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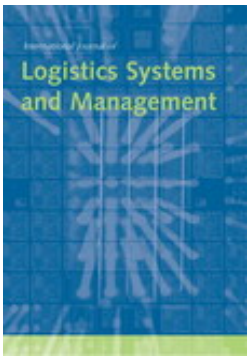

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Erika Marie Strøm, Tine Meidahl Münsberg, Lars Hvam, Anders Haug

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Digitalising the sales process for e-commerce warehouse services at a logistics service provider

Erika Marie Strøm*, Tine Meidahl Münsberg and Lars Hvam

Department of Civil and Mechanical Engineering,
Technical University of Denmark,
Koppels Allé 404, 2800 Kongens Lyngby, Denmark
Email: emst@dtu.dk
Email: tinemeidahl@gmail.com
Email: lahv@dtu.dk
*Corresponding author

Anders Haug

Department of Business and Sustainability,
University of Southern Denmark,
Universitetsparken 1, 6000 Kolding, Denmark
Email: adg@sam.sdu.dk

Abstract: Online shopping has grown in popularity in recent years, and e-commerce is expected to continue expanding. Logistics service providers (LSPs) play a crucial role in e-commerce, as e-tailers outsource transportation and warehousing to focus on their core business. E-commerce represents a significant new market, but rising operating costs, labour shortages and limited warehouse space necessitate enhanced efficiency and productivity. Traditionally, LSPs have tailored their services to individual client needs, but balancing this customisation with a growing client base is challenging. Thus, standardising services and digitalising sales processes are essential to meeting this demand. This study explores the development of a sales tool designed to digitalise the sales process for e-commerce warehouse services at a leading global LSP through action research. The case study showed that the approach could guide LSPs in the development of a sales tool, streamline business processes and centralise data, potentially improving data quality in the future.

Keywords: e-commerce; logistics service provider; LSP; warehouse services; action research; digitalisation; sales tool; configurator.

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Biographical notes: Erika Marie Strøm holds a PhD with a research focus on modularisation and configuration in the logistics industry. Her doctoral work, titled 'Driving digitalisation of warehouse services through modularisation and configuration', explores how structured service design can enhance digital transformation across logistics organisations, with a particular focus on warehouse operations.

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Tine Meidahl Münsberg has a PhD in Modularisation and Configuration of Logistics Services from the Technical University of Denmark. After finishing her PhD, she has been working as a technical project manager both within IT and intralogistics.

Lars Hvam is a Professor at the Technical University of Denmark. He has worked for more than 20 years on product architectures, complexity management, and product configuration as a teacher, researcher, and consultant. He has supervised over 30 PhD projects focusing on product architecture, complexity management, and the development and application of configuration systems.

Anders Haug is an Associate Professor of Information and Technology Management at the University of Southern Denmark. He received his PhD in Knowledge Engineering from the Technical University of Denmark. He has worked for several years in the private sector as a Software Engineer and Business Consultant. He has published more than 100 journal and conference articles. His current research focuses on Industry 4.0, data quality, knowledge-based systems, and information management.

This paper is a revised and expanded version of a paper entitled ‘The use of configurators to support warehouse service design: a case study of a logistics service provider’ presented at 25th International Conference on Engineering Design in Dallas, Texas, USA, 11–14 August 2025.

1 Introduction

Logistics service providers (LSPs) have evolved from offering basic storage and transportation services to delivering complex, customised solutions encompassing a wide range of value-added services (VASs) (Selviaridis and Spring, 2007; Wallenburg and Knemeyer, 2022). The increasing complexity of logistics operations, coupled with the expanding global reach of commercial activities, has driven this transformation (Borgström et al., 2021; Hosie et al., 2012). To better manage these complexities, an increasing number of companies are turning to LSPs for outsourcing their operations (Bask et al., 2011; Hosie et al., 2012; Sangka et al., 2019). The rapid expansion of e-commerce, particularly accelerated by the COVID-19 pandemic, has further intensified this trend. Consumers have increasingly shifted from traditional brick-and-mortar shopping to online platforms (Barthel et al., 2023; Perkumiene et al., 2021), leading to heightened expectations for fast deliveries and additional services, such as streamlined return processes (Akil and Ungan, 2022; Borgström et al., 2021; Carvalhosa et al., 2024; Rokicki et al., 2022). These demands place considerable pressure on e-tailers and the LSPs on which they rely on (Borgström et al., 2021).

LSPs in the third-party logistics (3PL) industry play a critical role in enabling e-tailers to focus on their core businesses by managing transportation and warehousing operations (Bowersox et al., 2020; Sangka et al., 2019). Logistics plays a crucial role in e-commerce (Akil and Ungan, 2022; Luk et al., 2019), and with the fragmented and competitive environment in the logistics industry (Wallenburg and Knemeyer, 2022), e-tailers are willing to change providers if they are dissatisfied with their services (Ngah et al., 2023). The operational challenges for LSPs include handling large volumes

of products, managing fluctuating daily orders and completing labour-intensive tasks, such as picking and packing (Azadeh et al., 2019; van Geest et al., 2021; da Silva et al., 2023; Vlachos and Polichronidou, 2024).

To address these issues, researchers suggest that LSPs should develop standardised or modular service offerings (Bask et al., 2011; Cabigiosu et al., 2015; Fulconis et al., 2016; Pekkarinen and Ulkuniemi, 2008), particularly to accommodate challenges and growing demand from the e-commerce industry (Borgström et al., 2021; da Silva et al., 2023). Given the inherently cocreative nature of service design (Borgström et al., 2021; Pekkarinen and Ulkuniemi, 2008), this shift will inevitably influence how these services are defined during the sales process. Consequently, this study explores how these sales processes can be digitalised and examines the operational impacts of such digitalisation.

There are numerous tools for digitalising sales processes in product-based companies (Rainsberger, 2023). Product configurators are expert systems, also known as knowledge-based systems, that assist users in creating customised products by combining components based on a predefined rule set (Haug et al., 2010; Hvam et al., 2008). Research suggests that configuration systems can significantly enhance sales processes in service-based companies (Kondrup Andersen et al., 2025; Mueller et al., 2022). However, existing research has not investigated service configurators in the 3PL industry. A review of Clarivate Analytics' Web of Science and Elsevier's Scopus databases reveals an absence of publications specifically addressing logistics service configurators.

