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Integrating Customer-Dominant Logic in Smart Product-Service Systems Development for the Packaging Industry

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Abstract

In today's dynamic and interconnected industry, the development of smart product-service systems (SPSS) is crucial for long-term business success. Traditional development approaches are reaching their limits in addressing the increasing complexity and specific customer requirements. Customer-Dominant Logic (CDL) offers a promising perspective by consistently placing the customer at the centre of all activities. This article examines the integration of CDL in SPSS development and presents an innovative reference model. The model enables manufacturers to better understand their role in the customer's ecosystem and contribute to customer goals through value-oriented solutions.

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1. Introduction

In the context of Industry 5.0, where human-centred innovation and sustainable development are prioritised, the development of smart product-service systems (SPSS) is becoming increasingly important for long-term business success [1]. Packaging machine manufacturers are under pressure to adapt their offerings to the growing complexity of customer requirements, while also considering sustainability and co-creation goals. Traditionally, packaging machines are special-purpose machines. However, traditional SPSS development models often fail, because they only partially address the dynamics of customer ecosystems and the need for continuous adaptation.

The Customer-Dominant Logic (CDL) represents a transformative approach that shifts the focus from a

manufacturer-centric to a customer-centric perspective. CDL positions the customer as the central actor in value co-creation and requires providers to integrate themselves into the ecosystem of the customer and align their offerings with the evolving objectives of the customer [2, 3]. This perspective is particularly important in the era of Industry 5.0, where technology serves human needs and long-term partnerships are necessary for sustainable success in sectors such as the packaging industry [1].

Despite its potential, the practical integration of CDL into the development of SPSS has not yet been sufficiently researched [3, 8]. Although CDL has gained increasing attention in service-dominant industries, its application in the manufacturing sector, especially in the continuous development of SPSS to adapt to changing customer needs, has been considered only to a limited extent. Existing development

models tend to focus on static processes, overlooking the dynamic and adaptive requirements that customers demand today in the context of Industry 5.0 [1].

This paper aims to fill this gap by presenting an innovative reference model that integrates CDL into the development of SPSS for packaging machine manufacturers. The Adaptive Design and Evaluation Process for SPSS (ADAPT-PRO) model presented here not only enables manufacturers to align their solutions with customer goals, but also ensures continuous adaptation to the development of customers' digital maturity [9, 10]. By embedding CDL principles in the development process, this model provides a flexible framework that supports the co-creation of long-term value and sustainable growth in line with the goals of Industry 5.0.

This contribution aims to answer the question:

How can CDL be integrated into the development of SPSS to strengthen the role of packaging machine manufacturers in the customer ecosystem and support dynamic customer requirements in the context of Industry 5.0?

2. From Goods-Dominant to Customer-Dominant Logic in Smart Product-Service Systems

The limits of Goods-oriented logic

In traditional industrial contexts, goods-oriented logic (GDL) regards value as embedded in the product itself, with the producer as the primary creator of value and the customer's role limited to consuming the value provided [3, 11]. This approach is heavily focused on material goods and transactional relationships. In the context of SPSS, however, the limitations of the GDL become clear, especially when it comes to dynamic customer needs. The rigid structure of the GDL does not consider the ongoing, adaptable relationships between providers, partners and customers that are necessary for the development of SPSS. The complexity of SPSS, which integrates products and services, requires a departure from purely product-centred thinking.

Service-Dominant Logic in the context of co-creation

The Service-Dominant Logic (SDL), introduced by Vargo and Lusch in 2004, marked a significant departure from GDL by redefining the roles of customers and providers. In SDL, value is no longer considered to be something embedded solely in a product, but rather something that is co-created between the provider and customer through their interactions [11]. This perspective emphasises the importance of 'use value', meaning that actual value is realised when the customer uses the product or service [11, 12]. In the case of SPSS, where services and digital technologies are deeply integrated into the product, this co-creation of value becomes evident. Suppliers and customers must engage in continuous interaction to ensure that the solutions offered meet the evolving needs of the customer. This also means that the customer must create some of the value themselves. Despite the progress made with SDL, the logic is still characterised by a supplier-oriented way of thinking. The supplier is seen as the mediator of value creation through the

interactions with customers that they design and manage. This leads to limitations in contexts where the customer's role is not just reactive, but dynamic and central to the value creation process itself. The increasing complexity of customer ecosystems and their needs requires an even greater change of perspective.

