ASPECTS OF DIGITALIZING THE SUPPLY CHAIN SOURCING PROCESS: A CASE STUDY FROM THE NORWEGIAN INDUSTRY

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ABSTRACT

While there is a strong interest to move towards a fully digitalized and integrated Business to Business (B2B) process, many companies oversee the importance of different aspects that should work together for a successful implemented B2B process. These aspects include alignment of the cross-organizational business process, organizational responsibility assessments, and technological readiness evaluation to reach at a sound digital B2B strategy. Without such a strategy, the business case for digitalizing B2B is not necessarily positive due to for example mismatch between strategy, process and technology, unclear responsibilities, and missing links in the technological infrastructure. Consequently, the investment on digitalization of a B2B process may not result in expected outcomes with over-budget implementations. This paper presents a framework for facilitating digital B2B integration, outlining and elaborating the aspects that should be considered in the digitalization of a supply chain process and information exchange. A case study from the maritime sector is discussed to map an ongoing project for the digitalization of a supply chain sourcing process, in the light of identified aspects. The case study explores the relationship between two suppliers and one manufacturer. They currently rely on an e-mail driven communication for the sourcing of products and have an ongoing incentive to further digitalize their relationship trough integrating an EDI system to their sourcing process. The paper contributes to theory and practice by proposing a holistic framework for digitalization of the supply chain sourcing process and providing insights and learnings from a real-life manufacturing company in this context.

Keywords: Supply Chain Management, B2B, Digitalization, EDI, Sourcing, Purchasing

1. INTRODUCTION

Creating a fully digitalized supply chain sourcing process within Business to Business (B2B) relationships is high on the agenda of most companies to improve their flexibility and responsiveness, and in turn competitiveness. The importance of digitalization in integrating partnering firms is highlighted by increasing decentralization of value-adding activities to other companies (Gunasekaran & Ngai, 2004). Digitalizing the B2B relationship can be defined as the process of making information, business activities, and offerings related to exchanges between two organizations digital (Salo, 2006). Managers have engaged in digitalizing the sourcing process since the 80s through electronic data interfaces (EDI) to connect local information systems for efficiency gains (Lim & Palvia, 2001). Throughout the years, the functionalities and technical capabilities of B2B have been expanded as the capabilities of digital tools have increased drastically. Through an extensive literature review, Salo (2006) argues that digitalizing B2B relationship, such as EDI

implementation, reduces the amount of manual labor and the mistakes, increases the business volume, and makes transactional activities more accurate, saves time on communication and negotiations.

Digitalizing the B2B relationship does, however, not ensure a flawless B2B integration and value generation. Research on EDI implementation shows that benefits and gains may vary from operational to strategic to opportunity benefits for organizations (Naudé, Holland, & Sudbury, 2000). That depends on several aspects as discussed below.

- Characterizing the business relationship. When digitalizing a relationship, organizations should first characterize the relationship by looking at the products and services exchanged, and processes conducted. In this context, the current state of the B2B relationship is reviewed and further digitalization roadmap is drawn (Parviainen, Tihinen, Kääriäinen, & Teppola, 2017). Reviewing the current state incorporates analysing the related process in accordance with the identified digitalization goal and identifying the challenges and potential improvement areas in the process through digitalization. Once the current state is analysed, the operational processes should be streamlined, indicating the impact of the digitalization on the process (Kohli & Johnson, 2011).
- Identifying the actors, competences, and responsibilities involved. A fully digitalized relationship exists very seldom. In most cases, human intervention is needed in the process. As such, responsibilities should be assigned to appropriate people in the business process Cabanillas et al. (2012).
- Identifying the level of IT maturity. Organizations possess different levels of IT system maturity with existing systems, tools, and processes when implementing a new tool for digitalizing a relationship between them. The level of IT maturity refers to the organization's IT adoption level in its processes. Identifying the maturity level will help the organization with drawing a baseline, benchmark and drive focused improvements in its capability and value contribution (Curley & Kenneally, 2011), when implementing a digital solutions towards an identified goal.

Without a clear understanding of these aspects and a strategy for implementation, B2B implementations can result in overspending and non-functional systems with limited business benefits and value. The research is also limited on the realization of digital transformation projects and how it should be managed (Henriette, Feki, & Boughzala, 2015). This study questions and elaborates on the aspects that play important role in the implementation success of digital tools for B2B relationship digitalization, through a field-based study concerned with the supply chain sourcing process. As such, it provides contributions by not only adding a real-life case study to the limited field-based literature on this topic but also exploring the phenomenon through a supply chain process. Further, the paper proposes a framework that can guide companies in the implementation process of the digital technologies.