To contribute to this area of research, this study, conducted through action research, focused on the e-commerce sales process at a leading global LSP. The remainder of this paper is organised as follows. First, a literature review outlines digitalisation in 3PL and configuration systems developed within the service industry. Next, based on existing approaches from the service industry, an approach to digitalising the sales process of warehouse services is proposed. The methodology and procedure for action research are then explained, followed by the presentation of the results and evaluation of the case study. Finally, the implications for research and practice are discussed and concluded with limitations and future research.

2 Literature review

The following sections explore digitalisation in 3PL, particularly in relation to e-commerce, and present a review of the existing approaches to digitalising processes in the service industry.

2.1 Digitalisation in 3PL

Digital transformation at LSPs can be described as an evolutionary process that uses technologies and digital capabilities across the organisation and its stakeholders to enhance operational efficiency, customer experience, new services and digitally enabled business models (Cichosz et al., 2020). With the advent of e-commerce, digitalisation poses both new opportunities and challenges in 3PL. Digitalisation enables LSPs to handle increased demand through automation solutions (Azadeh et al., 2019; Custodio and Machado, 2020; Winkelhaus and Grosse, 2022) and better manage the complexity arising from trends such as omnichannel logistics (Lee and Moon, 2024; MacCarthy and Ivanov, 2022).

In broader terms, digitalisation within the logistics industry is considered a core component of the Logistics 4.0 trend (Perotti et al., 2022; Rodrigues et al., 2024), which represents the fourth industrial revolution in logistics and involves the integration of intelligent and autonomous technologies to optimise operations (Baglio et al., 2024; da Silva et al., 2023; Strøm et al., 2025). A subarea specifically related to warehousing is *Warehouse 4.0* (Strøm et al., 2025; Tubis and Rohman, 2023), which Strøm et al. (2025), in the context of 3PL, define as a "highly integrated system that leverages advanced digital technologies and automation to achieve efficient and effective 3PL warehousing operations … designed to meet individualized client demands sustainably, without increasing costs, and to adapt to the dynamic challenges of 3PL warehousing" (p.16). In this regard, the integration of these technologies is crucial for the competitiveness of LSPs, particularly in response to growing e-commerce demands (Ali et al., 2024; Nand et al., 2023; Strøm et al., 2025).

Borgström et al. (2021) explained that LSPs in the 3PL industry risk being 'stuck in the middle' by taking on more clients to achieve economies of scale while struggling to adapt to individual client needs. In response to trends such as digitalisation, e-commerce and servitisation, LSPs can pursue two strategies:

1 offer standardised services that emphasise simplicity, minimalism and functionality to lower prices for more clients

2 innovate to integrate consumers into the logistics network.

Borgström et al. (2021) also highlighted the need for further studies on how LSPs are adopting servitisation, driving digitalisation and managing returns. Cichosz et al. (2020) found that the challenges associated with digital transformation in LSPs include the complexity of the logistics network and underlying processes, a lack of skilled resources, technology adoption, resistance to change and data protection and security breaches. Cichosz et al. (2020) reported that standardisation in terms of processes, systems, applications and data could help manage the complexity of the logistics network and underlying processes, which is one of the main barriers to digital transformation.

Rainsberger (2023) described digital transformation in sales as "a process supported by technological means to create new or modified sales models and approaches, customer experiences and sales processes to meet changing market and customer requirements" (p.41). Thus, the digitalisation of sales processes is about making changes to the company's core strategy. There are multiple tools and technologies that support quotation and sales processes, such as quote configuration systems, price calculation tools and up- and cross-selling tools (Rainsberger, 2023). However, existing research has largely overlooked the application of these tools within LSPs.

There are distinct differences between products and services that also have an impact on sales processes. Services are intangible in nature and are produced by people, processes and systems (Løkkegaard et al., 2016). It is vital to understand that services are cocreated by the service provider and the customer; thus, customers play an active role in the service process (Pekkarinen and Ulkuniemi, 2008). According to Pekkarinen and Ulkuniemi (2008), the level of service standardisation can vary according to providers' strategies, that is some services can be standardised, whereas others are highly customised to meet certain customers' needs. Pekkarinen and Ulkuniemi (2008) emphasised the importance of customer segmentation when applying modularity to business services, such as logistics services. Thus, modularity can enhance

standardisation of service production. Several studies have explored the potential for implementing modularisation within the logistics industry, presenting it as an approach for dividing systems into distinct parts or modules. This allows companies to deliver flexible service offerings to their customers while benefiting from economies of scale (Bask et al., 2011; Cabigiosu et al., 2015; Pekkarinen and Ulkuniemi, 2008; Rajahonka, 2013).

2.2 Development of service configuration systems

Quote configuration systems and product configurators have been extensively utilised in the manufacturing industry to streamline the sales process for customised products (Abbasi et al., 2013; Hvam et al., 2008; Rainsberger, 2023). Several studies focused on the development of service configuration systems have found that these could increase efficiency and improve the response time to user needs, improve resource allocation and knowledge utilisation and enhance quality (Campo Gay and Hvam, 2022; Hellström et al., 2017; Mueller et al., 2022; Tiihonen et al., 2014b). The major difference between modelling and configuring physical products and services is that services are based on processes as opposed to physical components (Bask et al., 2010; Mueller et al., 2022). Consequently, service modularity is closer related to process modularity (Bask et al., 2011), and customers play an active role in the service production process (Bask et al., 2010; Pekkarinen and Ulkuniemi, 2008). Therefore, modelling variability of services includes modelling the stakeholders and environment as well as the service delivery processes and resources (Tiihonen et al., 2014b). While it appears that modular service offerings could benefit LSPs and that service configurators have multiple benefits, existing research has not addressed the development of configurators for logistics services.

Table 1 Approaches for developing service configurators

Author(s)	*Application*	*Approach*
Hellström et al. (2016)	Identification and communication of the value of project execution services.	An iterative approach based on three design criteria: 1 must address problems (i.e. project risks), both internal and external 2 must take uncertainty and the cocreative nature of the project front-end into account 3 must be based on a modular service architecture.
Campo Gay and Hvam (2022)	Support physicians during the drug prescription process.	Seven-step procedure by Hvam et al. (2008): 1 development of specification processes 2 analysis of product range 3 object-oriented modelling 4 object-oriented design 5 programming 6 implementation 7 maintenance and further development.

Table 1 Approaches for developing service configurators (continued)

Author(s)	*Application*	*Approach*
Mueller et al. (2022)	Specification of commissioning services for complex engineer-to-order products.	Five-step approach based on literature on commissioning services and product configuration: 1 scoping of the commissioning configuration project 2 commissioning service analysis 3 modelling of the knowledge base 4 implementation of the commissioning configurator 5 operation, documentation and maintenance.
Kondrup Andersen et al. (2025)	Management of product-related services.	Five-step approach based on Mueller et al. (2022): 1 scoping 2 analysis 3 design 4 deployment 5 operation, maintenance and further development.

