Identifying Potential Applications of Service Configuration Systems in a Logistics Company

Erika M. Strøm [1], Tine M. Münsberg [1] and Lars Hvam [1]

[1] *Technical University of Denmark, Koppels Allé 404, 2800 Kgs. Lyngby, Denmark*

Abstract

The logistics industry is challenged by the demand for customized services. This challenge is especially apparent to third-party logistics (3PL) companies offering warehousing services. These services include inbound, storage, and outbound logistics along with value-added services (VAS) based on client requirements. 3PL companies must deliver customized services to a wide range of clients while remaining efficient and competitive. Product configuration systems (PCS) have shown to play a key role in providing customized products efficiently. However, literature on the application of configuration systems to services is limited. This paper investigates the potential applications of a service configuration system (SCS) in a logistics company offering customized warehousing services. The aim of this paper is to identify potential applications of a configuration system to a company offering a large variety of services. Modularization of services and applications of configuration systems are shortly investigated and a framework to identify possible applications of PCS is adjusted and applied to services. The framework is applied to a 3PL company to identify potential applications of SCS and to assess the difference between application of configuration systems to products and services. The study uses qualitative data collected in interviews from the case company. The identified applications provide a basis for further scoping of configuration projects in the logistics company.

Keywords

Configuration Systems, Services, Logistics Companies, Third-Party Logistics (3PL), Applications

1. Introduction

Third-party logistics (3PL) companies operate in a highly dynamic and competitive environment [1–3]. These companies manage logistics operations for a wide range of clients from different industries [2]. The warehousing segment manages multi-client warehouses with concurrent logistics operations for different clients [1, 4]. These operations include inbound, storage, and outbound logistics along with value-added services (VAS) [1, 5]. VAS are activities that go beyond the basic logistics operations and add value to the product. VAS are customized to the individual client and encompass a wide range of services, such as labelling [3] or returns handling. Logistics companies can achieve higher profits from providing VAS as the profit margin on simply moving and storing goods is minimal. VAS also enable logistics companies to build closer relationships with clients and differentiate themselves from the competition [3]. The ability to provide VAS plays an important role in gaining a competitive advantage. However, the high level of customization generates several challenges such as complex and time-consuming specification processes for new clients.

The challenges associated with customized services are similar to those of customized products. The concept of mass customization describes the delivery of customized products using mass production techniques to achieve similar lead time, prices, and quality to mass produced products [6]. Product configuration systems (PCS) have shown to be key drivers when enabling mass customization of products. PCS support the development of specifications for customized products [6, 7]. This process includes the activities related to gathering client information, configuring products, and generating product specifications [6]. Case studies have shown the implementation of PCS to reduce man-hours and lead-time related to preparing quotations along with reduced errors in the specification process [6–9].

The development and implementation of configuration systems for products is described in numerous literature [6, 7, 9]. However, limited literature describes configuration systems for services. This poses the question of whether configuration systems can be applied to logistics services to yield similar benefits as with products. The logistics services described in this paper have an undefined solution space as the services can be configured in almost infinite combinations to meet the individual clients' needs. Parallels can be drawn to engineer-to-order (ETO) companies with similar

ConfWS'23: 25th International Workshop on Configuration, Sep 06--07, 2023, Málaga, Spain
EMAIL: emst@dtu.dk (A. 1); time@dtu.dk (A. 2); lahv@dtu.dk (A. 3)
ORCID: 0000-0002-7123-2832 (A. 1); 0000-0001-8924-8026 (A. 2); 0000-0002-7617-2971 (A. 3)
© 2023 Copyright for this paper by its authors. Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).
CEUR Workshop Proceedings (CEUR-WS.org)
CEUR-WS.org/Vol-3509/paper9.pdf

undefined solution space and complex processes [6, 10]. Due to this complexity, multiple configurators or PCS are often required to support the specification process in ETO companies and the implementation process is gradual [11]. Kristjansdottir et al. [11] describe a need for identifying and prioritizing PCS projects before initiating development of PCS in ETO companies. This may also apply to logistics services.

This paper aims to contribute to literature on configuration systems for services and provide a framework for identifying potential applications of service configuration systems (SCS). The framework is based on a framework for ETO companies developed by Kristjansdottir et al. [11] and adjusted to services based on the studied literature. The framework is applied to a case company offering a wide range of logistics services.