2. METHODOLOGY

This study takes an inductive research method of model building from a case study. As it has been frequently discussed in literature, there is a clear divide between the theoretical premises of the digital technologies and their implementation outputs in practice. As such, a natural way to reduce the theory–practice gap is to conduct more field-based research. Inductive case studies enable to generate deeper insight into the phenomenon within its real-world context and lead to analytic generalizations (Eisenhardt & Graebner, 2007). The case company was chosen from an ongoing

collaborative research project that involve the researchers and the company, among others.

The case consists of two supplying and one sourcing company, all located in Norway. The sourcing company produces highly specialized maritime equipment (called P1 for the remainder of the paper). The facility in Norway has approx. 450 employees and is part of a larger international corporation with over 4200 employees. The two strategic suppliers deliver electronic (S1) and mechanical parts (S2) mostly in an engineer and make-to-order (ETO/MTO) setting. The long lead time items are procured in a make to stock basis through forecasts. P1 makes small batches of engineer-to-order (ETO) products. The company is currently digitalizing the sourcing process through implementing a new EDI solution, which ensures that the research phenomena can be studied (Voss, 2009).

This research has been an iterative and recursive process involving literature study and case study, which is common in field-based research (Eisenhardt & Graebner, 2007). The literature study provided initial insight and constructs into the digital transformation aspects that influence the implementation success. The case study helped with validating, elaborating, and expanding the insights gained through the literature study, resulting in the framework for guiding the implementation of digitalization technologies for B2B integration in practice.

The case data was collected and verified in five site visits of one day duration to the company over a 6 months period in 2019. In these site visits semi-structured interviews and workshops were conducted with the company employees taking roles in the sourcing process. The first interviews were focused on mapping the current B2B supply chain sourcing process, desired level of digitalization and identifying current activities to digitalize the relationship. These were conducted with both the strategic suppliers and sourcing company. After that, a round of workshops was conducted to map the desired to-be situation for the B2B relationship with the sourcing company. In a second round of workshops, these analysis and results were verified and validated with the three companies involved. The captured data was analysed around flowcharts and process maps, which were further verified through follow up questions in the workshops. The details of the data collection and verification methods are given in Table 1.

Table 1: Summary of the data collection and verification methods

Site visit	Aim	Data collection
1	Understanding and mapping the sourcing process, and the digitalization needs.	Group interview and workshop with project manager, supply chain manager, and procurement manager. An overview of today's purchasing tasks was mapped, the main processes were identified. 1 day.
2 - 4	Identifying and modelling the to- be situation of the digitalized sourcing processes.	Group interviews with the supply chain manager and procurement manager (P1) to initialize a draft of desired to-be processes. 3 separate interview days for the different processes.
5	Verification of the desired to-be situation of the sourcing processes.	Workshop with the supply chain manager and procurement manager of P1, the chief supply chain officer of S1, and the CEO of S2. 1 full day workshop.

2. LITERATURE BACKGROUND

2.1 B2B Digitalization

B2B digitalization can be traced back to the rise of EDI, "a process of computer to computer,

business to business data transfer of repetitive business processes involving direct routing of information from one computer to another without human interference, according to predefined information formats and rules." (Holland, Lockett, & Blackman, 1992) EDIs are the first systems that have crossed organizational boundaries by sending standardized documents over networks that predate the internet, with the first messages sent in the 60s and the first standards designed in the 70s.

As EDI can make use of its own networks, standardized documents can also be sent over the internet. EDI, however, consists of standardized protocols for sending standardized messages with formats such as X12 and EDIFACT. These messages are sent in batches. With the advancements of digitalization, APIs (application programming interfaces) are complementary to EDI, building a real-time exchange of data between two systems. Gartner estimates that 25% of all B2B interactions will take place through an API by 2020, but legacy approaches will remain for handling the bulk of transactions. (Gartner, 2019)

APIs are not standardized towards B2B interaction like EDI, and APIs can have completely different implementations in similar industrial settings. API will most likely complement existing EDI systems to query for real-time information and real-time communication between systems, e.g. status of shipments and inventory stock levels.