Several studies have focused on the development of configuration systems in services and described approaches to doing so (Campo Gay and Hvam, 2022; Hellström et al., 2016; Kondrup Andersen et al., 2025; Mueller et al., 2022). These are summarised in Table 1.

Since there is a lack of existing research on the development of configuration systems specifically for logistics services, this study draws upon approaches established in the broader field of service configuration, which are grounded in methodologies originally developed for product configuration.

3 An approach to digitalising the sales process of warehouse services

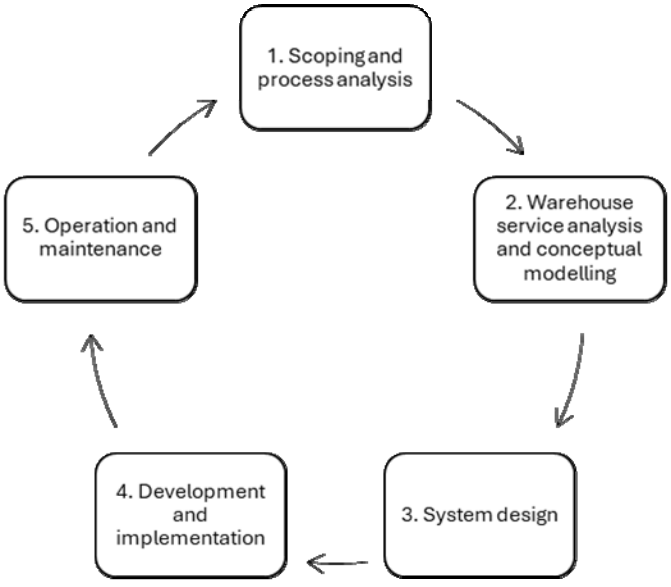
Based on the reviewed literature, an approach to digitalising the sales process of warehouse services using configuration is proposed. This approach consists of five steps similar to those proposed by Mueller et al. (2022) and Kondrup Andersen et al. (2025) (see Figure 1).

3.1 Scoping and process analysis

The first step in developing the sales tool is to define its scope. The scope of LSPs can vary depending on their size and the types of clients they serve. It may be constrained by specific markets, client segments or the range of services offered (Fulconis et al., 2016). According to Pekkarinen and Ulkuniemi (2008), conducting market segmentation is essential to identifying relevant application areas, as LSPs operate in diverse market segments with varying customisation needs. This process helps in deciding which segments and services should be included in the sales tool. The objectives and goals of

implementing a configuration system should be clearly defined, and all relevant stakeholders involved in the project should be identified (Strøm et al., 2023).

Figure 1 Proposed approach to digitalising the sales process of warehouse services



To further define the scope, the entire sales process should be mapped using techniques similar to those employed in product configurator projects by Hvam et al. (2008). By analysing the current sales process, potential areas for digitalisation can be identified, and the project's scope can be determined. It is crucial to involve stakeholders early in the scoping phase, including sales, implementation and software development teams and clients, to ensure that the sales tool is well received and effective (Haug et al., 2019).

3.2 Warehouse service analysis and conceptual modelling

The warehouse service analysis and conceptual model begin with the market segmentation, which facilitates the mapping of all services that are currently provided to the targeted market segments. The warehouse services are analysed and modelled using a technique similar to the product variant master developed by Hvam et al. (2008) (see Figure 2). The product variant master consists of three views – customers, engineering and production (part) – which are adapted to warehouse services based on Strøm et al. (2024):

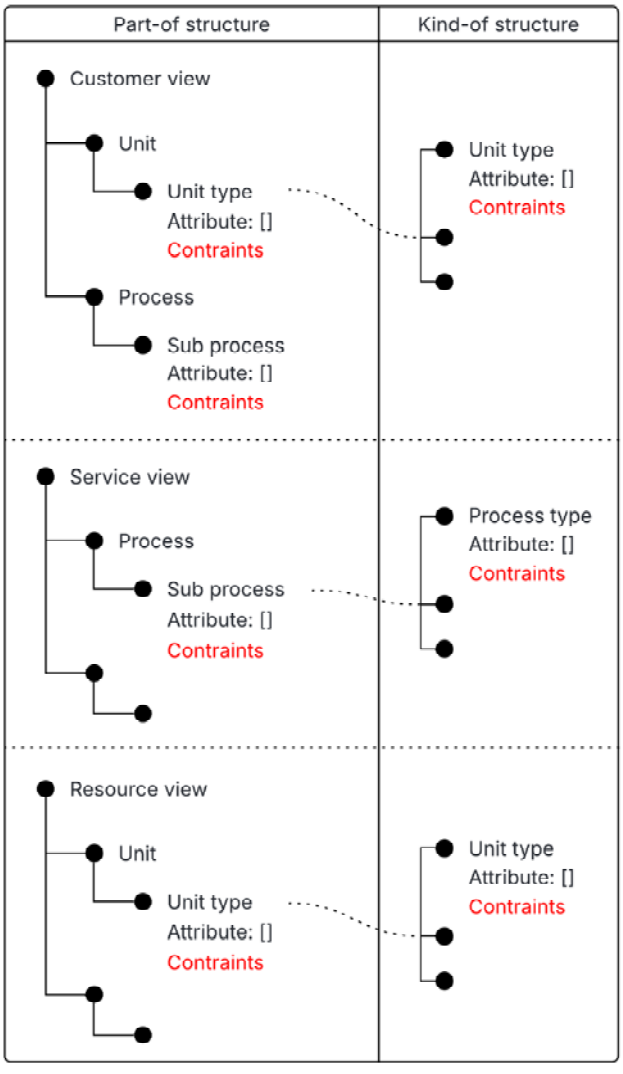
1 *Client view:* describes the warehouse services from the client's perspective and is based on the market segmentation. It includes constraints that describe the connections between the client's choices and the rest of the offerings.

2 *Service view:* describes the structure and variety of warehouse services, that is the sequence and different methods of offering services.

3 *Resource view:* describes the resources required to produce the warehouse services, such as facilities, equipment, people, information technology (IT) and consumables.

As illustrated in the figure, the model outlines both a part-of structure and a kind-of structure to represent the hierarchical levels of units and the classification of processes (Haug et al., 2010).