The paper is structured as follows: Section 2 describes the literature within services and configuration systems and Section 3 explains the research method used in this study. Section 4 describes the adjusted framework for services and Section 5 describes a case study of a 3PL company. The framework and case study are discussed and concluded upon in Section 6 along with considerations for future research.

2. Literature review

The literature review describes existing literature within modularization of services and application of configuration systems. Previous application of configuration systems to services is described and the research gap is identified.

2.1. Modularization of services

Modularization and the use of modules is closely related to product configuration [6, 12]. Modularity and product platforms enable companies to efficiently develop and produce products to meet the needs of different market segments [13]. Configuration systems build products from modules according to a set of defined rules and constraints [6]. Hvam et al. [6] describe one of the problems associated with developing and implementing configuration systems as a lack of clearly defined product families and a lack of consensus regarding which variants to offer or which market segments to serve.

Research in the field of service modularity is limited [14–17]. It is an apparent challenge for service companies to define standard variants due to the nature of services [16]. Christensen [18] defines services as intangible, heterogenous, and perishable. Services are a co-creation between the clients and the service industry and are simultaneously produced and consumed [18]. Chervonnaya [19] describes customer behavior in services as volatile and unpredictable. Several authors argue that the concept of modularity could benefit service-based companies [15, 16, 20]. Løkkegaard et al. [16] argue that service companies should adopt the concept of modularization to remain competitive in a growing and dynamic sector.

Some authors have defined modularization in the context of services. Pekkarinen and Ulkuniemi [14] describe a modular service consisting of several service modules. A service module is "one or several service elements offering one service characteristic" [14] and a service element is the smallest unit a service can be divided into [14]. Tuunanen et al. [21] adopt a similar definition of modular services and service modules. Pekkarinen and Ulkuniemi [14] define three dimensions of modularity with interfaces between each dimension: (1) modularity in services, (2) modularity in processes, and modularity in organization. Generally, there are different interpretations of service interfaces [15, 16].

Pekkarinen and Ulkuniemi [14] and Løkkegaard et al. [16] develop a conceptual model for service platforms. The authors incorporate market segmentation in both models as applied to products in the Power Tower by Meyer and Lehnerd [13]. The authors argue that it is important to understand the market in a platform context due to the service industry's dynamic environment and the heterogonous nature of services.

2.2. Application of configuration systems

Configurators are widely developed and used in the manufacturing industry [7, 9, 11]. Numerous articles describe strategies and approaches for developing configuration systems for manufacturing companies [7, 9]. Kristjandottir et al. [11] argue that the existing strategies do not provide guidelines for identifying different applications of PCS. Kristjansdottir et al. [11] develop a framework to identify possible applications of PCS in ETO companies. The study aims to address the challenges in identifying and prioritizing PCS projects prior to the development process. The authors argue that this step is particularly important in ETO companies where multiple PCS support the specification processes. Thus, there is a need for a structured approach to breakdown and prioritize PCS projects. The framework is divided into three overall steps: The first step identifies potential PCS, the second step aligns the PCS with IT systems, and the third step provides an overview of the possible applications of PCS [11].

Literature describing approaches for applying configuration systems to services is limited. Christensen [18] applies a procedure for products by Hvam et al. [6] to services and suggests an adapted approach to mass customize service level agreements based on a service variant master to map the service platform. Some of the identified issues are defining the different types of services which is important for the quality of the service delivery and modularizing services with existing theories for products [18]. Mueller et al. [9] suggest a five-step approach for developing and implementing configurators for commissioning services in ETO companies. The application to a case study showed that ETO companies can achieve a significant reduction in specification time and resources for commissioning services. The authors develop the approach based on strategies for PCS. The first step aims to scope the commissioning configurator project. The authors argue that it may be beneficial to only include part of the commissioning service, but guidelines on how to scope this are not described [9].

The literature does not describe how to identify potential applications of configuration systems for services. Thus, there is a need for a structured approach to identify potential applications of SCS.

3. Research method

The research method is divided into two sections: Development of the framework and validation of the framework. The first section describes the development of a framework to identify potential applications of configuration systems to services based on the framework for PCS. The second section explains the process of validating the framework in a logistics company.