2.2 IT System Maturity

The IT maturity level of an organization provides a basis and roadmap for improvements to be made to next steps (O'Regan, 2011). A survey conducted by Lin et al. (2007) indicate that the level of IT maturity has significant direct relationship with B2B adoption readiness which significantly influences the B2B digitalization benefits. IT maturity model is a helpful tool for addressing the issues such as what needs to be measured and how, and what to compare it with to achieve an objective assessment of the AS-IS situation (Becker, Knackstedt, & Pöppelbuß, 2009).

IT maturity should be aligned with the business maturity to obtain expected values from digitalization. Sledgianowski and Luftman (2005) suggest that firms should understand the business-IT linkage and set up aligned goals, for strategic alignment of their IT-business maturities. This relationship also applies to the supply chain integration, as shown by the study of Plomp and Batenburg (2014), showing evidences for positive relationship between the business/IT alignment and supply chain integration.

In this context, Van Grembergen and Saull (2001) propose an IT balanced scorecard assessing the alignment maturity of IT implementation with users' view, business contribution, operational excellence, and future orientation. Becker et al. (2009) take a comprehensive approach for IT maturity assessment of organizations through three dimensions:

1. "contents" looks at the relevance of the applied IT performance solution for the IT management.
2. "organization" assess the integration of the IT solution into the companywide concepts.
3. "technology" examines the applied components and architectures in the solution.

IT maturity models consequently aim at assessing the value generation from the IT capability. Curley and Kenneally (2011) identify the importance of four macro processes (See Figure 1) to generate value from IT capability, in their IT capability maturity framework (IT-CMF). Using this approach, interrelated strategies and associated maturity curves for these four processes can be adopted to help deliver more value from IT.

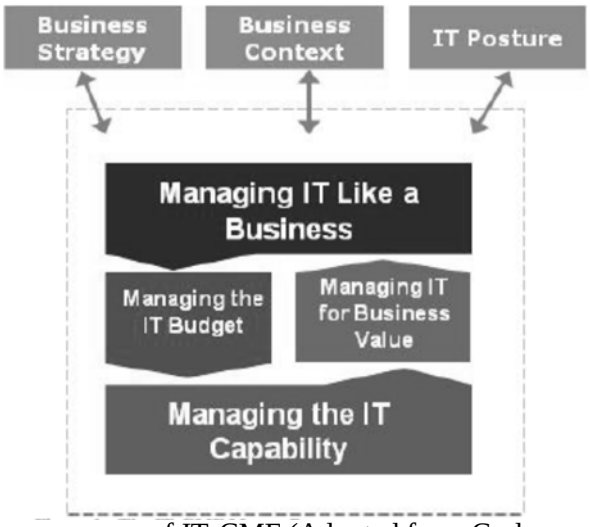

Figure 1. Four macro processes of IT-CMF (Adopted from Curley and Kenneally (2011))

2.3 Process design and alignment

Business process management (BPM) mainly looks at "supporting business processes using methods, techniques, and software to design, enact, control, and analyse operational processes involving humans, organizations, applications, documents and other sources of information." (Weske, van der Aalst, Verbeek, & Engineering, 2004) Designing a business process, however, is not easy. Making a business process model needs to "ensure better alignment between business and IT staff, provide security, manage the rapidly changing business environment, manage rapidly changing business processes, manage customer power, be easy to reengineer, ensure IT goals can be easily derived from business goals and be built and implemented easily as a web service." (Alotaibi, 2016) Critical success factors (CSFs) should therefore be considered when designing business processes. Trkman (2010) classified CSFs for BPM (1) contingency theory, (2) dynamic capabilities and (3) task-technology fit to ensure (1) match between business environment and business process, (2) assure sustained benefits, and (3) have a suitable fit between IT and business processes. To ensure a fit between the business environment and processes, organizational strategy should be aligned with BPM, the level of IT investment should match strategy, and performance of new processes should be measured. To ensure sustained benefits, organizational changes should be harnessed, process owners should be appointed, the quality of implementation should be ensured and continuous improvement is necessary. To ensure a task-technology fit, processes need to be standardized and automated where possible. Furthermore, employees should be trained and empowered for the new processes designed. (Trkman, 2010)

For modelling of business processes, many different methods exist, such as UML, BPMN and IDEF0, each with its advantages and disadvantages, see for example Wohed, van der Aalst, Dumas, ter Hofstede, and Russell (2006) for a comparison between BPMN, UML2.0 AD, BPEL and Oracle BPEL PM.