Figure 2 Conceptual model of warehouse services (see online version for colours)



Source: Adapted from Hvam et al. (2008) and Strøm et al. (2024)

3.3 System design

Once the warehouse service analysis is completed, the conceptual model should be translated into an information model with an overview of data for the software along with the design of user interface (Hvam et al., 2008). This overview should be easy to understand for all stakeholders working on the conceptual model, including knowledge

managers, and the developers working on the software. The overview can be presented in a tabular format, such as Microsoft Excel (Mueller et al., 2022). Assessing integration into other IT systems is crucial for determining software capabilities. A simple UML diagram can illustrate system connections (Hvam et al., 2008).

The choice of software should be guided by both the available budget and the flexibility of the solution. Flexibility is especially important given the need to configure services rather than physical components, for which most off-the-shelf software is typically designed. Suitable options include existing commercial platforms with customisable shells or internally developed solutions (Mueller et al., 2022). If the model involves only a limited number of constraints, it may be feasible to implement it using Microsoft Excel or through a simple in-house development effort (Forza and Salvador, 2006; Hvam et al., 2008).

3.4 Development and implementation

This phase focuses on programming the configurator, which consists of the back-end and front-end, used by the end users. It can be programmed internally or externally with gradual implementation of functionality and market segments (Forza and Salvador, 2006; Hvam et al., 2008). An agile approach helps maintain continuous alignment and visibility between the LSP's requirements and the software under development (Campo Gay and Hvam, 2022; O'Regan, 2022; Shafiee et al., 2020; Tiihonen et al., 2014a). Alongside development, the software should undergo both white-box and black-box testing to ensure its correctness and usability. Before full-scale implementation, user acceptance should be ensured (Hvam et al., 2008). Comprehensive documentation of the software and its integration is essential to prevent reliance on a limited number of individuals with specific organisational knowledge. Finally, the implementation process should include structured training for end users to ensure that they are well acquainted with the system and can use it effectively (Mueller et al., 2022).

3.5 Operation and maintenance

During the operation of the configurator, documentation of the software should be updated when changes are made. Furthermore, when new services or processes are added to the portfolio, they should be added to the information model and the software for sales to sell these warehouse services (Haug et al., 2012). Maintenance involves the efforts of software developers to preserve software quality and implement potential enhancements to both the software itself and its interfaces.

4 Research method

An action research approach was undertaken by two researchers to investigate how the sales process of e-commerce services could be digitalised. This was carried out at a leading global LSP that offers logistics solutions, such as transportation and warehousing. The case company employs approximately 75,000 people and is present in more than 80 countries.

This study followed the action research cycle described by Susman and Evered (1978):

1 diagnosing
2 action planning
3 action taking
4 evaluating
5 specifying learning

4.1 Step 1: diagnosing

Initially, through discussions with the case company, it was decided that the warehousing segment was an obvious candidate for digitalising sales processes due to its high complexity and level of customisation. Due to prolonged negotiations and the time-intensive nature of implementing tailored warehouse solutions, the sales and onboarding process for new clients can extend over several years. While this is not an issue for larger clients, smaller clients, especially in e-commerce, often face challenges. Their complex VAS needs and smaller scale make the tailored approach inefficient and lead to lost sales or unprofitable deals. As a result, many smaller e-commerce clients are turned away, leading to missed business opportunities. To mitigate these challenges, the company has developed a strategy for e-commerce to attract more e-tailers and gain a larger market share. This strategy focuses on segmenting e-tailers and providing a standard e-commerce product with a set of standard warehouse services with predefined prices. These services are based on a standard warehouse layout and standard operations, enabling the company to also standardise contracts, operating procedures and service-level agreements. The goal was to have clients operational in the warehouses within two weeks. This standard product is currently offered in several European sites.

4.2 Step 2: action planning

Step 2 involved developing an approach to digitalising the sales process of warehouse services based on existing literature. Together with the case company, the goals and timeline were agreed upon based on this approach.

4.3 Step 3: action taking

In the third step, the two researchers played an active role in the five-step approach, offering continuous support to the company throughout each phase. During the development stages, they facilitated workshops and conducted interviews to guide the case company (see Table 2). The methods outlined in each phase were applied together with the company's employees. Where necessary, these methods were adapted to better align with the specific requirements of mapping warehouse services.

Due to time constraints, Steps 4 and 5 were only partially executed in the case study, which prevented the full implementation and operation of the configurator within the case company. Nevertheless, the approach resulted in a fully functional configurator, enabling evaluation of the proposed approach. At the time of writing, this configurator is expected to be implemented within the case company.

Table 2 Overview of interviews and workshops during the execution of the five-step approach

Phase	*Purpose*	*Method*	*Participant(s)*	*Period*
1 Scoping and process analysis	Define the scope and engage relevant stakeholders	Workshops Personal and group interviews	Senior manager of e-commerce (1) Director of business development, e-commerce (1)	3 sessions of 60 min in Q4 2023 and Q1 2024
2 Warehouse service analysis and conceptual modelling	Model warehouse service offering	Workshops Personal interviews	Senior manager of e-commerce (1) Director of business development, e-commerce (1) Senior business support specialist of e-commerce (1)	9 sessions of 60 min in Q1-Q2 2024 and Q1 2025
3 System design	Create information model, design user interfaces and select software	Workshop Personal interviews	Senior manager of e-commerce (1) Solution architect (1) Senior business support specialist of e-commerce (1) Project manager (1) Software developer (1) Senior manager of digital solutions (1)	4 sessions of 30 min in Q4 2024 and Q1 2025
4 Development and implementation	Status of programming Agreement on user interface User testing User training	Group interviews Personal interviews	Project manager (1) Software developer (2) Senior manager of digital solutions (1) Senior manager of e-commerce (1) Director of business development, e-commerce (1) Senior business support specialist of e-commerce (1)	32 sessions of 15–30 min in Q1-Q2 2025
5 Operation and maintenance	Plan documentation and maintenance	Workshop Personal interviews	Senior manager of e-commerce (1) Project manager (1) Software developer (2)	2 sessions of 60 min Q2 2025

4.4 Step 4: evaluation

The developed software and the proposed approach were evaluated by a project manager, senior manager of e-commerce, senior business support specialist of e-commerce and business development manager (sales manager) of e-commerce during six 30-minute sessions with one of the researchers.

4.5 Step 5: specifying learning

Finally, the data gathered in Steps 3 and 4 were analysed to identify key insights and implications for both research and practice. The primary aim was to evaluate the effectiveness of the developed approach.

5 Case study

The following section describes the development of the software to support the sales process for e-commerce warehouse services at the case company utilising the proposed approach.

