies implement BMI? – the example of CS

Sub questions:

1. *What are the consequences of implementing BMI in steel processing companies? – the example of CS*

2. *How can steel processing companies minimize risk vulnerability through stakeholder interaction?*
3. *How can a steel processing company assure the level of quality of their operations?*

A suitable answer to the main and research questions offers a comprehensive overview of changes and threats when introducing BMI on a financial, strategic, and operational level. This results in an overview of the risks that arise. For the risk mitigation, a recommendation is made based on the insight that the research among stakeholders will provide. These results combined create advice on how to complete the translation and maintain operational success after the implementation of the BMI.

1.3 Research Approach and Relevance

The purpose of this study is to identify risks that arise with the desired BMI. To make the risks applicable to a steel processing company, the case study methodology is used (Rashid et al., 2019). Topics such as BMI, risk analysis and inventory management have been researched before. Various models and literature are available. For this reason, filters to select industry-specific literature will have to be applied within the selection. The case study allows existing literature to be reflected on a branch or organisation. For this research specifically, the risks involved in the change of BMI. Hence, a case study is used to analyse changes in a translation phase.

The relevance of the research can be found in the specifics of this case. BMI is a widely researched phenomenon that occurs across different industries. Stock optimisation is also a widely researched topic in the literature. Stock optimisation has mathematical models and theoretical frameworks in several industries. Offering a product as a service is partly researched but also gains a lot of ground in the current market. In the current BMI, The steel processing company Steel combines various existing and new theories to best serve the market in the future. This means that literature wise, a branch-oriented study will be carried out that applies to large players in the steel processing industry. Hence, the research contributes literarily to BMI's insights into the steel processing industry. Currently, the theory on CS in the steel industry is very limited. This research contributes literature to the

implementation of CS in the steel processing industry. This is an industry that is characterised by long-lasting products, high investments, and long-term customer relationships.

The research can help companies in the steel processing industry make decisions about implementing BMI in practice. Companies in the steel processing industry without experience in CS but interested in CS can currently find little information in the existing literature on implementation and execution. This research helps these companies with an applied form of research. Risk factors for companies in the metal processing industry that are related to CS will be addressed.

2 Theoretical Framework

The subtopics of this chapter are based on the research question and sub-questions. First, the theory of BMI is discussed. This clarifies the choice of a BMI and shows motives and first insights into risks. Second, the applications and translation benefits and risks of CS are examined. Third, the theoretical aspects of the financial framework are addressed. The three topics result in the chapter risks, which is an important aspect of this research. The risks are divided into strategic, financial, and operational. Finally, the substantive aspects are reflected in the results and conclusion in combination with the case study.

2.1 Business Model Innovation

Teece (2010) states that “A BM articulates the logic, the data and other evidence that support a value proposition for the customer, and a viable structure of revenues and costs for the enterprise delivering that value” (p. 179). Meanwhile, Osterwalder et al. (2005), define a BM as "A blueprint of how a company does business" (p.4). A BM is therefore a conceptual model in which relationships of business elements are defined. The added value of the company describes various elements in terms of value addition to service, materials, and sustainable growth (p. 10). Hence, a BM must ensure that a company becomes more customer oriented (Teece, 2010).

BMI is applied to create a change in the way a company adds value to a product or service. Over the past decades, the urge to innovate has grown among companies. Companies are changing their market position to make profits and maintain their position in a changing world. Research by Labbe and Mazet (2005) defines BMI as a change in one or more dimensions of the BM to create and implement the most valuable combination of factors.

According to Hossain (2016) BMI is a leading way to change and extend an organisation. The various definitions refer to BMI as a change in configuration of the internal elements or a change in the whole. Meanwhile Geissdoerfer et al. (2018), state that BMI is applied as a response to an opportunity or challenge that arises in the organization's environment. However, within the current literature, it remains unclear whether specific conditions are required, such as service or product innovation, to qualify as BMI as a whole. However, it appears that constant innovation and application of BMI can lead to a strong change mentality and long-term competitive advantage (Geissdroeffer et al., 2018).

BMI can have different purposes, but also different causes. Technical companies innovate their BM based on technology (Teece, 2010). Technical innovation does not guarantee economic success. For this reason, companies in the steel processing industry look critically at new innovative products compared to their current BM. The value chain that a company links to a product may therefore change. BMI can hence be applied to present a new product in the market but can also be applied for the purpose of an acquisition, merger, or process transformation (Geissdoerfer et al., 2016). For example, a technical innovation may not be directly related to a product but may improve the customer experience. This is another possible reason for implementing BMI.

A steel company's BM should add value through a unique architecture combined with resources that are valuable and can create competitive differentiation and ultimately generate revenue (Olko and Brzóska, 2017). Research by Grabowska and Furman (2015) emphasises that the steel industry is characterised by high energy and material costs. This affects internal costs as well as the climate. The high costs and increasingly stringent requirements set by governments make it necessary to take a critical look at ways of innovating the BM. According to Olko and Brzóska (2017), a steel company must innovate to remain sustainable over a long period. Additionally, Pomyskalski (2018) emphasises this by referring to current trends such as recycling, sharing economy and longer lifetime of products. The different levels of innovation are mentioned by Grabowska and Furman (2015) as a reason for a steel processing company to innovate at the highest level through constant BMI.

According to Teece (2021), in practice, BMI is not always entirely self-generated. In many cases, BMs are adopted from fellow companies or other industries. For example, Battini et al. (2010) state that more and more companies are moving towards CS.

2.2 Consignment Stock

While inventory management in the past was done by physically counting products in the warehouse to check whether there was enough stock for possible orders, inventory management has changed a lot. According to Beheshti et al., (2020) the first implementations of information technology in inventory management can be traced back to 1970. Here, the first networks were created to securely connect customers and vendor for delivery, payment, and orders. Initially, data was sent and entered manually.

Today, companies in the manufacturing industry work with smart enterprise, resource, and planning (ERP) systems that are interconnected and can forecast usage using mathematical models. This can provide improved communications and options for better collaboration. The vendor uses the data from the customer's ERP system and can adjust numbers and predict the forecasts.

On average, a quarterly forecast is made with existing data (Beheshti et al., 2020). Based on the existing figures, the customer can request the number of desired products using the forecast from the ERP system. With close cooperation, the vendor can also use the data to make a purchase offer. This offer is also based on the customer's usage. Even an incomplete ERP system can be used to generate numbers. According to Zeng and Yen, (2017), a supply chain expert can help estimate a procurement model if no ERP data is available.