3.1. Development of the framework

The development of the framework is based on the literature within services and configuration systems and knowledge about the case company. The literature contributed to an understanding of (1) existing research within modularization of services along with relevant definitions and methods and (2) the importance of identifying potential applications of PCS to complex products and processes and existing case studies on the development of configuration systems for services. The framework was based on the framework for PCS by Kristjansdottir et al. [11] and adjusted to services based on literature and discussions within the research team.

3.2. Validation of the framework

The framework is validated through a case study in a logistics company offering warehousing services. A case study was chosen as it allows the study of phenomena in its natural setting and generation of theory from real-world observations [22].

The case company, also referred to as *the company*, selected for the study has very limited experience with configurators and no experience with large configuration projects. Multiple stakeholders in the company have expressed an interest in the application of configuration systems and potential areas of application have been proposed in previous projects. However, a structured approach for identifying potential applications of configuration systems in the company is lacking.

The framework was applied to the case company by the researchers for validation. The data used in the case study was collected from semi-structured interviews with different stakeholders in the case company. The framework and the generated results were presented to managers from different business units and the feedback was used to improve the framework for services.

4. Framework for identifying potential applications of SCS

The proposed framework to identify applications of SCS consists of three overall steps derived from Kristjansdottir et al. [11]. The steps are as follows: (1) Identifying potential SCS, (2) Aligning IT development, and (3) Establishing an overview of SCS applications. Figure 1 shows the framework. The individual steps and sub-steps are described in the following sections.

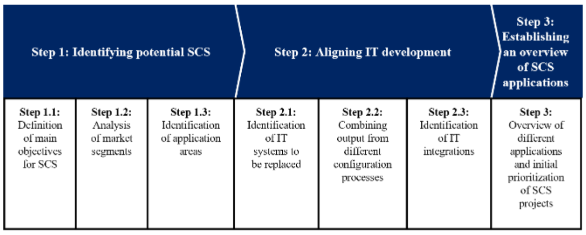

Figure 1: The proposed framework to identify applications of SCS.

4.1. Step 1: Identifying potential SCS

The aim of step 1 is to identify potential SCS. The step is divided in three sub-steps: Step 1.1 defines the main objectives for SCS, step 1.2 analyzes market segment, and step 1.3 identifies application areas.

4.1.1. Step 1.1: Definition of main objectives for SCS

The aim of this step is to identify the main objectives for the SCS. Kristjansdottir et al. [11] describe how objectives are important as they influence decision-making when evaluating application areas in step 1.3 and when evaluating the overview of the SCS applications in step 3. This step also applies in the process of identifying applications for SCS. The intangible and heterogenous nature of services may emphasize objectives surrounding standardization of specification processes, e.g. guidelines or pricing strategies to ensure specification processes are consistent and efficient. Likewise, there may be an enhanced need for uncovering and understanding client needs as services can be modified during operation which requires adjustments to specifications along with additional resources and potentially higher costs.

4.1.2. Step 1.2: Analysis of market segments

The aim of this step is to analyze the market segments served by the company. This step is added to the framework because the company must assess which market segments to serve and which services to include in the configuration system. As described by Hvam et al. [6], one of the problems associated with developing and implementing a configuration system is the lack of clarification and consensus regarding the variants to include. Market segmentation is used to define and differentiate service variants as described by Løkkegaard et al. [16].

4.1.3. Step 1.3: Identification of application areas

In step 1.3 potential application areas of the configuration system are identified. These application areas can be split into a commercial and a technical configuration process as described by Forza and Salvador [23]. The product is described with the specifications determined by the customer in the commercial configuration process, while each distinct product variant is described in the technical configuration process, e.g. with bill of materials (BOM). [23] The same could apply to services.

The objectives identified in step 1.1 serve as guidelines for application areas along with the list of questions described by Kristjansdottir et al. [11].

4.2. Step 2: Aligning IT development

The aim of this step is to understand the current IT systems supporting the specification processes and to align with the configuration system [11]. The second step is divided into three sub-steps: Step 2.1 identifies IT systems to be replaced, step 2.2 combines the output from different SCS, and step 2.3 identifies IT integrations.

4.2.1. Step 2.1: Identification of IT systems to be replaced

In step 2.1 the IT systems or tools which will be replaced by the SCS are identified. The purpose of replacing IT systems is to standardize IT application in the specification processes [11].