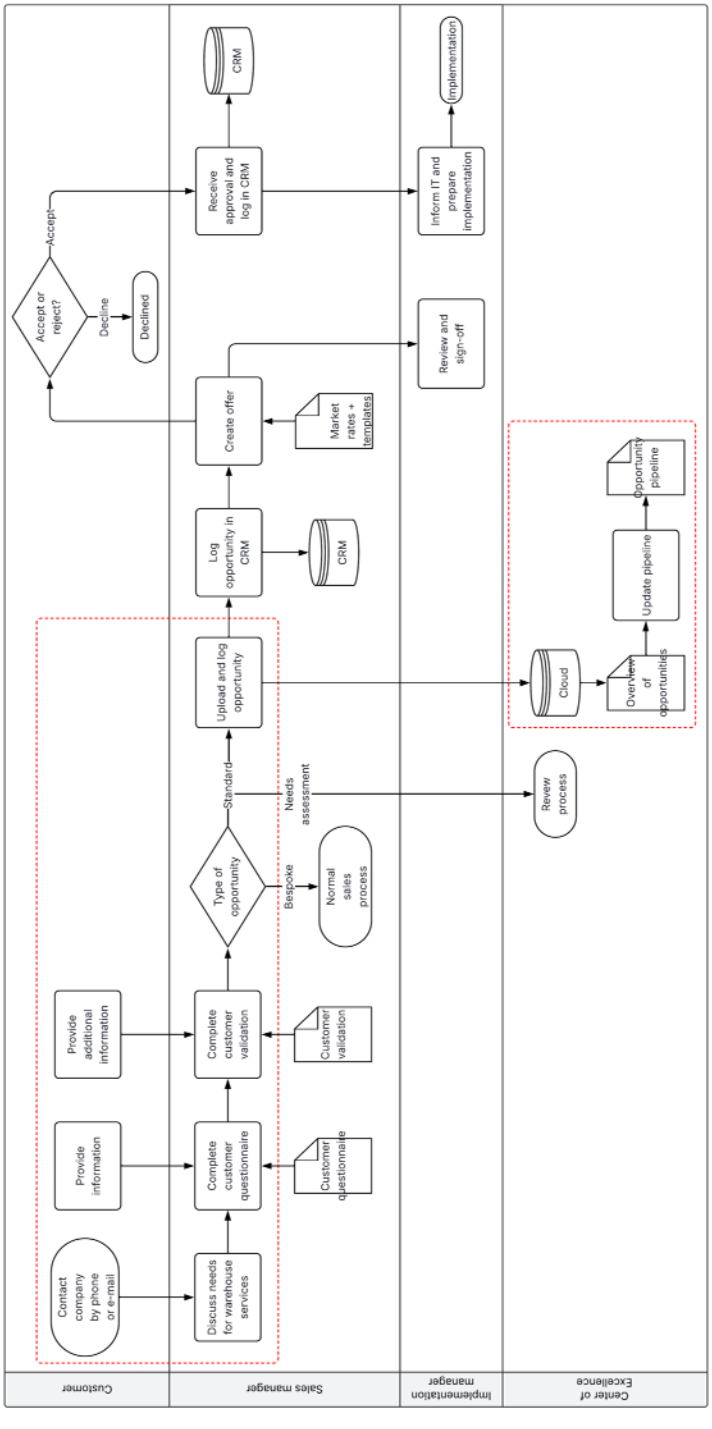
5.1 Scoping and process analysis

The company has a large client base, and while e-commerce is strategically important, the e-commerce segment was specifically chosen for the project. The clients vary in size; therefore, it was decided to exclude large e-commerce clients from the scope and focus on smaller ones, due to their collectively higher volume and the need to deliver services more quickly and cost-effectively.

In collaboration with the senior e-commerce manager and the director of business development, the project's objectives and overall goal were defined. The primary aim was to streamline and digitalise the sales process for e-commerce services while providing sales managers with a structured approach to gather and assess client information relevant to warehouse service needs. The following key objectives were defined:

1 qualify new clients and determine whether they are eligible for the standard e-commerce product
2 establish a centralised platform for collecting and managing client data and opportunities
3 enhance communication and engagement with e-commerce clients
4 reduce lead time in qualifying potential clients for warehouse services.

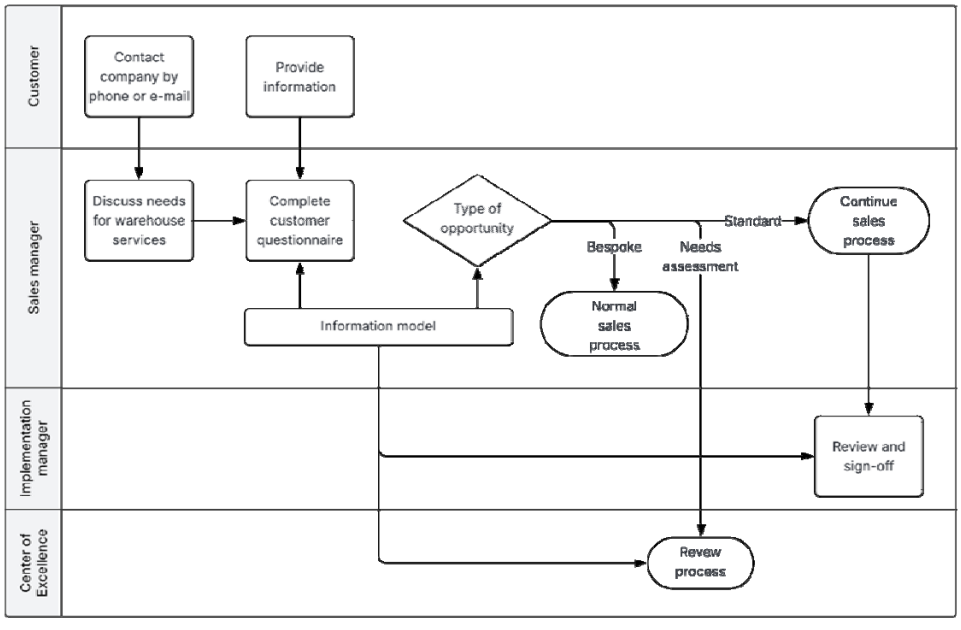
Figure 3 As-is e-commerce sales process and scope of project shown in red (see online version for colours)



Next, the current sales process for e-commerce clients was mapped (see Figure 3). The figure illustrates how different departments interact with potential clients during the sales process. Currently, the process is primarily supported by spreadsheets. After discussing the client's warehouse service needs, the sales manager completes the customer questionnaire spreadsheet, which consists of a series of questions about these needs. Based on this spreadsheet, the sales manager completes the customer validation spreadsheet, which uses conditional statements to determine if the client is eligible for the standard e-commerce offering, requires a bespoke solution and thus needs to continue the normal sales process, or needs to be assessed by the Center of Excellence (CoE) to determine whether it is a standard or bespoke opportunity. If the opportunity is eligible for the standard e-commerce services, the sales manager creates an offer that the client can accept or reject.