The vendor can also take over the responsibility of supplying materials. This is called vendor managed inventory (VMI) (Beheshti et al., 2020). In this case, the vendor has insight into the customer's systems and delivers when stocks run out. The vendor agrees on minimum stock levels with the customer. Before this level is reached, the customer receives additional stock. Zanoni et al., (2017) distinguish between a two-tier and a three-tier VMI system. The two-tier system consists only of a vendor and a customer. The three-tier system consists of a supplier, vendor, and customer. While the three-tier system involves an additional party, both forms aim to streamline the process of order fulfilment.

CS is an increasingly popular solution. Persona et al. (2005) states that CS can be defined as "stocks owned by the vendor". CS is the stock managed by the end-user or final seller but legally owned by the vendor or producer. Literature speaks of a CS agreement or CS policy which means the same thing. Within a CS agreement, the stock of the vendor is transferred to the customer. The customer, depending on the agreement, is free to use the product from the stock when needed. The product is paid for when the customer takes it out

of the stock for use (Chakraborty et al., 2021). Zanoni et al. (2013), suggest that CS and VMI should be implied together in practice. Beheshti et al. (2020), acknowledges the synergy but does not call dependent implementation a necessity.

CS is implemented because it has several advantages for the vendor and the customer. According to Battini et al. (2010), the customer benefits because materials are always within reach. Secondly, it saves management costs for the customer since they do not have to deal with purchasing anymore. Thirdly, product lead times are reduced because a product is only purchased when it is needed. Next, the production method also becomes more flexible. By having the vendor's products in stock, the customer can choose from several materials. At last, materials are only paid for when the customer considers them necessary. Besides the advantages for the customer, there are also advantages for the vendor.

Firstly, the vendor can optimally arrange transport. Secondly, the vendor can adjust purchasing and production accordingly. Thirdly, the vendor receives valuable information about the customer's consumption. This can be used by the vendor to create a progressive insight for new customers. Fourthly, if the vendor keeps stock, it can be shifted to the customer in the CS model. This gives the vendor an advantage in space. Fifthly, the vendor maintains a long-term relationship with the customer which is more intimate as both parties are contractually bound. All aspects from the text are shown in Table 1.

Table 1: Benefits CS (Battini et al., 2010)

Benefits for buyer	Benefits for the vendor
1. Materials always on-hand	1. Optimisation of transport
2. Reduced management costs	2. Optimisation of production lot size
3. Procurement leads time drastically reduced	3. Information on real consumption is available
4. Production mix more flexible	4. More space available
5. Immediate payment only for materials quantities used daily	5. Long term relationship

This table provides an overview of all the benefits CS offers to the buyer and vendor.

According to Beheshti et al., (2020) implementing CS is not without risks. Failure of implementation can be caused by strategic but also by operational problems. Risks, effects, and causes are discussed separately in 2.4. It is also noteworthy that no specific literature can be found on CS in the steel processing industry or the steel industry in general.

2.3 Financial Transition

This chapter discusses the general financial aspects of BMI and the introduction of CS. According to Teece (2010), a BM is "essentially nothing more than the financial architecture of a company". Even though a BM primarily refers to a conceptual way of doing things rather than a financial model. As mentioned in section 2.1, a BM refers to adding value. Also, BMI implementations must be financed by internal or external cash flows (Osterwalder et al., 2005).

In regular product sales, a purchase is paid for immediately, this is not the case with CS. Although the products are located at a customer's premises, they are only purchased when they are needed. This means that a CS agreement causes a change in cost structure for both vendor and customer (Battini et al., 2010). The customer has storage costs for the material of their vendor. However, the costs incurred by the vendor for production and materials are reimbursed later, when the customer buys the products. Sarkar et al., (2018) propose different scenarios within a CS agreement. The first is a traditional CS model in which the product is paid for when it is used but localised to the customer in advance. A second scenario refers to a customer transferring an amount of money to the vendor in advance. The payment is equal to the stock that the customer has. According to literature, this is a royalty that the customer pays for the cooperation. A third scenario proposes that a vendor in a three-tier system not only approaches the customer for advertising funding but also their suppliers. The three scenarios exist to make the financial implementation burden for a CS agreement more bearable for a vendor. Gharaei et al., (2019) state that a CS agreement, regardless of structure, should always maintain a financial ceiling to keep external stocks manageable. Although costs can be shared at the operational level, the vendor remains financially responsible for the products that are with the customer until the actual moment of sale (Sarkar et al., 2018). This means that the vendor is responsible for the quality and shelf life of the consumables. The vendor is also liable for the consignment unless otherwise agreed with the individual customer.

Grabowska and Furman (2015) rightfully associate the steel industry with high material costs. This is due, among other things, to high raw material prices and high energy costs for processing materials. They also associate heavy steel products with transportation costs. Thus, the implementation of CS in the steel industry is associated with large sums of capital.

It is noteworthy that much research has been done on CS, stock keeping and optimal shipping costs. However, there is no prominent theoretical framework for implementing a CS strategy for the manufacturing industry. Also, there has been little in-depth research into the exact change of financial facets. Besides operational payment changes, financial changes also involve risks. These are discussed separately in 2.5.

2.4 Risks

Onu and Mbohwa (2019) describe risk as something that can have a negative impact and counteract value creation. The following section lists all the risks that arise in a change of BM with a focus on CS. The risks mentioned in this section come from the literature and are divided into three different topics. The topics are operational-, financial- and strategic risk. There is overlap between the topics, which is why the same risk may be repeated per topic with a different specific focus.

2.4.1 Strategic Risks

Beheshti et al. (2020) indicate that a VMI model can fail because the strategic goals do not match the operational model. The article describes that a company should look carefully at whether a CS agreement fits the company. Internally, there must be enough support for a transformation. The vendor and customer must both see the added value of the system and want to exchange data. In a three-tier model, there is also a supplier involved. In addition, the vendor must be certain that no competitors are offering the same service with superior technology. Technological development in the broad sense is also an aspect that can make strategic implementation unnecessary. Pomykalski (2018) emphasises that digitisation can be disruptive in the steel industry. According to the literature, digitisation lowers entry barriers. The CS model also requires close cooperation with a logistics partner, which may pose a risk if services are not delivered carefully (Vrbová, 2019). Research by Geisdoerfer et al. (2018) indicates that 70% of all BMI translations fail, however, they did not mention a specific reason for this. They do indicate that good preparation makes a significant difference in succeeding.

This overlaps with the article by Vrbová (2019) who mentions 'too little knowledge about CS' as a risk.

In addition to the strategic risks involved in conducting CS, Faur et al. (2020) also refer to the implementation of CS on its own as a risk. The implementation causes that placing an order or setting up an order system initially takes more time, can cause confusion internally due to the absence of a format, and requires additional staff training. This is emphasised by Branca et al. (2019) who indicate that staff in the steel industry who are stuck in their methods of working have more difficulty in adopting new working methods regarding digitisation. The aspects mentioned by different authors come together in Table 2.