For supply chain sourcing processes, different standards exist. Most large IT providers propose their own set of processes, such as source-to-pay (S2P, provided by Oracle, SAP) and procure-to-pay (Basware, Ariba), describing the full set of process between sourcing and supplying party. These processes are sales oriented to promote IT systems that can provide the processes proposed. General process descriptions exist as well, and a well-recognized model is SCOR, linking processes, performance metrics and best practices. The SCOR model defines level 1 (main processes in a supply chain), level 2 (process strategy for an industry type) and level 3 (specific processes and

its inputs and outputs) processes. Level 4 processes are company specific processes that can be derived from the reference processes in the SCOR model. (Supply Chain Council, 2012)

2.4 Responsibility alignment

The modelling and streamlining of the operational process discussed above tracks the execution of the process. However, the resource assignments are missing in business process models. For a successful implementation process, activities and responsibilities should be assigned to appropriate people in the business process. This is not only important to have an action plan, but also to obtain a global view of the responsibilities. Few models are proposed for assigning responsibilities in a business process. La Rosa et al. (2008) proposes a meta-model for configurable processes, incorporating task-role associations and task-object associations. Yang et al., (2008) apply Markov models to describe the complicated relationships among employees and to allocate them for a business process. Another responsibility assignment model is so called RACI matrix, also known as Responsibility Assignment Matrix (RAM) or Linear Responsibility Chart (LRC) (Cabanillas et al., 2012). RACI roles consists of the following functions:

- Responsible (R): person who must perform the work
- Accountable (A): person who must approve the work
- Consulted (C): people whose opinion sought while carrying out the work
- Informed (I): person who is kept up-to-date about the work

RACI model offers a simple but useful approach for integrating the responsibilities with business process modelling. By introducing so called binding information concept (e.g. organizational unit context and additional restrictions for the organizational roles), Cabanillas et al. (2012) introduces an approach to automatically generate a business process model with RASCI information. RASCI is a variant of RACI, with an additional role called Support (S) who may assist in completing an activity.

3. CASE STUDY

3.1 Case Description

The current sourcing process is e-mail based, i.e. quotations, purchase, changes orders and invoices are all send by e-mail by collecting information from several IT systems. The initial strategy for improving B2B has been to invite different EDI software providers to digitalize the B2B process and get an insight in today's possibilities. This strategy has so far not been fruitful, as no clear requirements or goal had been set out. The case therefore set out to map a clear strategy based on current IT maturity, designing future processes, and discussing future responsibilities. Each of these elements will be discussed in depth in the next sections.

3.2 Current IT maturity and challenges

All three companies use current day ERP solutions for production planning and control. These solutions all provide basic MRP planning. For P1, the ERP solution is connected to Siemens Teamcenter such that the latest product versions and bill-of-materials (BOM) are available in the ERP system. The current maturity of the process is largely limited to sending traditional sourcing documents through either e-mail or FTP protocols. Processes to complete a sourcing process are unstandardized and not digitalized beyond e-mail, which is considered the main challenge to implement a new B2B system. It is required that P1 better understands its business-IT linkage as suggested by Sledgianowski and Luftman (2005), such that value can be generated from a new solution. A current assessment through the Becker et al. (2009) dimensions would classify the current "contents" as limited, as the current IT solution (e-mail) is not necessarily relevant for B2B.

The "organization" of IT is limited, as there are no clear protocols for the use of today's IT tools, nor is the value of the IT systems used perceived as high. As for "technology", the different systems used today for B2B processes have a limited integration, limited functional range, and limited automation and standardization. However, the case companies have a clear aligned IT strategy through a collaborative research project focusing on this theme.