4.2.2. Step 2.2: Combining output from different configuration processes

The outputs from different configuration processes in the company are combined to reduce redundancies. Communication between departments is streamlined by combining outputs and using the configuration system as a platform for data [11].

4.2.3. Step 2.3: Identification of IT integrations

Integration should be established to exchange information between the configuration system and other IT systems, such as ERP, CAD, and WMS. These IT systems can be both internal and external to the company [11].

4.3. Step 3: Establishing an overview of SCS applications

In step 3 an overview of SCS applications is created to make an initial prioritization of SCS projects. The entire specification process is mapped based on the analysis in step 1 and 2 [11]. The overview is evaluated and the SCS applications can be prioritized based on the analysis.

5. Case study: Application of the framework in a logistics company

The framework presented in the previous sections was applied to a world-leading logistics company. The company operates 3PL warehouses for a wide range of clients and wishes to investigate how configuration systems could support the specification processes for new contracts. The services offered by the company include inbound, storage, and outbound logistics along with VAS. The warehouse flow is customized to each client and the client can request virtually any VAS. The number of offered services is almost infinite due to the broad client base and high level of customization. The company has not worked with modularization or configuration systems for warehousing services. The analysis is based on one Danish warehouse, but the results are expected to be similar in other Danish warehouses and warehouses in other European countries. After the investigation of the potential the company has started developing a prototype to test the potential of using a configurator in the sales process.

5.1. Step 1: Identifying potential SCS

5.1.1. Step 1.1: Definition of main objectives for SCS

This step provides an understanding of the objectives for implementing SCS. The goal of implementing SCS is to improve the integration of new clients. The following objectives are formulated based on interviews with stakeholders involved in the sales and integration process of new clients and the warehouse operations after implementation. The main objectives for implementing SCS in the company are as follows:

- Provide a clear split between standard and non-standard clients early in the sales process.
- Enhance understanding of the company's capabilities across departments, e.g. the type of services the company can offer.
- Improve documentation in the sales process to reduce errors and misunderstandings between departments and between the company and the client.
- Reduce lead time to generate proposals and time to integrate new clients.
- Provide a clear pricing strategy.

5.1.2. Step 1.2: Analysis of market segments

This step identifies the different market segments served by the company. Generally, the services acquired by all the clients consist of three main processes: Inbound, storage, and outbound logistics. Each process consists of several subprocesses, which are adjusted to the individual client. The client can also acquire VAS, which are services customized specifically to the client. The order of the main processes is fixed, but VAS can be added at any point in the flow. The solution space is undefined as the combination of services and number of VAS is close to infinite. Clients with very specific needs are challenging to define and require highly customized services.

Figure 2 shows the market segments, range of services, and the potential application of SCS. The case company has defined four types of clients in Denmark based on industries. The customer segments have different demands to the main processes based on the type of goods handled. The level of customization depends on the deviation from the main processes. Clients in the highly customized segment often have very specific or demanding needs and are of strategic importance to the company. Highly standardized clients have a simple warehouse flow with few specific needs. This differentiation is defined by sales and project managers in the company. The SCS is expected to be applicable to most customer segments except for clients requiring highly customized services, e.g. significant modification to the three main processes and/or very singular VAS.

The four client types are confidential as it is not in the company's interest to disclose their clients.

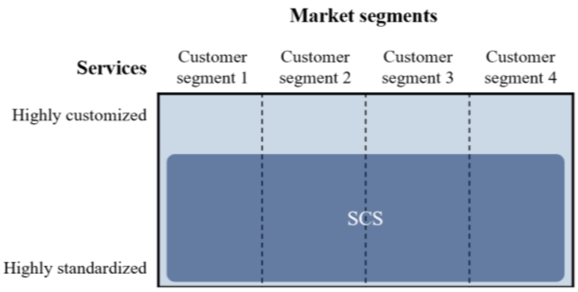

Figure 2: Potential application of SCS within the market segments.