Table 2

Strategic aspects extracted from theory	
Primary aspect	*Secondary aspect (effect)*
Alignment with an operational model	
Organisational support	
Adds value to current BM	
Extraction of data	
Lack of competition	Being outperformed
Technological development	
'Too little knowledge'	Failing business model
Implementation: staff training	
Implementation: internal confusion	Additional investments

This table lists all strategic aspects concerning risks mentioned in the theory. If a secondary aspect, such as an effect, is mentioned, it is listed in the second column.

2.4.2 Financial Risks

Depending on the agreements made between vendor and customer, the vendor is in most cases financially responsible for the product. This is because, in the CS model, the vendor remains the owner until the customer needs and buys the product. The vendor, therefore, bears the risk of the product being physically lost, damaged, or defective altogether. Secondly, a product may become unsold, unused, and outdated by a customer. Thirdly, a product may become obsolete within a company. Fourthly, the ERP system of the customer plays a role. If the customer does not have an effective inventory system, there may be disagreement about the time of payment (Vrbová, 2019). Fifth, the vendor may make a wrong assessment of attractiveness. In the case of unmitigated success, it means that the vendor has a large amount of capital in materials at various customers. Sixth, Battini et al. (2010) state that raw materials and products can be price sensitive. In the case of direct sales, this can be adjusted, in the case

of a CS agreement, the delay of the sales moment can have both negative and positive effects for the supplier, vendor and the customer. Finally, Beheshti et al. (2020) state that the vendor should consider the financial aspects of keeping inventory levels high. Running out of product has a negative effect financially for the customer and may result in a fine for the vendor or price increase of consumables as a response. In order to provide an overview of the various financial aspects, Table 3 is used.

Table 3

Financial aspects extracted from theory	
Primary aspect	*Secondary aspect (effect)*
Financial responsibility	
Product being lost, damaged, or defective	Related to responsibility
Product being unsold, unused, or outdated	Related to responsibility
Inventory system	Incorrect charging
Disagreement about the time of payment	
Distribution of capital in goods	
Prices sensitive goods	Missing out on earnings
Running out of product	Fine and loss of trust in vendor

This table lists all financial aspects concerning risks mentioned in the theory. If a secondary aspect, such as an effect, is mentioned, it is listed in the second column.

2.4.3 Operational Risks

Beheshti et al. (2020) state that lack of internal support affects employee performance. This may arise if employees do not understand the need to innovate and are satisfied with the current way of working (Grabowska and Furman, 2015). Onu and Mbohwa (2019) recognise the problem and mention a lack of background knowledge as a weighing factor and feature of workers in the metal industry. New procedures, daily work and stock scanning are important pillars of CS. If these tasks are carried out with reluctance, it can harm the effectiveness figures. Stock figures can also differ from reality if products are taken out incorrectly. This also applies to incorrect scanning of products that are at the customer's location. In addition to the organisational culture of the customer and vendor, there are also strong changes in the logistics process (Beheshti et al., 2020). It is up to the vendor to optimally plan the number of orders in bulk, so orders are sent regularly and with as much time in between as desirable. Too many shipments could cause financial risks. Faur et al. (2020) also indicate the importance of having a transport partner. If this partner does not meet the obligations, understocking may occur, and the customer will experience negative consequences. Under- and overstocking can also be created by incorrect data processed by the vendor (Vrbová, 2019). Under- and overstocking do not only affect the customer's ease of use but, depending on the contract,

may also have financial consequences for the vendor. The various operational aspects are shown in Table 4.

Table 4

Operational aspects extracted from theory	
Primary aspect	*Secondary aspect (effect)*
Internal support	Incorrect stock figures
Logistic process	Running out of stock
Shipment optimization	
Risk of understocking	Negative effect on customer relationship

This table lists all operational aspects concerning risks mentioned in the theory. If a secondary aspect, such as an effect, is mentioned, it is listed in the second column.

3 Methodology

This section describes the methodology used to investigate how the company involved in this case study can innovate their BM by implementing CS while reducing risk vulnerability. The chapter is divided into three subsections. First, the research itself is described by highlighting the method and substantive case. Secondly, the tangible part, namely the participants in the research, will be explained. Subsequently, the way of handling data is discussed.

3.1 Research Design

3.1.1 Case Study

Case study, according to Denscombe (2014, p.35), is a technique that focuses on a specific change or phenomenon. The case study results in an in-depth overview of events, relationships, processes, or experiences for a specific situation. This method is used in multiple research situations due to its multi-applicability. The purpose of a case study is to determine the general by looking at several specific cases (Denscombe, 2014, p.36). A case study is chosen to go into depth, a technique such as a survey impedes further questioning. In describing a case study, Yin (2003) refers to the aspects of a contemporary event in a real-life context. A case study is particularly appropriate when there is overlap between different aspects. Case study methodology is a sufficient and appropriate method for certain important research tasks in the social sciences, and it is a method that stands firm compared to other methods in within social science research methodologies (Flyvbjerg, 2006). Denscombe (2014) states that relationships and processes can be interconnected and interrelated. To observe and report on the linking and underlying factors, the case study is very suitable. This is because

there is room to adequately identify the complexity of specific situations. A case study is therefore 'holistic' rather than taking isolated factors into account. The method is most effective when the researcher wants to map out a certain situation in depth to be able to explain the complexity in sub-factors and to reflect on the real-life situation. For this, the researcher should choose a few of a larger number of research objects as a sample. The selection is not random but based on several factors. The factors the participants must meet are separately explained in chapter 3.2 participant selection. Participant selection is important because the research group must be representative of the generic research objective. If there is a mismatch, no general statements can be made about the results. Ultimately, it is possible to compare the research results with theory or an earlier study for validation purposes.

3.1.2 Case Description

The company oriented at the steel processing industry for sheet metal, H beams and surface treatment of steel. The firm has around 500 employees and operates internationally. Steel processing machines are delivered separately or in an entire production line that is assembled especially for the customer.

In most cases, the manufacturer of steel processing machines, also referred to as ‘vendor’, is also the contact point for maintenance and spare parts. The consumables sold ranges from replacement modules in a machine to drills and other wear-sensitive aspects. The company offers to sell consumables on a close contact basis. As an example, they offer a smart storage toolbox. The system consists of a smart storage cabinet with lockable drawers. The system has a terminal in which all stock can be kept by means of a barcode scanner. When used, new consumables are scanned in and out. In this way, the user, but also the vendor, are kept informed of stock levels. When stock runs out, the smart system sends a message to the owner, and if the owner needs it, to the vendor as well. Currently, the customer or the vendor can estimate stock levels based on usage and make an order quantity proposal. The smart toolbox offers a central point from which stock can be retrieved and maintained. It also offers insight into usage and stock figures via a dashboard.