During the mapping process, several issues in the sales process were identified. The use of locally saved spreadsheets presents multiple challenges. They must be manually shared across departments, increasing the risk of errors, and they lack both functionality and user-friendliness. As a result, sales managers often skip questions or leave the questionnaire incomplete. According to the senior manager of e-commerce, some questions are also difficult for sales managers to interpret. When customer validations are missing, the CoE must follow up, consuming additional time and resources. Moreover, the two spreadsheets are not connected, even though many questions are similar, resulting in extra time spent by the sales manager and clients providing information multiple times.

Figure 4 To-be e-commerce sales process



Offer generation is also inefficient, as salespeople must manually create proposals – even though standard templates exist. Tracking new opportunities is another challenge: Files are not consolidated, and there are frequent delays in logging opportunities in the customer relationship management (CRM) system. Sales managers must upload spreadsheets to a cloud platform and record opportunities in a separate file for analysis and reporting by CoE. The CoE then updates a pipeline overview spreadsheet, but this process is prone to missing opportunities. If opportunities are not logged, the CoE sends the spreadsheet to the director of business development for validation monthly.

The participants decided that the scope should be limited to the early stages of the sales process, focusing on gathering information from potential clients to determine their eligibility for the standard e-commerce offering. This step is crucial for obtaining accurate information to make fast decisions. Consequently, the spreadsheets will be replaced. The future e-commerce sales process, supported by this tool, is illustrated in Figure 4.

5.2 Warehouse service analysis and conceptual modelling

In collaboration with the participants, the researchers conducted a comprehensive analysis of the warehouse services. The analysis began with the clients identified during the segmentation and utilised spreadsheets and standard templates from the sales process to detail the warehouse services offered. This exercise involved integrating all service knowledge from existing documentation and validating it with stakeholders, which was particularly time-consuming. The warehouse service offering was then modelled in Microsoft Visio during discussions with the team. Details of this model have been omitted and simplified for illustration purposes due to the confidential nature of the service offering. Figure 5 shows the simplified conceptual model of the warehouse service offering, with constraints in red determining whether opportunities are standard, bespoke or requires an assessment. As shown, ‘products’ are constrained by ‘shelf space’.

5.3 System design

Various software including Microsoft Excel and Microsoft Power Apps, were evaluated for use in the sales tool. After multiple iterations with different configuration software and Microsoft Excel as modelling tools, the IT management at the case company decided to build the software in-house. Subsequently, the conceptual model was transformed into an information model. This step involved converting the conceptual model into data and constraint tables using Microsoft Excel, making it easier for the development team to understand and implement (see Figure 6). The data outlined in the Microsoft Excel model were subsequently used to define the computer model within the software. In turn, the Excel-based data model served as documentation for the implemented computer model. Due to the limited scope of the project, there were no integrations with IT systems, although the possibility of connecting the configurator to the company’s CRM system was discussed. The user interface was brainstormed and sketched collaboratively by the senior manager and senior business support specialist of e-commerce, the development team and one researcher.

Figure 5 Simplified conceptual model of the warehouse service offering (see online version for colours)