5.1.3. Step 1.3: Identification of application areas

This step identifies application areas of SCS based on the objectives in step 1.1. The case company does not use any configurators. The analysis showed that a configurator could support the sales process and the following integration processes. Figure 3 shows the configuration processes that could be implemented and the generated specifications. The commercial configurator supports the sales department and generates lists of services with cost estimates, offers with price estimates, and drafts of contracts and standard operating procedures (SOP). When the offer is accepted by the client, information from the commercial configurator is input to the technical configurator which supports the integration processes of new clients. The technical configurator generates flow diagrams and BOM with input from project managers. The configuration system shown in Figure 1 is moderately automated as the human operators are not entirely replaced [23]. The decision to have two successive configuration stages is based on the complexity of warehousing services and the degree of service knowledge of the clients.

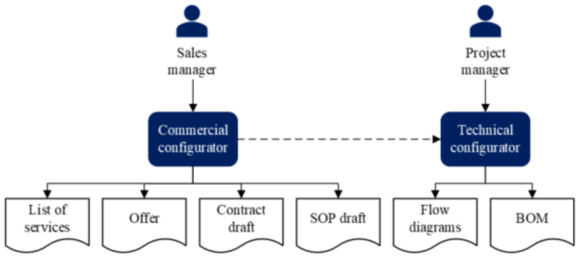

Figure 3: SCS consisting of a commercial and technical configuration process with input from two departments.

5.2. Step 2: Aligning IT development

5.2.1. Step 2.1: Identification of IT systems to be replaced

This step identifies the IT systems to be replaced with the implementation of SCS. The case company is currently using two Excel models to calculate costs and prices of services and two Word templates to generate contracts and SOPs. Based on the analysis in step 1.3, the commercial configurator can replace the Excel models and the Word templates. The remaining documents showed in Figure 1 are not supported by any specific IT systems.

As previously stated, this case study is based on the analysis of one warehouse. It was established in interviews that other warehouses are using different models and templates which are not identified in this study.

5.2.2. Step 2.2: Combining output from different configuration processes

This step combines the outputs from different configuration processes to show the information flow and dependencies across departments. Two configuration processes were identified in step 1.3. Thus, only one dependency exists between the sales department and the project managers.

5.2.3. Step 2.3: Identification of IT integrations

This step identifies integrations between the SCS and other IT systems in the company. Integration with other IT systems will be a long-term process as the company is currently not using any SCS. The configuration system should be able to retrieve data from the company's warehouse management system (WMS). This data includes key performance indicators from different warehouses and services, e.g. capacities and efficiencies. Furthermore, it would be beneficial to connect the SCS with the company's communication platform for clients, the customer relationship management (CRM) system. The communication platform is used to message the client during the sales process and exchange documents.

5.3. Step 3: Overview of SCS

In the final step an overview of the SCS is created based on step 1 and 2. The overview in Figure 4 shows the identified SCS application areas, generated output, and integration with other IT systems in the case company.

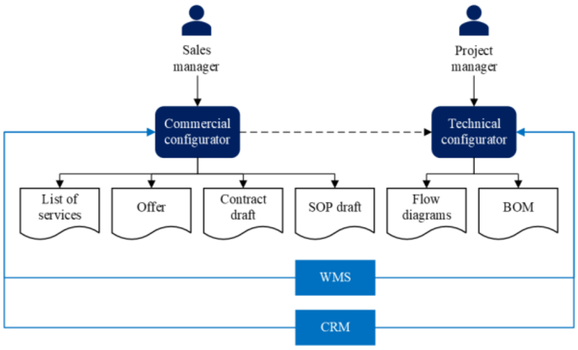

Figure 4: Overview of the potential applications of a configuration system in the case company.

The overview was used to communicate potential SCS applications in the case company. Stakeholders had a greater understanding of configuration systems and the applicability to the company's specification processes. The overview was used to make an initial prioritization of SCS projects which resulted in prioritizing the commercial configurator and generating lists of services, excluding cost estimates, for all customer segments.

The biggest challenge in the logistics service company is that each warehouse operates as its own company that develops a relationship with its clients, and its primary goal is to fulfill its client's needs. The level of customization allowed will be a challenge, as the goal of the configuration system is to standardize the different services offered in the warehouses. However, solving this by allowing customization in the commercial and technical configurator allows the warehouses to customize unique services when specific clients require them. The next step is to map the service platform of the logistics service company and investigate the level of service customization that should be allowed in the different warehouses with different customers both in type of products and size.

6. Discussion & conclusion

Logistics companies are challenged by the demand for highly customized services in 3PL warehouses. These companies must continue to meet the clients' needs to stay competitive. However, the high level of customization leads to several challenges when new clients are integrated in the warehouses.