By means of CS, the company in this case study wants to take stock management completely out of the hands of the customer. In combination with smart toolbox, the vendor can always see stock levels in their system. By collecting data, the vendor gains insight into the consumption of the customer and based on this, can adjust ordering times and quantities.

To maintain a long-term relationship with the customer, the customer only must pay for the products when they are scanned by the smart toolbox. By introducing CS, the vendor wants to completely unburden the customer in terms of stock and bind them to them for the long term.

3.2 Participant Selection

Several factors play a role in this BMI. The factors have been recorded as completely as possible from the above literature. To shape the practical case, information is gathered from internal and external stakeholders in the BMI. Participant participation is important because the information that is collected will eventually be compared to the literature and the conclusion will be based on that information. This means that the participants must have knowledge of the subject, the current structure and have an interest in the change. The participant selection is done based on interviews with the COO of the company that acts as a vendor. As the initiator of the research and ultimately responsible for the BMI, the COO has the most interest in a transformation with the least possible risks.

The participants' list consists of customers, suppliers of the vendor, and people from the vendor internally. Possible factors that play a role in the selection are degree of progression within the company, contact with the vendor, size of the company, current way of handling stock. Three suppliers operate internationally and represent the group of suppliers in the interview. Internal participants are managers of the Parts & Consumables department and the management. The customers who participate are selected on the above criterion in consultation with the vendor. The participants are described by function and nationality in Table 5.

Table 5

Participants		
Participant	*Function*	*Nationality*
Supplier1	Director	Dutch
Supplier2	Project manager	Dutch
Supplier3	Account manager	Dutch
Supplier4	Account manager	Dutch
Vendor1	Director	Dutch
Vendor2	Department manager	Dutch
Vendor3	Improvement engineer	Dutch
Customer1	Director	Dutch
Customer2	Project manager	German
Customer3	Profile manager	British

This table lists all the participants that took part in the interviews. The table shows their relationship in the study. This is indicated by 'Supplier', 'Vendor' or 'Customer'. In addition, the position of the participant and the nationality of the branch in which the participant works are indicated.

3.3 Data Collection

Data collection consists of interviews. The interview method is ideally suited for in-depth discussions of a particular topic. Conducting interviews requires prior knowledge of the interview topic from all parties involved (Denscombe, 2014, p.173). Conducting an interview requires permission from the parties involved to process the information afterwards. This can be done openly or confidentially based on the agreements made. According to Denscombe (2014, p.174), the researcher uses interview methodology when interaction or relationships between different aspects occur. Semi-structured interviews are used for the study. This methodology allows for follow-up questions, which allows topics to be discussed in depth. However, the applied structure allows for retrospective comparison of information from different participants. Prior to the interviews, a pilot is held with internal participants who are easily accessible. The aim of the pilot is to gauge whether the interview questions are understood, and the answer relates to the right subjects. The pilot ensures that the interviews that ultimately count are used as effectively as possible.

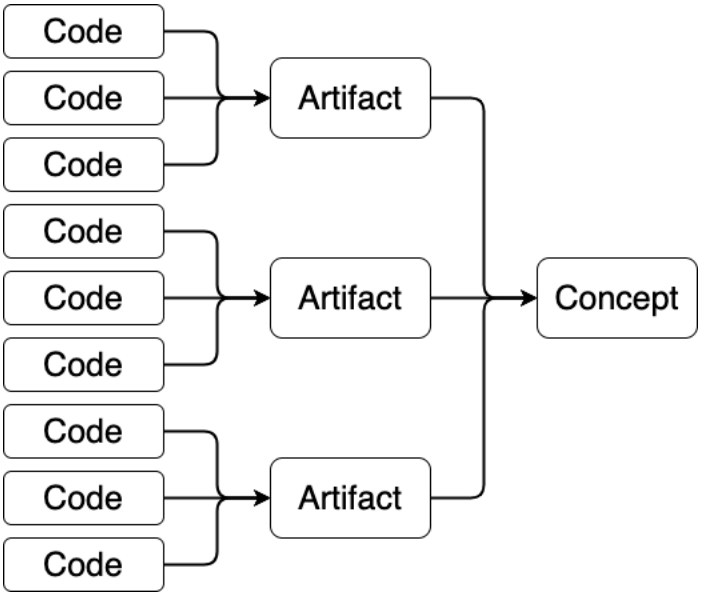

Figure 1: Coding process (Locke, 2020)

The information obtained from the interviews is transcribed into text by anonymised participant number. In the first step, all written-out text is labelled using quotations in qualitative software Atlas.ti. Atlas.ti is used to label and code text such as an interview. This software package also helps to display interconnections. This means that character interests are linked to the text about the content of the statement. The codes have a mutual interaction structured on the statement. In the second step, the codes are divided into an artefact as can be seen in Figure 1. The artefact aims to combine different codes and to create clear categories of mutual statements. This makes patterns in the statements more visible (Locke et al., 2020). In the third step, patterns from the artefacts are combined to form a concept. The concept results in a conclusion and is in this way traceable from the information gained. The concepts are finally mirrored with theory from the literature.

4 Results

In this section, the results concerning the interview are explained by means of text and tables. The results are interpreted based on how often they were mentioned and on links to other topics. Additionally, the first links are made with the theory in this chapter. The topics found are compared with all the theory found. This is done because theory relating to the steel processing industry is limited. For this reason, theory on CS in the general manufacturing industry is also used. The strategic subjects are dealt with first, the financial subjects second and the operational subjects third. During the study, it became apparent that many subjects, regardless of the category they belong to, are dependent on other

subjects as well. In some cases, they only exist because of each other. Therefore, fourthly, cross-link interaction of most mentioned subjects will be discussed. Results will be substantiated with the data from the tabulations and interview citations.

4.1 Strategic Aspects

Although unnecessary for some participants and readers with knowledge on the subject interrelationships of codes may be realised logically, it is still important to explain them. Relationships between codes are important because many subjects cannot exist without each other. The codes are displayed chronologically based on Table 6. An example is the first code in Table 6, 'Usage data' is composed of an organisational and a strategic aspect.