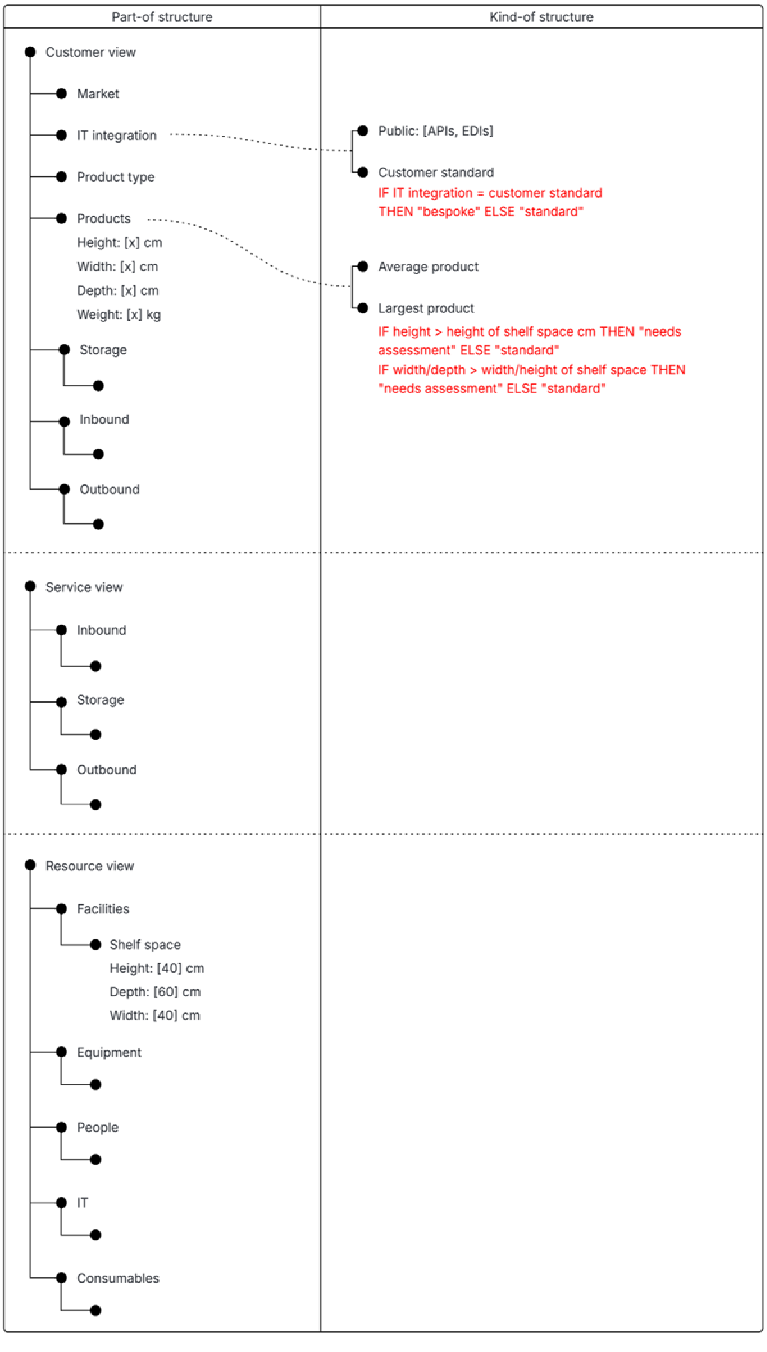


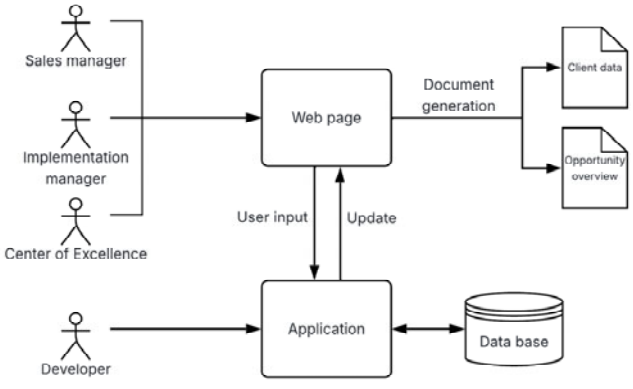
Figure 6 Example of the information model in tabular format in Excel

	A	B	C	D	E	F	G
1	Header	Sub-header	Sub-sub-head	Question	Showhide?	Field	Field option
2	General customer data			Expected go-live date (DD-MM-YY) (EXPECTED_GO_LIVE_DATE_DD_MM_YY)		free-text	
3				Sales person (SALES_PERSON)		free-text	
4				Company name (COMPANY_NAME)		free-text	
5				Website (WEBSITE)		free-text	
6				Address (ADDRESS)		free-text	
7				Zip-code, city (ZIP_CODE_CITY)		free-text	
8				Country (COUNTRY)		free-text	
9				Contact person (CONTACT_PERSON)		free-text	
10				Title (TITLE)		free-text	
11				Telephone number (TELEPHONE_NUMBER)		free-text	
12				E-mail (EMAIL)		free-text	
13	General information			Description (DESCRIPTION)		free-text	
14				Expected yearly revenue (EUR) (YEARLY_REVENUE)		numeric	
15				Preferred warehouse location (PREFERRED_WAREHOUSE_LOCATION)		single-select	yes
16				What channel(s) does the merchandiser have? (CHANNELS)		multi-select	yes
17				IT integration (IT_INTEGRATION)		single-select	yes
18				Preconfigured integration (IT_PRECONFIGURED_INTEGRATION)	if IT integration = Preconfigured integration	single-select	yes
19	Products			Product type (PROD_TYPE)		multi-select	yes
20		Largest product dimensions		Largest height (cm) (PROD_LAR_HEIGHT_CM)		numeric	
21				Largest width (cm) (PROD_LAR_WIDTH_CM)		numeric	
22				Largest depth (cm) (PROD_LAR_DEPTH_CM)		numeric	
23				Largest weight (kg) (PROD_LAR_WEIGHT_KG)		numeric	
24				Percent of SKUs over 20 kg (PROD_LAR_PER_OVER_20_KG)	if largest weight (kg) > 20	numeric	
25	Storage			Yearly no. of new SKUs (YEARLY_NO_NEW_SKUS)		numeric	
26				Full pallet storage (FULL_PALLET_STORAGE)		y/n	
27				Number of pallets (NUMBER_OF_PALLETS)	if Full pallet storage = yes	numeric	
28				Can all SKUs can be stored on shelves? (SKUS_ON_SHELVES)		y/n	
29				Is bulk storage required? (BULK_STORAGE)		y/n	
30				Is replenishment required? (REPLENISHMENT_REQUIRED)		y/n	
31				Hanging garments (HANGING_GARMENTS)		y/n	
32				Is warehouse space available for this customer? (WAREHOUSE_SPACE_AVAILABLE)		y/n	

5.4 Development and implementation

An agile approach was used to develop the software, with weekly meetings between the developers and one of the researchers over three months. This was followed by a month of testing by the researcher, with changes implemented based on feedback. Finally, the senior manager of e-commerce performed user acceptance testing.

Figure 7 Software architecture



The tool is a .NET-based application connected to a cloud-based database (see Figure 7). This is linked to a front-end interface used by four sales managers, around 10–14 implementation managers at different warehouse sites and the CoE (two employees). The front-end consists of several pages. Sales managers log in and are directed to a landing page with an overview of opportunities, where they can edit new or existing ones. Each opportunity includes three pages:

1 customer validation

2 summary and validation

3 questionnaire (see Figure 8).

To access the summary, sales managers must complete the customer questionnaire. The summary indicates whether the opportunity is standard (green), bespoke (red), or

requiring further assessment (yellow), based on the constraints defined in the conceptual model. They can then complete the detailed questionnaire. Opportunities can be saved and completed later and are submitted once all fields are filled. Sales managers can download the opportunity as a PDF or spreadsheet to share with other stakeholders in the sales process. Implementation managers can log in and see new opportunities. The CoE can also log in and export an overview of opportunities for further analysis. The tool also has user management with permissions for the two types of users:

1 normal users, who can create and edit opportunities

2 administrative users, who can manage user accounts and manage opportunities.

Figure 8 Front-end user interfaces (see online version for colours)

5.5 Operation and maintenance

The information model is maintained in Microsoft Excel to ensure easy access and clear documentation. To maintain alignment between warehouse operations and the development team, any changes made to the application should be reflected in the Excel-based information model. The CoE is responsible for maintaining the Microsoft Excel information model by updating it whenever new services are introduced or existing ones are modified. They must then inform the developers, who will update the corresponding computer model.

5.6 Evaluation

5.6.1 Evaluation of the tool

The evaluation of the developed configurator showed that the tool provided a platform for data in one place. According to the senior manager of e-commerce, the application is more user-friendly than their previous approach and enables them to gain a better overview and analyse opportunities more easily. Users can filter by country, view

rejections and more. This overview could also be integrated into the CRM system to ensure that opportunities are logged in the future.

According to the participants, the configurator could potentially increase the time required to complete the data collection, as it includes more questions than before. However, this impact could be mitigated by adjusting which questions are mandatory. In the long term, the configurator is expected to improve data quality, as it collects more information and enforces consistent input.

During the evaluation, it became clear that onboarding clients and getting them operational in the warehouses within two weeks was not feasible. Onboarding is largely dependent on the clients' readiness, for example, whether they are prepared to cancel existing contracts. Nevertheless, the tool can support the company's readiness and streamline the onboarding process when clients are prepared.