The literature describes numerous mass customization strategies to manage similar challenges associated with products. PCS have yielded several benefits in the specification processes of customized products. However, literature on the application of configuration systems to services is limited as well as literature on modularization of services. Parallels can be drawn between logistics companies and ETO companies, which have been subject to numerous studies on implementation of PCS [7, 8, 11]. Both have an undefined solution space and complex specification processes, which have shown to require several configurators or PCS to support the specification processes in ETO companies. Hence, it is necessary to identify and prioritize potential applications of configuration systems prior to development.

This paper contributes to literature on configuration systems for services and suggests a framework to identify potential applications of configuration systems for services. The framework provides a structured approach to analyze and scope potential projects and communicate SCS applications in organizations with no previous experience with configuration systems.

The proposed framework was based on an existing framework for ETO companies and literature within modularization of services. The framework consists of three steps: (1) Identifying potential SCS, (2) Aligning IT development, and (3) Establishing an overview of SCS applications. The main difference between the framework for products and services is the addition of a third sub-step to step 1. This step analyzes market segments to determine the applicability of configuration systems.

The framework was validated through a case study in a case company. The case company is a logistics company providing warehousing services to a wide range of clients. The company has not worked with modularization or configuration of warehousing services previously. The framework facilitated an understanding of how SCS could be applied to the case company. This was especially advantageous in identifying a need for SCS and communicating potential SCS projects to stakeholders in the organization. The case study indicated a need for analyzing market segments when identifying potential SCS due to the diverse client base. The company can use the analysis to determine future SCS projects.

The framework does not assess modularity of services in the company, which could be interesting in future studies. Investigations of modularity in services is relevant to standardize service offerings, define modules [16], and implement configuration systems [6]. Further analysis could also extend the framework and include a data-driven market segmentation with performance levels [13, 16] within the customer segments. This market segmentation could determine the exact segments and clients to include in the configuration system.

The differences between a product configuration system and a logistics service configuration system were minimal when investigating the potential application of a logistics service configuration system. However, mapping and developing the logistics service modularization is expected to be different as mapping processes that can quickly be changed and adopted differs from mapping parts of a product that will be handed over and cannot change over time.

The framework has only been applied to one case company providing logistics services. The framework should be applied to more companies to validate the approach with other types of services and different levels of customization. Likewise, the case company has yet to develop and implement the suggested SCS. The validity of the framework and the suggested application areas can be assessed once the company has developed and implemented SCS. Future research into modularization of services and service platforms can contribute to identifying potential application areas of SCS.

Acknowledgements

The authors would like to acknowledge the case company and the stakeholders that contributed to the research.

References

[1] G. Baruffaldi, R. Accorsi, R. Manzini, and E. Ferrari, "Warehousing process performance improvement: a tailored framework for 3PL," *Business Process Management Journal*, vol. 26, no. 6, pp. 1619–1641, Nov. 2020, doi: 10.1108/BPMJ-03-2019-0120.

[2] Y. Lin and S. Pekkarinen, "QFD-based modular logistics service design," *Journal of Business and Industrial Marketing*, vol. 26, no. 5, pp. 344–356, Jun. 2011, doi: 10.1108/08858621111144406.

[3] L. Jum'a and M. E. Basheer, "Analysis of Warehouse Value-Added Services Using Pareto as a Quality Tool: A Case Study of Third-Party Logistics Service Provider," *Adm Sci*, vol. 13, no. 2, Feb. 2023, doi: 10.3390/admsci13020051.

[4] N. S. F. A. Rahman, N. H. Karim, R. M. Hanafiah, S. A. Hamid, and A. Mohammed, "Decision analysis of warehouse productivity performance indicators to enhance logistics operational efficiency," *International Journal of Productivity and Performance Management*, 2021, doi: 10.1108/IJPPM-06-2021-0373.

[5] M. Khakdaman, J. Rezaei, and L. Tavasszy, "On the drivers of demand for innovative freight transportation services," *IEEE Engineering Management Review*, pp. 1–27, 2022, doi: 10.1109/EMR.2022.3223313.

[6] L. Hvam, N. H. Mortensen, and J. Riis, *Product customization*. Springer, 2008. doi: 10.1007/978-3-540-71449-1.