Table 6

Strategic codes			
Code name	*Total nr. of mentions*	*Nr. of respondents mentioning this item (max. 10)*	*Nr. of links with other codes*
Usage data*[1/3]	27	9	4
Data transparency*[1]	20	8	5
Responsibility*[2]	19	9	5
Type of customer usage*[1]	15	8	4
Way to add value*[1]	13	8	3
Trust*[1]	12	5	3
Good contract	11	6	4
Lock-in	10	7	3
Project-based vs repeating work	9	4	3
Country/ cultural differences	8	6	3
Automate*[1]	6	4	2
Protocol for conflicts	5	4	2
Competition*[1]	4	4	2
Save downtime	4	4	2
Acquisition threshold	4	3	2
High switching costs	3	2	1
Missing out on deals	2	2	1

This table shows how often strategic items were discussed. Column 'code name' is the description of the code itself. The second column shows how often a topic that falls within the code was mentioned in total. The third column shows how many respondents mentioned a topic that falls within the code of the row. The fourth column shows how often the code was mentioned in combination with another code, i.e., the number of links to other codes. If a code has a * followed by a number, it will appear in the 'Comparison with theory' tables. Here 1 stands for strategy, 2 for financial and 3 for operational.

Table 6 in combination with the previous text and quotes gives value to the codes and associated relationships. From this, it can be concluded that the lock-in offers strategic advantages for the vendor and the suppliers, provided that the strategy meets the

preconditions. In this case, the preconditions consist of the availability of data and the data itself. After all, predictions can only be made if a pattern emerges through repeated use by the customer. If this is the case, the vendor can reduce downtime through automation and add value with CS. In this respect, a good and complete contract must define responsibilities and conflict scenario solutions. It also appears from the interviews that CS is particularly suitable for clients and suppliers that the vendor trusts and that have confidence in the vendor. Despite naming or denying these advantages and disadvantages, there is a chance that the client prefers the competition due to their financial focus and wants to avoid high switching costs. The topics mentioned by the participants in the strategic perspective are compared in Table 7 with the topics found in the theoretical framework.

Table 7

Comparison with general theory – strategy

Corresponding aspect from interview	*Aspects from theory*
Type of customer usage	Alignment with the operational model
Trust	Organisational support
Way to add value	Adds value to current BM
Usage data / Data transparency	Extraction of data
Competition	Lack of competition
Automate	Technological development
-	'Too little knowledge'
-	Implementation: staff training
-	Implementation: internal confusion

This table compares the codes mentioned in the interviews under the topic strategy with the topics related to strategy from the theory. The items in the left column are the codes that emerged from the interviews. The items in the right-hand column are the topics that emerged from the theory. The items next to each other are the same or have overlap.

Beheshti et al. (2020) mentions that it is important that the operational model is in line with the strategy. The participants mentioned that the type of consumption of the customer is important for the functioning of the strategy. This has overlap because the example from the interview code is a direct example of alignment. Beheshti et al. (2020) emphasises the importance of organisational support in BMI. The interviewed customers mention that the implementation of the system is up to the management and that the employees must adapt. Customers mention that mutual trust is important. Branca et al. (2019) states that support within the organisation is important for a new system to work properly within the metal processing industry. Suppliers agree with this statement. The effects of lack of support are

discussed in detail in the operational part of this chapter. Vendor's staff seem to be devided about the role of customer employees.

According to the theory, BMI should contribute to adding value in an organisation at various levels. The vendor uses CS as a financial tool but emphasises that the strategy is to be a total solution for the customer. It is also clear from the interviews that the customer is interested in the financial gain. In addition, suppliers say that it is an absolute must to be a total solution and, in this way, to add value to the business chain.

Extraction of data is mentioned by Pomykalski (2018) as an important strategic point of success. All interview participants agree with this. Customers and the vendor are willing to provide openness of data and suppliers indicate that this is necessary for trust, validation, and success. Data is also necessary for technological development. The vendor's staff emphasise that CS must be a living development that makes improvements based on data and technological changes. This is in line with theory that mentions technological development as an important indicator of innovation (Teece, 2010). Theory also states that a lack of competition is strategically necessary for success. Competition is often mentioned during the interviews in combination with country factors and prices.

Three subjects from the theory were not or barely touched upon during the interviews. This relates to 'too little knowledge', a basic expression to justify failing BMI. It is difficult to reflect this directly the business case of the vendor and their network partners because this research indicates that they are directly engaged in the acquisition and exchange of knowledge. This is reflected in theory, and two strategic points related to implementation (Faur et al., (2020). Implementation is covered in the cross-sectional aspects of this chapter.

It is noteworthy that the theory found does not mention all the topics discussed in the interviews. This can be seen in Table 6. Not all topics are marked with a *. For some codes, such as 'project-based vs. repeating work', it can be argued that this is branch specific. Some aspects are mentioned secondarily. For example, it could be argued that 'missing out of deals' could fall under the competition aspect. It remains striking basic aspects such as 'lock-in' are not mentioned in theory. This aspect was mentioned ten times in the interviews by a total of seven respondents. It seems to be a basic aspect of CS.

4.2 Financial Aspects

Interview participants relate financial topics to operational and strategic issues. For this reason, the text sometimes refers to other sub-chapters. Table 8 is formed with the financial elements from interviews conducted. The subjects are listed chronologically based on how often they were mentioned. For example, 'unused items' is the code that has been used the most within the financial section. The code relates to consumables within CS that have been with a customer for a long time and are not being used.

Table 8

Financial codes			
Code name	*Total nr. of mentions*	*Nr. of respondents mentioning this item (max. 10)*	*Nr. of links with other codes*
Unused items*[2]	15	7	3
Financial exposure*[2]	14	5	8
Return agreement*[2]	11	5	2
Non-payment*[2]	7	4	3
Bankruptcy	5	3	2
Customer credit check	3	2	1
Financial limit	3	2	1
Financial credit	3	1	1

This table shows how often financial items were discussed. Column 'code name' is the description of the code itself. The second column shows how often a topic that falls within the code was mentioned in total. The third column shows how many respondents mentioned a topic that falls within the code of the row. The fourth column shows how often the code was mentioned in combination with another code, i.e. the number of links to other codes. If a code has a * followed by a number, it will appear in the 'Comparison with theory' tables. Here 1 stands for strategy, 2 for financial and 3 for operational.

Based on the interviews and Table 8, it can be stated that financial exposure is the largest overarching risk. The most frequently mentioned risk can be ranked below it. This is that items are lost or not used. All those involved in the three-tier also agree that property rights must be properly documented using a contract. In this way, the vendor and supplier will not run into problems in the event of bankruptcy of the customer. Financial exposure can be limited by a contract, but the participants also indicated a financial limit for CS, a credit check for the customer and a financial credit from the supplier help.

Thus, the risk for a vendor is reduced and spread among the participants within the three-tier agreement. The contract can determine the responsibility of different parties. If participants of the CS agreement agree to this, they carry a responsibility that another party will not bear.