3.3 Designing future processes and assessing responsibility

Before designing new processes, the to-be designed processes needed to be elicited. With the help of the SCOR framework, initial process maps could be drawn as a starting point for standardization. Selecting a suitable business processing language had two requirements: (1) understood by business users, and (2) easily translatable to IT implementation. This resulted in using the Business Process Modelling Notation (BMPN) as BPMN is developed to "provide a notation that is readily understandable by all business users, from the business analysts that create the initial drafts of the processes, to the technical developers responsible for implementing the technology that will perform those processes, and finally, to the business people who will manage and monitor those processes." (Object Management Group, 2011)

The initial processes were primarily based on the SCOR level 2 make-to-order and engineer-to-order sourcing processes. Selected level 3 processes let to a discussion on which other processes had to be included in digitalizing the B2B relationship. This gave a set of six to-be processes, supported by corresponding level 3 reference processes from the SCOR system where possible, see Table 2. The SCOR system is not exhaustive, e.g. no clear processes for engineering change orders are defined. These processes were therefore designed using the knowledge available in the case.

Table 2: To-be designed processes and reference processes used (Supply Chain Council, 2012).

Process	P1 SCOR level 3 reference processes	S1/S2 SCOR level 3 reference processes
1. Request for quotation	S3.1, S3.2	D2.1
2. Purchasing under supplier agreement	S2.1	D3.2, D3.3
3. Purchasing change request	--	--
4. Supplier shipment → Receipt verification	S2.2	D3.5 – D3.12
5. Receipt verification (Quality control)	S2.3, R1.1, R1.2	D3.13, R1.3
6. Engineering change order	--	--

The processes were designed by following a structured approach for each process.

1. A basic reference process was constructed for each process using the reference processes and relevant knowledge in the case.
2. For each process, a one to two hours workshop was planned with the supply chain manager and the procurement manager at P1.
3. During the workshop, the process was updated to reflect the situation, wishes and possibilities at P1 and S1/S2, to ensure a match between the business environment and the business process (Trkman, 2010).
4. For each process step, responsibilities were assigned using the RACI matrix. This is to initiate sustained benefits by appointing process owners (Trkman, 2010).
5. After all workshops, a 2-day workshop was planned with participants from P1 and S1/S2 to alter and verify the processes and related RACI matrices (Cabanillas et al., 2012). This led to a

set of to-be processes, mapping the sequence of tasks and related responsible roles for each task. By completing this structured approach, the case companies had a reference for digitalizing the sourcing process. From these to-be processes, it can determine which process steps need to be performed by a software solution. These tasks need to be cost-effective, error-free and effective, meaning that relevant KPIs should be determined to measure the effectiveness of the defined processes.

This resulted in a discussion on responsibilities. When a process step is done manually, both an accountable and responsible actor must be assigned. In case of automation, a computer system performs the process step, i.e. becoming responsible for the process step. Because the responsibilities lie across the organizational boundaries, the assignment of accountability is crucial in case of malfunction. For example, if a purchase order does not reach its intended receiver, who should be held accountable for the lost communication: P, S1/S2 or 3rd party IT provider? It would be unlikely to have the supplier as accountable if the error is on the purchaser side, but contractual obligations for delivering purchase orders might complicate this.

3.5 Current status, lessons learned and selection of a software provider

The case companies constructed and agreed upon the to-be processes mentioned in Table 1. These are now leading to design the future sourcing digitalization effort. Two software providers have responded to the preparation work done. The case companies have learnt that most process steps can be digitalized, either in existing systems or a new system provided by a software provider, but it became also evident that this requires investments in IT to improve the maturity of its "contents", "organization", and "technology" aspects. (Becker et al., 2009).

It became apparent that a new set of processes and responsibilities is not finished before the digitalization effort is completed. It also became evident that a digitalization effort must improve (part of) a process compared to its manual counterpart. The processes developed are never in an end-state and need to be continuously improved as internal or external factors demand such a change. This needs to be managed as one of the CSFs mentioned by Trkman (2010).

The cost of implementing and maintaining new to-be processes is currently unknown, as well as the cost per process transaction. Because of the unknown costs, a comparison between new software solutions and following the processes with the current available systems is not possible, the following costs are unknown:

1. Implementation cost for a new system.
2. Maintenance cost for the system.
3. Transaction cost of each transaction that involves human labour.
4. Transaction cost for each automated transaction
5. Error rate of different processes.

The case companies did learn from the exercise of designing processes and responsibilities, internally agreeing on how to run their supply chain sourcing operations, but also learning what effects this imposes on their counterpart (supplier and sourcing company resp.). This created a unified vision on how to standardize the sourcing processes.

Another learning point is that the collaborative effort by P1 and S1/S2 was crucial in defining the new processes who are now supported across company boundaries. It also started the discussion on cost sharing and integration methods for a new system.