[7] A. Haug, L. Hvam, and N. H. Mortensen, "Definition and evaluation of product configurator development strategies," *Comput Ind*, vol. 63, no. 5, pp. 471–481, Jun. 2012, doi: 10.1016/j.compind.2012.02.001.

[8] A. Haug, S. Shafiee, and L. Hvam, "The costs and benefits of product configuration projects in engineer-to-order companies," *Comput Ind*, vol. 105, pp. 133–142, Feb. 2019, doi: 10.1016/j.compind.2018.11.005.

[9] G. O. Mueller, N. H. Mortensen, L. Hvam, A. Haug, and J. Johansen, "An approach for the development and implementation of commissioning service configurators in engineer-to-order companies," *Comput Ind*, vol. 142, pp. 1–16, Nov. 2022, doi: 10.1016/j.compind.2022.103717.

[10] S. Shafiee, L. Hvam, and M. Bonev, "Scoping a product configuration project for engineer-to-order companies," *International Journal of Industrial Engineering and Management*, vol. 5, no. 4, pp. 207–220, 2014, [Online]. Available: www.ftn.uns.ac.rs/ijiem

[11] K. Kristjansdottir, S. Shafiee, and L. Hvam, "How to identify possible applications of product configuration systems in engineer-to-order companies," *International Journal of Industrial Engineering and Management*, vol. 8, no. 3, pp. 157–165, 2017, [Online]. Available: http://www.xx

[12] M. Hellström, R. Wikström, M. Gustafsson, and H. Luotola, "The value of project execution services: a problem and uncertainty perspective," *Construction Management and Economics*, vol. 34, no. 4–5, pp. 272–285, May 2016, doi: 10.1080/01446193.2016.1151062.

[13] M. H. Meyer and A. P. Lehnard, *The power of product platforms: building value and cost leadership*. The Free Press, 1997.

[14] S. Pekkarinen and P. Ulkuniemi, "Modularity in developing business services by platform approach," *The International Journal of Logistics Management*, vol. 19, no. 1, pp. 84–103, May 2008, doi: 10.1108/09574090810872613.

[15] S. A. Brax, A. Bask, J. Hsuan, and C. Voss, "Service modularity and architecture – an overview and research agenda," *International Journal of Operations and Production Management*, vol. 37, no. 6, pp. 686–702, 2017, doi: 10.1108/IJOPM-03-2017-0191.

[16] M. Løkkegaard, N. H. Mortensen, and T. C. McAloone, "Towards a framework for modular service design synthesis," *Res Eng Des*, vol. 27, no. 3, pp. 237–249, Jul. 2016, doi: 10.1007/s00163-016-0215-6.

[17] N. Iman, "Modularity matters: a critical review and synthesis of service modularity," *International Journal of Quality and Service Sciences*, vol. 8, no. 1, pp. 38–52, Mar. 2016, doi: 10.1108/IJQSS-05-2015-0046.

[18] T. T. Christensen, "Konfigureringssystemer for kundetilpassede serviceydelser med fokus på industrielle servicekontrakter (SLAs)," 2009.

[19] O. Chervonnaya, "Customer role and skill trajectories in services," *International Journal of Service Industry Management*, vol. 14, no. 3, pp. 347–363, 2003, doi: 10.1108/09564230310478864.

[20] F. Ponsignon, P. Davies, A. Smart, and R. Maull, "An in-depth case study of a modular service delivery system in a logistics context," *International Journal of Logistics Management*, vol. 32, no. 3, pp. 872–897, 2021, doi: 10.1108/IJLM-07-2020-0295.

[21] T. Tuunanen, A. Bask, and H. Merisalo-Rantanen, "Typology for modular service design: review of literature," *International Journal of Service Science, Management, Engineering, and Technology*, vol. 3, no. 3, pp. 99–112, 2012.

[22] C. Voss, N. Tsikriktsis, and M. Frohlich, "Case research in operations management," *International Journal of Operations and Production Management*, vol. 22, no. 2, pp. 195–219, 2002, doi: 10.1108/01443570210414329.

[23] C. Forza and F. Salvador, *Product information management for mass customization: connecting customer, front-office and back-office for fast and efficient customization*. Palgrave Macmillan London, 2006. doi: 10.1057/9780230800922.