Table 9

Comparison with general theory – financial	
Corresponding aspect from interview	*Aspects from theory*
Responsibility	Financial responsibility
Losing items	Product being lost, damaged, or defective
Unused items	Product being unsold, unused, or outdated
Well-function software	Inventory system
Non-payment	Disagreement about time of payment
Financial exposure	Distribution of capital goods
Return agreement	Price sensitive goods
-	Running out of product

This table compares the codes mentioned in the interviews under the topic financial with the topics related to financial topics from the theory. The items in the left column are the codes that emerged from the interviews. The items in the right-hand column are the topics that emerged from the theory. The items next to each other are the same or have overlap. If a code is mentioned in the interviews in italics such as *'Responsibility'*, this is an indication that the code was mentioned in a subject other than 'financial'.

Table 9 shows the codes that emerged from the interviews according to the topics offered by the theory concerning CS. The theory mentions financial responsibility. From the interviews, several aspects emerged about responsibility. For example, responsibility for a well-functioning system but also for lost consumables. This is described in the operational code losing items. Theory also indicates that lost or damaged products are a real risk of the CS model (Vrbová, 2019). Also, the theory corresponds with the interviews regarding unused consumables. Both items play a major role in the interviews, and this corresponds with the theory. The need for an inventory system as described in the theory is implemented by the participants who attach importance to a well-functioning software programme. This should ensure that inventory levels remain at the right level but are also comprehensible for all parties. Vrbová (2019) describes that disagreements might arise about the time of payment. The study shows that even the participants who are suppliers, vendors, and customers themselves recognise the risk of payment delays. Financial exposure is referred to in the theory as the distribution of capital goods. The distribution of capital goods is considered a risk by suppliers and the vendor. But it is also stated that more capital goods are needed with CS than in the current system. Theory mentions price-sensitive items (Battini et al., 2010). The items within CS have some form of time sensitivity according to a supplier. A return policy is also seen as an important aspect. This means that mutual agreements must be made about percentages and repayment times.

Beheshti et al. (2020) mentions 'running out of product' as a risk factor. This was rarely mentioned in the interviews. It can be argued that it is taken for granted that this does not occur by all parties. Also, it is indeed a secondary aspect of good software and inventory management. In Table 9, it is striking that many codes are printed in italics. This means that they come from a different segment than financial. That they belong to a different segment is due to where the participants have mentioned it.

4.3 Operational Aspects

The operational aspects discuss all the issues that participants involved in the three-tier agreement experience within their daily use of CS. The operational aspect concerns the short-term operation and thus what the parties involved encounter in the short term. The codes are listed in Table 10, which shows how often they are mentioned and how they relate to other factors. The codes are discussed individually based on their chronological order and their direct relationship to other codes.

The most frequently mentioned code of the operational aspect, and for that matter, the entire study is 'losing items'. This was mentioned by nine out of ten respondents. The code relates to responsibility for ‘logistics’ and ‘customer usage’. Customers mention that they are afraid of being invoiced for consumables that never arrived.

Table 10

Operational codes			
Code name	*Total nr. of mentions*	*Nr. of respondents mentioning this item (max. 10)*	*Nr. of links with other codes*
Losing items*[2]	28	9	5
Usage data*[1/3]	27	9	4
Well-functioning software*[2]	22	7	3
Changing customer needs	22	10	4
Contact maintenance*[3]	21	9	3
Registration*[3]	20	8	6
Fool-proof	15	6	1
Staff feel controlled*[3]	10	7	1
Good bookkeeping	9	4	1
Critical parts	8	6	2
Fast movers	8	4	5
Logistics*[3]	8	4	1
Time aspect of unused items	6	4	3
Customer auditing	1	1	1

This table shows how often operational items were discussed. Column 'code name' is the description of the code itself. The second column shows how often a topic that falls within the code was mentioned in total. The third column shows how many respondents mentioned a topic that falls within the code of the row. The fourth column shows how often the code was mentioned in combination with another code, i.e., the number of links to other codes. If a code has a * followed by a number, it will appear in the 'Comparison with theory' tables. Here 1 stands for strategy, 2 for financial and 3 for operational.

The data from Table 10 is explained textually based on the previous sections in this chapter. Both have shown that losing consumables is the most discussed item in this study. The vendor recognises this risk but indicates that the current system, in combination with properly functioning software and registration, is sufficiently tight. Suppliers indicate that they prefer a system with totalitarian control. An example of this would be a vending machine. Suppliers say they have a lot of experience with disappearing items in consignment. Although agreements with management can be clear, respondents mentioned that there is always a deviation from reality because managers never fill the cabinet themselves or take items out. Customers indicate that they do not expect conflict to arise from items going missing. Customers also indicate that employees should be able to work with a level system based on consignment. In addition, interview results show that employees may feel controlled by the registration. Customer's opinions are divided on this. However, several customers indicated that the loss of items could also be due to the fact that too few consumables were sent. However, registration and good software are necessary to generate data that can be used for optimisation and for selecting fast movers. It is also mentioned that data can be used for critical parts. Based on both registration and good software, the logistics must be organised

efficiently. With fewer deliveries, more stock will need to be kept on site, which means more financial exposure. If products are not used over time, neither the vendor nor the supplier will receive any payment. For this reason, agreements must be made for instalments being paid on time. Finally, the software is important to keep track of stocks and to provide transparency over liquid assets in the chain. But customers indicate that data alone is not enough. They indicate that there should be more than one contact moment per year about the products that are in CS on location. The initiative for this should lie with the vendor. Software can help to manage this.

Table 11

Comparison with general theory – operational	
Corresponding aspect from interview	*Aspects from theory*
Staff feel controlled	Internal support
Logistics	Logistic process
Logistics	Shipment process
Usage data	Risk of understocking
Good bookkeeping/ registration	Incorrect stock figures
Contact maintenance	Negative effect on customer relationship

This table compares the codes mentioned in the interviews under the topic financial with the topics related to financial from the theory. The items in the left column are the codes that emerged from the interviews. The items in the right-hand column are the topics that emerged from the theory. The items next to each other are the same or have overlap.

Table 11 shows how the codes that emerged from the interviews relate to the theory. Internal support is mentioned in the theory as an operational factor that makes a difference in the short term (Beheshti et al., 2020). It is mainly related to the client's working method. Customers who participated in the interview indicate that, as a manager or director, they have decision-making authority and, for that reason, they attach relatively little value to internal support from the rest of the organisation. Suppliers agree with Branca et al. (2019) and indicate that internal support from employees who work directly with the CS is indeed important for the proper functioning of the system. Logistics and dispatch are seen as the same by the participants and, in relation to this research, this mainly affects the bundling of dispatches and the speed with which they arrive. If the CS system is functioning well and the stock level is in order, the speed of shipments becomes less important because it can be planned.