Customer-Dominant Logic: Shifting the focus to the customer's ecosystem

Customer-Dominant Logic (CDL) goes one step further by positioning the customer as the dominant player in the value creation process [8]. In CDL, value is not only co-created during specific interactions, but rather formed and embedded in the broader life and context of the customer. The customer's ecosystem, which encompasses their environment, experiences and long-term goals, becomes the focus for understanding value creation. This paradigm recognises that value creation is multi-contextual and ongoing, transcending specific transactions or interactions between customer and provider.

Instead of seeing the customer as a participant in the provider's value creation process, CDL regards the provider as embedded in the customer's life and contributing to their overall experiences and goals.

Servitization and CDL integration in SPSS

The transition from GDL to CDL is supported by the concept of servitisation, which refers to the shift from product-centric to service-oriented business models [13]. This shift is particularly relevant for manufacturers of machines, where integrating services alongside products enables companies to differentiate themselves from the competition and meet the changing needs of their customers. Servitisation is not just about adding services to products; it is about a fundamental shift in the way companies think about value creation [13, 14].

In SPSS, where digital technologies such as the Internet of Things (IoT) and Artificial Intelligence (AI) facilitate real-time data sharing between providers and customers, servitisation is enhanced by CDL. Continuous feedback and data from customers allow providers to refine and customise their offerings during the entire lifecycle. CDL plays a critical role in this process by ensuring that the provider's focus is on the customer's broader ecosystem, rather than on isolated product features. By adopting a CDL approach, packaging machine manufacturers can understand how their solutions fit into the customer's life and long-term goals, ensuring that their services evolve with the customer's needs. This shift enables the manufacturer to become a long-term value-added partner, embedded in the customer's continuous journey and responsive to the complex and dynamic realities in the lives of its customers.

3. Methodology

This contribution uses a structured Design Science Research (DSR) approach to investigate the integration of the CDL into SPSS [15]. The framework was developed and tested with packaging machine manufacturers in the special purpose

machinery industry, where adaptability is essential. The aim of the research was to improve customer integration and ensure continuous adaptation of the SPSS to dynamic customer needs.

Problem identification

A literature review and expert interviews with stakeholders from the packaging machinery industry revealed the limitations of traditional models such as GDL and SDL. These models focused on static solutions and were not flexible enough to continuously adapt to changing customer needs and digital maturity. They also did not adequately support long-term customer retention, which requires close customer integration and co-creation. Therefore, a new framework is needed that takes a closer look at CDL and places a greater emphasis on customer-centric adaptation and long-term partnerships.

Research design

The study involved workshops and expert interviews with professionals in the fields of sales, development, product management, and business development. These methods allowed for practical input and iterative refinement of the framework based on practical feedback from industry stakeholders.

The workshops focused on how CDL could enhance customer integration in the specialist machinery sector, emphasising the importance of dynamic feedback loops. Experts from a range of fields provided key insights into the challenges of integrating CDL into SPSS development. These contributions helped to refine the framework to support long-term customer engagement and continuous adaptation based on real-time customer feedback. Through several iterations, the framework was continuously updated based on feedback from workshops and interviews. This iterative process ensured that the framework remained consistent with the CDL principles.

Data collection and validation

The data for this study was collected through a series of expert interviews and workshops. An iterative approach was adopted, using the results of the interviews to gradually shape the process. Common themes, particularly related to customer integration and system adaptability, were identified through qualitative content analysis.