In addition, a major learning point was the distribution of accountability for digitalized or fully automated processes in case the technology fails, e.g. who is responsible for the failure of a purchase order message delivery, P, S1/S2 or the software provider? These accountability issues

need to be discussed and recorded during the design and implementation of new processes.

4. FRAMEWORK & DISCUSSION

From the literature background and the case study, a framework is synthesized in Figure 2. It describes how to design future processes from standardized process, the current IT maturity and business strategy of the involved parties, and the needs existing in the B2B relationships. It lays the foundation for determining how the new process should function and perform. KPIs and corresponding threshold values can be created to determine which process steps should be digitalized. The created processes are not finalized after the first design. As it is determined on whether and how each process steps will be digitalized and automated, the responsibilities and performance of the system changes, making it a continuous improvement process to determine process steps, KPI target values, responsibilities and digitalization efforts.

As literature discusses the different elements of the framework proposed, the links between them have not been explicitly listed in the perspective of B2B in the literature. The framework proposed in this study makes it explicit that continuous improvement is required as soon as a process, system, KPI or RACI changes. Starting from a certain IT maturity, e.g. mapped through Becker et al. (2009), and a organizational strategy, processes for B2B digitalization can be constructed and continuously improved over time. Linking KPIs, IT functionality, process steps and responsibility leads to a B2B process for which one can asks: Who performs the task, what is done, how is it done, and what is the expected outcome. Using the SCOR and RACI model as references gives managers an accessible reference to construct their own processes, such that this framework can be used in practice.

Throughout the case certain aspects were elicited. First, standardization should have priority over digitalization to keep partners aligned on B2B processes. Digitalization without such effort can lead to over-budget implementations or non-functioning solutions. During the case it was also observed that the preparatory work done by the project partners led to a more constructive dialogue with software companies to provide solutions. It seems that standardization therefore precedes digitalization.

Second, standardized processes are needed to assess the costs of a standardization and digitalization effort to determine the costs involved in such a project, both from an implementation and day-to-day business perspective. This allows for managers to find a solution that fits the requirements and budget for digitalizing B2B processes.

Third, strategic alignment and a clear mandate for IT investment is necessary. The message that IT investment does not solve the problem was not heard when the case commenced. Digitalization is only useful when the strategy and related processes require digital solutions, and the process as described in Figure 2 led to that insight within the case companies.

And lastly, one issue has remained critical; the onboarding and integration of partners. With different systems and different maturity levels, it can be difficult to connect suppliers to existing solutions. Sourcing companies want to integrate as many suppliers as possible into their B2B solution as it standardizes their process. There are examples of companies that do not trade with suppliers whom are not willing or able to integrate their systems into the supplier proposed solution. Advancements in EDI do give suppliers new possibilities to interact with the sourcing company. One example is that a supplier can access all EDI information through a web-portal, without the need to integrate its own information systems.

	Level		Examples	Comments
	#	Description		
Within scope of SCOR	1	Process Types (Scope)	Plan, Source, Make, Deliver, Return and Enable	Level-1 defines scope and content of a supply chain. At level-1 the basis-of-competition performance targets for a supply chain are set.
	2	Process Categories (Configuration)	Make-to-Stock, Make-to-Order, Engineer-to-Order Defective Products, MRO Products, Excess Products	Level-2 defines the operations strategy. At level-2 the process capabilities for a supply chain are set. (Make-to-Stock, Make-to-Order)
	3	Process Elements (Steps)	• Schedule Deliveries • Receive Product • Verify Product • Transfer Product • Authorize Payment	Level-3 defines the configuration of individual processes. At level-3 the ability to execute is set. At level-3 the focus is on the right: • Processes • Inputs and Outputs • Process performance • Practices • Technology capabilities • Skills of staff
Not in scope	4	Activities (Implementation)	Industry-, company-, location- and/or technology specific steps	Level-4 describes the activities performed within the supply chain. Companies implement industry-, company-, and/or location-specific processes and practices to achieve required performance