Contrary to this, theory calls understocking a risk within CS (Vrbová, 2019). However, this means that the basic principle of CS is not maintained. Participants assume that

understocking does not or seldom occur in CS. However, they do indicate that the importance of usage data with direct feedback in a software system is important to prevent understocking and optimise stock levels. This includes that the customer follows the bookkeeping and registration according to protocol. This means that the customer checks the numbers when the stock arrives. It also means that a record is kept of who takes consumables out of the smart toolbox.

Strategic research has shown that mutual trust is an important factor. Theory indicates that there can be a negative effect on the customer relationship if CS is not meeting promised standards. This is logical to reason since the customer places trust in the vendor for stock management. This requires a well-functioning system but also contact on multiple management levels. This is because CS relates to multiple management levels. Customers have indicated that their demand for consumables, also in terms of CS, can change throughout the year. They expect the vendor to take the initiative to contact them.

4.4 Cross-sectional Aspects

Within the strategic, organisational, and financial codes, it is common to find an interconnection between the three disciplines. To be able to visualise the mutual connection, we have chosen to make a cross-sectional aspects sub-chapter. In this sub-chapter, the most frequently mentioned aspects are highlighted in their ecosystem.

First, the choice was made to go deeper into the implementation phase of CS. This is because implementation brings challenges. Four participants relate the investment to implementation, as shown in Table 12. Because the smart toolbox can currently be purchased with a service agreement for a monthly fee under VMI, there is already experience with this. Customers call the smart toolbox a good solution but find the 'purchase threshold' high because they also must purchase the content. CS helps the customer with financing. For the supplier and vendor, each new customer means an investment in consumables. The vendor and suppliers indicate that usage 'data' is needed in the implementation phase to compose a baseline of consumables. All three tiers want to prevent understocking. A logical consequence would therefore be to supply more consumables, but 'overstocking' creates greater financial exposure for a vendor and the supplier. This means that the data provided by the customer must be reliable and accurate for a thorough analysis prior to implementation.

Table 12

Implementation codes			
Code name	*Total nr. of mentions*	*Nr. of respondents mentioning this item (max. 10)*	*Nr. of links with other codes*
Implementation: data	19	9	3
Implementation: overstocking	11	5	1
Implementation: investing	4	4	1

This table shows how often implantation items were discussed. Column 'code name' is the description of the code itself. The second column shows how often a topic that falls within the code was mentioned in total. The third column shows how many respondents mentioned a topic that falls within the code of the row. The fourth column shows how often the code was mentioned in combination with another code, i.e., the number of links to other codes.

Secondly, interview results show that losing consumables is related to financial exposure. This is because a non-payment situation arises. Losing items consists of two stages. In the first stage, fewer products arrive at the customer than was intended. A check on the supplier can help, but implementation and requirements are difficult regarding cooperation with several suppliers. For this reason, a protocol should exist whereby the customer is given a timeframe to check the stock and provide feedback within the smart toolbox. The second stage consists of losing items through incorrect use. In normal use of the smart toolbox, it is possible to take more items out of the system than indicated. Registration offers a threshold and can work to stimulate good use. However, it can also make staff feel controlled. Suppliers agree that a vending machine with total control is a better solution because it eliminates the human aspect. A soft solution would be to agree that the entire stock is the customer's responsibility after the check-in. However, this still means that over time, the stock levels in the system can differ from the stock levels. This, therefore, requires more customer auditing.

Thirdly, within the interviews, a subject relating to one code was mentioned by all respondents. This code is about changing customer needs. This means that customers need different tools for certain jobs. The interviewed customers indicated that they work on a project basis and that their tooling changes. Suppliers indicate that it is very difficult to make predictions about the usage of consumables when the customer is working on a project basis. Data is needed to predict which tooling is frequently used by the customer. For this reason, complete transparency of data must be aimed at from the beginning. The data is needed to provide insight into consumption, but it can also be used to optimise.

5 Conclusion and Discussion

5.1 Conclusion

This research was conducted using a case study to answer the following research question: "*How can steel processing companies implement BMI? - the example of CS".* To decrease complexity, three sub-questions have been formulated: "*What are the consequences of implementing BMI in steel processing companies? – the example of CS" (1). "How can steel processing companies minimize risk vulnerability through stakeholder interaction?" (2). "How can a steel processing company assure the level of quality of their operations?" (3).*

The results are based on a case study in comparison with theory on CS in the manufacturing industry and various papers on CS in the steel processing industry. Research by Chakraborty et al. (2021) has shown that CS uses a different payment time compared to VMI. However, in practice, it becomes clear that CS in a three-tier agreement is not only a financial issue but a subtle interplay of risks and responsibilities. The research has shown that stakeholders distribute risks over 41 codes within three categories. The categories are financial, strategic, and operational. The research also showed that there is a range of underlying links. Implementation of CS is therefore a financial issue and relates to the fact that the data structure from the vendor must be good to be able to regulate predictions and registration. In addition, the vendor must collect data for the prediction and insight of consumption for a supplier. CS results in consequence for responsibilities as a vendor. Although responsibilities are distributed at the front end, the vendor remains ultimately responsible (Sarkar et al., 2018). These responsibilities can be seen as risks of CS if they are not fulfilled.

There are responsibilities in the form of risks that can be shared with network partners in the three-tier agreement as described by Zanoni et al. (2013). As with VMI, the vendor remains responsible for delivering consumables based on data. However, the financial burden is not on the customer but the vendor and supplier. This means that consumption data must be actively monitored to optimise stock levels and avoid overstocking. Apart from the division of costs, the vendor remains responsible for stock management. In case registration is not watertight, the vendor can ask the customer to take responsibility for consumables in consignment. This means that the vendor remains the owner of the consumables and can

provide a registration method to the customer. The customer is then responsible for the correct use and therefore financially liable.

To ensure the quality level of operations, it has become clear that the vendor must have a functioning system. The more actions are taken away from people, the fewer mistakes can be made. This relates to consumable picking, stock counting, stock forecasting and contacting the customer. Especially contact with the customer is, according to this research, essential to keep a CS system successful over a longer period. The study mentions that an annual contact moment is not sufficient in a BM that requires live information provision. Contact is necessary to manage stock types and relationships.

A steel processing machine producer can implement CS as a BM by acting as a vendor and turning the network into a partnership. In this case, the vendor takes the initiative and needs a well-functioning facilitating system, contract, and network of trusted partners. Risks can be spread by making a financial commitment to suppliers and agreeing on responsibilities for consumables on-site at the customer. The vendor is responsible for access to and dissemination of data, facilitation and maintenance of the system, and forecasting and delivering stock based on data and demand.