The sales manager argued that it is sometimes easier to use Excel because it can be accessed on the go, whereas logging in to the tool requires a VPN connection. However, the tool offers a more centralised platform, ensuring that all stakeholders are involved and that a consistent workflow is maintained. One benefit is that if something is flagged for a specific country, relevant stakeholders are notified and have access to the information. The sales manager also suggested that the tool could be simplified further and, in the future, potentially be made accessible to clients, allowing them to answer questions via a self-service feature on the company's homepage. Overall, the sales manager emphasised that the organisation needs to become more agile and flexible, as e-commerce clients and their needs frequently change.

The development of the software in-house had several limitations. In particular, changes to the sales tool could only be made by the developers (see Figure 7), making it an impractical process because updates to the services need to be requested. Furthermore, this can become an issue if the tool is scaled and adopted by more users within the LSP. Software that offers a user interface allowing domain experts to directly update the sales tool as services evolve may be more suitable for warehouse operations.

5.6.2 Evaluation of the approach

The developed approach offered several benefits. The process analysis enabled a clearer understanding of both the current and future business process while also helping identify existing challenges. Involving stakeholders from the beginning increased their engagement in the development, testing and evaluation phases.

The conceptual model of the warehouse service offerings provided a comprehensive overview of the information required from clients and ensured consistent definitions across the system. Additionally, it offered a visual representation of warehouse services, which helped various departments better understand the configurator's knowledge base.

The various views within the model facilitated the identification of connections between the services offered to clients and the internal resources required to deliver them. The accompanying information model presented a well-structured, tabular overview of the development requirements, including available options and constraints. This format was easily understood by developers and remained simple to update as changes occurred.

6 Discussion and conclusions

This study explored the effect of digitalising the sales process of e-commerce warehouse services in an LSP based on configuration. To develop this sales tool, relevant literature on service configuration was reviewed, leading to the formulation of a five-step approach to digitalising the sales process of warehouse services. The approach was utilised to develop an application to standardise the initial process steps of the sales process for e-commerce clients.

6.1 Implications for research

This study offers two distinctive contributions to the academic literature:

1 an approach to digitalising the sales process of warehouse services

2 knowledge about the potential from applying this approach to an LSP.

The first contribution is an approach to digitalising the sales process of warehouse services, grounded in literature on the development of service configurators. While the overall structure of the approach – comprising distinct phases – aligns with existing frameworks (e.g., Campo Gay and Hvam, 2022; Mueller et al., 2022; Kondrup Andersen et al., 2025). The focus of these phases differs somewhat, particularly in terms of identifying market segments and analysing warehouse services.

The second contribution involves applying each phase of the approach within a project at an LSP, during which it supported the development of a sales tool. The approach provided a structured method for digitalising sales processes. The case study demonstrated that the warehouse service analysis can be used to create an overview of the service offering and standardise definitions and names, thus creating a common knowledge base. In turn, this model also ensures that the developed software adheres to the naming conventions of services.

6.2 Implications for practice

The case study demonstrated that the five-step approach could guide the LSPs through the development of a tool to digitalise the e-commerce sales process. This approach helped the organisation better understand the challenges within its existing processes. Additionally, the conceptual model of warehouse service offerings ensured alignment between the services being offered and those that could be delivered. These insights and the structured approach can be valuable to other LSPs aiming to standardise their service offerings.

The study further demonstrated that digitalising the sales process for e-commerce warehouse services can enhance user-friendliness, centralise data on a single platform and streamline business operations. In the long term, the sales tool has the potential to improve data quality. However, it may initially increase the time required for data collection. Finally, the study highlighted the importance of carefully selecting the software platform for development. The right choice can make the tool easier to maintain and more scalable in the future.

6.3 Limitations and future research

This study has notable limitations that should be considered. First, the proposed approach was applied in a single case company. However, to mitigate potential bias, two researchers analysed each step and the results. Second, the approach was applied to a single segment – small e-commerce clients – with the aim of streamlining the sales process and standardising the service offering. While this provided valuable insights, the approach could be extended to a broader scope to assess its applicability across different market segments. Third, due to time constraints, the study did not include a quantitative evaluation of the configurator, which limited the ability to thoroughly assess the objectives formulated during the initial phase of the case study. Such an evaluation could provide valuable insights into the impact of digitalising the sales process within LSPs. Furthermore, the partial application of the proposed approach also limited the evaluation, and this should be further validated to assess its usefulness.

Future research should examine the approach's applicability across diverse companies and client types to assess its robustness and generalisability. Additionally, examining the barriers to implementing configurators beyond traditional product and process industries could provide valuable insights, particularly given the reluctance observed during development at the case company. Furthermore, since updating the software proved impractical, it should be examined how to best build a scalable tool – for example, by using software that includes a knowledge base editor for domain experts (Hvam et al., 2008).

This study did not specifically address the modularity of warehouse services. Instead, it was based on the architectural framework proposed by Strøm et al. (2024), which supports the design and development of modular logistics services. As the scope of the sales tool expands, future studies should further investigate modular warehouse services, potentially building on existing research in this area.

Finally, with the rapid advancements in smart warehousing, digitalisation, and automation within the 3PL industry (Baglio et al., 2024; Min, 2023), it could be interesting to explore how configurators can be integrated with innovative technologies to enhance efficiency and sustainability (Baglio et al., 2024; Campo Gay et al., 2024; Rodrigues et al., 2024). For instance, Internet of Things could enable real-time tracking of warehouse operations (Baglio et al., 2024) and provide data to the configurator. Another possibility is the use of digital twins to simulate complex warehouse environments (Baglio et al., 2024; Fernando et al., 2024; Strøm et al., 2025), allowing for detailed modelling of warehouse service offerings and supplying data to the conceptual model. However, these applications remain in the future due to the current digital maturity in the 3PL industry, as reported by Baglio et al. (2024). An additional area for future application could relate to increasing sustainability requirements in the industry (Prataviera et al., 2023; Strøm et al., 2025). In this context, the configurator could play a crucial role during the sales process by providing clients with clear information about the environmental impact of the solutions they purchase. For example, it could calculate and present this data, thereby supporting more informed decision-making (Campo Gay et al., 2024).

Acknowledgements

This article presents an expanded and revised version of the authors' earlier research, where the case study focused on developing a proof of concept. This journal article significantly expands upon that work by refining the methodology and introducing a structured approach to digitalising the sales process of warehouse services. Additionally, it incorporates a new case study centred on the development of a sales tool that builds upon the same analytical framework established in the original conference paper.

Declarations

All participants provided informed consent prior to their involvement in the study.

All authors declare that they have no conflicts of interest.

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