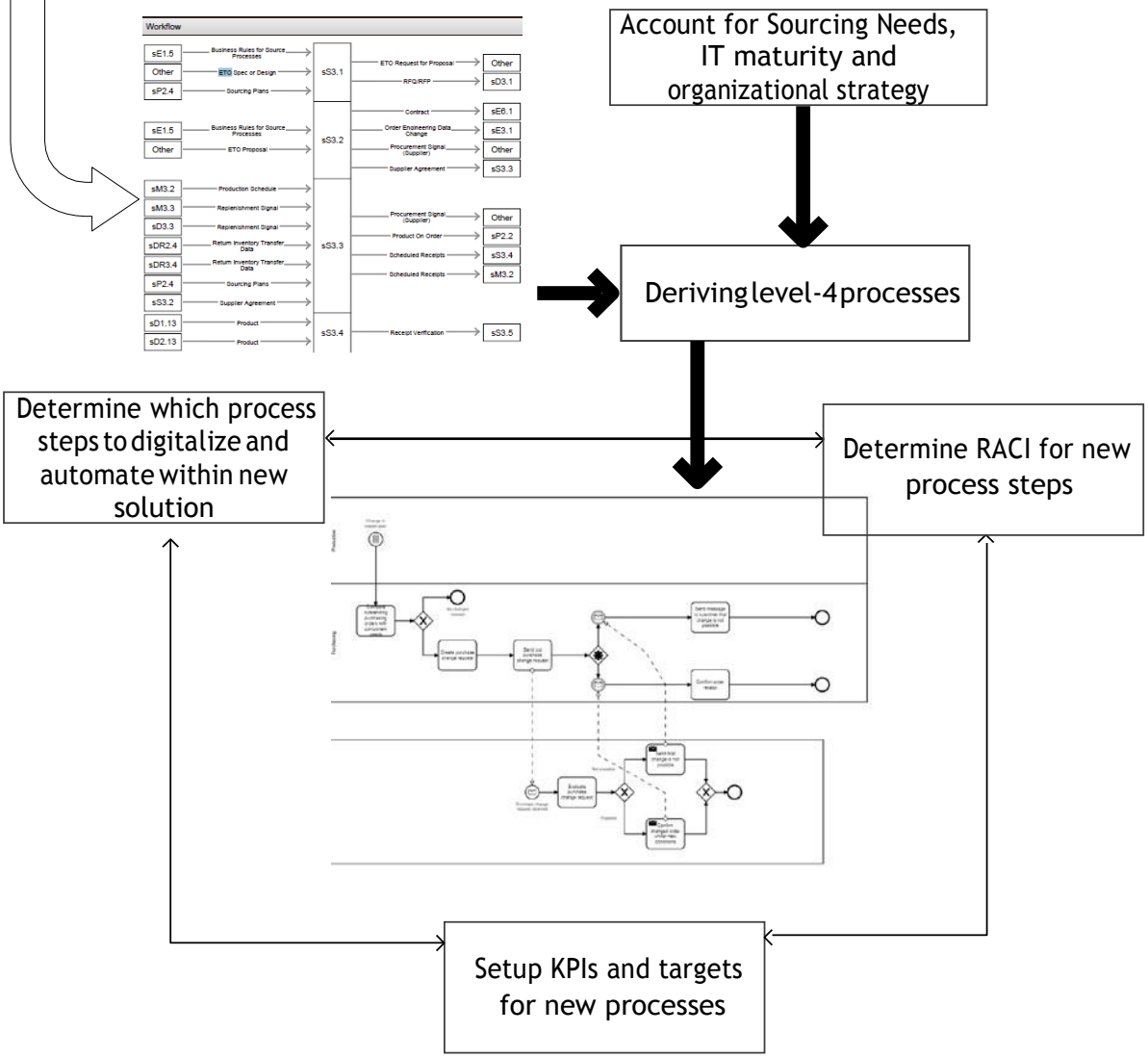

Figure 2. Framework for digitalizing sourcing processes

5. CONCLUSION & FUTURE RESEARCH

This paper developed a framework for digitalizing B2B relationships by discussing different aspects of the sourcing process and synthesizing knowledge from a deductive case study. It was found that standardization of processes is an important aspect of digitalizing B2B. This standardization should be a mix of reference processes, business strategy, IT maturity and case needs. Resulting processes should be updated iteratively based on digitalization efforts, KPI targets and responsibilities.

Future research should focus on onboarding and integration of partners into the digitalized supply chain sourcing process. In addition, different techniques for business process design and management could be tested. CSFs remain critical to this endeavour, especially the dynamic between the business environment and chosen strategy, as this advances the design, implementation and continuity of digital supply chain sourcing.

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