5.2 Discussion

During this study, an in-depth approach was taken to the analysis of BMI, the case of CS. A case study was carried out at a company that produces machines for metal processing and its ecosystem of network partners. The study focused on risks arising, risk management and risk distribution among network partners. Ten semi-structured in-depth interviews were conducted with stakeholders from seven companies. The mutual distribution of suppliers, customers and the company from the case study was considered. The smart toolbox developed by the core company of this study, has been considered a given. In this section, it is discussed how the result relates to the theory found.

In the interviews, it was discussed why it is appropriate to apply BMI in the form of CS in the metal processing industry. The metal processing industry is an industry that, according to Pomykalski (2018), may be disrupted by the introduction of digitalisation. Additionally, Branca et al. (2019) imply that workers who have been working with the same method for a long time in the steel industry may find it difficult to learn a new way of working. However, the interviews reveal that CS is chosen as a BMI to add more customer value. This is directly

in line with statements by Teece (2010) who implies that BM ensures that a company becomes more customer-focused and adds more value to their service or product over time. A steel company must add value through a unique architecture according to Olko and Brzóska (2017). This is in line with the case study where an attempt is made to add value to a product already sold by the vendor by means of service, in this case CS.

An ERP system that does not work effectively is a risk to the functioning and payment of CS (Vrbová, 2019). Theory also makes it clear that under- and overstocking can be a consequence of incorrect data. The interviews have shown that a basic level of consumption must be established before implementing CS. This is a deepening view on the existing theory. What overlaps is the fact that data provides the most accurate estimate of a starting level. This also directly solves the risk of overstocking. The interviews have shown that overstocking is a smaller risk than understocking, which results in a standstill at the customer. Although overstocking, in turn, brings more financial exposure. Also, this causal connection is not explicitly mentioned in the current theory. The demonstrable importance of data on the risk of overstocking has been most applicable in the current case.

Thus, strategy should therefore focus on data use and the division of responsibilities. First, according to theory and the interviews, data is the core of a well-functioning CS system. Such a system must be capable of analysing, predicting, and converting customer consumption data into invoices. If this does not work properly, the vendor has a lot of extra work to do in terms of manual analysis and operation of data. If consumption cannot be predicted by a software system, consumption cannot be optimised and there is a greater risk of financial exposure. Secondly, the risk can be strategically spread by contractually agreeing in advance on the responsibility for participating in CS in a three-tier agreement, these are the vendor, supplier, and customer. Literature discusses three fixed scenarios for the division of CS responsibilities (Sarkar et al., 2018). The interviews revealed that many hybrid solutions can be devised to best represent the requirements of all parties involved.

5.3 Limitations and Further Research

This case study and its accompanying findings are based on a steel manufacturing company and its ecosystem and network. Although the theory consists of general information about the industry and matching themes, the interviews are done based on convenience sampling. At this stage, it is not possible to validate whether the wide range of risk topics found in this study can be directly applied to other firms with different characteristics. Additional research could involve more firms and thus address the uncertainties regarding the multi-applicability of this research.

In addition, the survey was conducted among existing networks. With the given time location and company preference, this choice can be substantiated. However, it has not been specifically investigated how much the particular items related to the acquisition of new customers. It is also possible that new customers bring more risks that were not mentioned in this research. Additional research is needed to rule this out.

Each participant was asked in advance whether the difference between VMI and CS is clear. It was mentioned that this research only concerns CS and the aspects related to VMI may be omitted. If the respondent did not know the difference, this was explained on site. During the interview, we noticed that many respondents still mentioned aspects of VMI in relation to CS. This cannot be separated in retrospect. For this reason, it is possible that the research about CS also involves aspects of VMI. Although this paints a more global picture, it also dilutes the separation bias of the research.

Finally, the study highlighted that international aspects play a role. Culture and working methods were mentioned as different factors per country. This subject did not receive any consideration in the research's scope. This means that only the surface of this subject has been touched. Future research can focus on the effects of international cultural differences on the CS district method.

5.4 Theoretical Implications

From a theoretical perspective, our inductive research offers a comprehensive analysis on the risks that occur in BMI in the form of CS. Here we focus on a three-tier system as described by Zanoni et al. (2017). The definition of CS is implemented as 'stock owned by the vendor' (Persona et al., 2015). This study compares the benefits of CS previously studied by Battini et al. (2010). In addition, a reflection has been made with the risks mentioned by Vrbová (2019).

Conducting additional risk research is in line with the paper by Beheshti et al. (2020), who indicates that implementation of CS is not without risks.

We imply here that the degree of digitisation plays an important role in the operation of a CS system in a three-tier system. We emphasise that the degree of a reliable system is positively influenced by the degree of automation. This is in line with the research of Vrbová (2019) that links manual operations with unregistered missing consumables. We indicate that misuse can be a consequence of the disruptive aspects that digitisation can bring. This gives a clarifying meaning to the research of Pomykalski (2018) who mentions that digitisation can be disruptive in the steel industry.

Furthermore, under- and overstocking are mentioned by Verbová (2019) as risks. The theory currently relates this to logistical properties. Order bundling and a responsible transport partner are important aspects (Beheshti et al., 2020; Faur et al., 2020). This research result validates the risk for under- and overstocking. However, this study suggests that the main reason is linked to the absence or incompleteness of data. This research has less focus on logistical challenges.

Finally, we emphasise the significance of long-term conditions to ensure quality. This is currently theoretically underexposed by scholars. This research has shown that a well-functioning system based on data in combination with customer contact is important. Ultimately, we add to theory that the work type performed by the customer influences how much customer contact is required. These parameters are underexposed in the literature about CS and especially in the theory about CS in the steel processing industry.

5.5 Practical Implications

Our work has multiple practical implications. First, the results of our research show the importance of a good digital structure. Risk analysis shows that a good IT system helps to implement CS. According to Faur et al. (2020), implementation of CS is a risk in itself. A good digital structure reduces this risk.

Second, we imply that there should be a strategic focus on data transparency throughout the three-tiers. The three-tier agreement requires mutual trust. This includes that all parties involved must be able to view live information to have an insight into financial exposure and stock levels. In addition, we concur with Gharari et al. (2019) who imply that customers in a

CS should have a financial limit. This study supports a financial limit by stating that in this way financial exposure is limited when non-payment occurs.

Third, we state that staff of a client who works directly with CS should be trained to work with CS. In addition, there needs to be support for implementation from customer staff. Research by Branca et al. (2019) implies that employees in the steel industry can have difficulties with changing working methods. We imply with this research that workers can make or break CS and therefore their contribution is important.

Fourth, we show that vendors who decide not to restrict withdrawals are substantially more at risk of losing consumables than vendors who work with a vending machine principle. This is directly linked to research by Vrbová (2019) who writes that the disappearance of consumables is a risk. This study is consistent with the findings of Vrbová and makes a direct link to financial exposure.

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