The interviews were complemented by a continuous enrichment through literature research, which allowed the model to be refined with theoretical [15].

In addition, an event storming workshop was conducted, in which experts worked together from different perspectives on the key process areas [16]. This workshop helped to reconcile different views and highlight critical points of contact in the SPSS framework.

The model was validated and further refined by alternating between interviews, literature research and field tests, which confirmed its ability to support continued customer retention and system adaptability [15].

ADEPT-PRO Model: A structured six phase framework for SPSS development

The ADEPT-PRO model is a structured framework that promotes the development and continuous adaptation of SPSS, aligned with the CDL [10]. CDL emphasises the central role of the customer in value creation and ensures that their evolving needs and ecosystem shape the entire development process [3]. The model, therefore, enables manufacturers to embed themselves into the customer's ecosystem and adapt solutions in a way that supports long-term partnerships. The model consists of six phases, with a focus on Phase 1 of problem identification as a divergent phase and Phase 6 of dynamic development, which is crucial for establishing and maintaining customer focus throughout the entire SPSS lifecycle. In the problem discovery phase within the first diamond, the customer's challenges are identified and thoroughly analysed based on the Quadruple Diamond Framework (QDF) [6]. CDL plays a key role here by looking at the problem from the customer's perspective rather than from the vendor's.

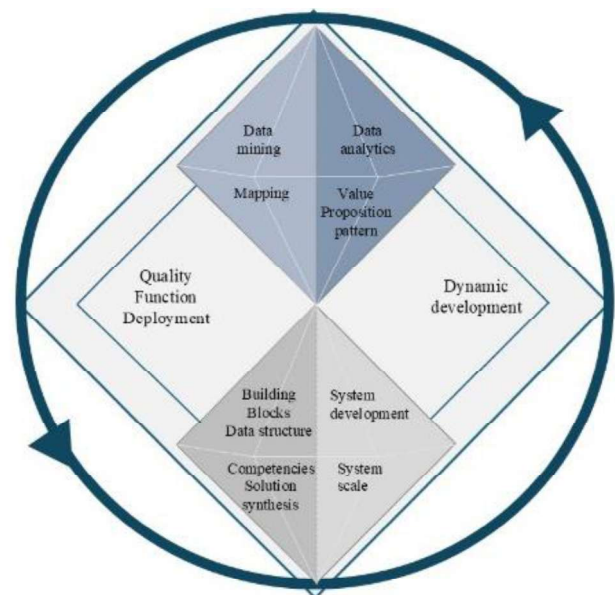


Figure 1: ADEPT-PRO model (own representation according to [4–7])

As shown in Fig.1, this phase begins with the identification of stakeholders and a comprehensive system analysis with the aim of opening the problem space to thoroughly explore the customer's needs and ecosystem. CDL ensures that the customer's goals, environment and long-term vision are at the centre of this discovery process and that the customer is the driving force behind the entire development. The customer's digital maturity is also assessed at this stage, which provides an initial basis that is tracked and adjusted throughout the entire process [9].

In the problem definition, the identified customer challenges are linked to business model patterns, while ensuring that the problem space remains open and adaptable to prevent premature narrowing of the solution options [17]. The first validation is carried out with key customers, whereby the defined requirements are compared with their expectations.

This phase ensures that customer feedback continues to shape the development of the solution, and that the customer has influence on the process.

The third phase, Quality Function Deployment (QFD), serves as a bridge between customer requirements and the development of concrete functions within solutions. QFD converts the needs identified in earlier phases into technical and service-oriented solutions, using building blocks from the provider's solution space [5]. The QFD plays an important role here by ensuring that the business model patterns identified in Phase 2 are implemented in components that match the customer's problem space. This ensures that the solution is developed to continue to reflect the customer's ecosystem and its evolving needs [18].

Solution development focuses on the creation of the actual technical and service components of the SPSS. Here, the developed solutions are continuously refined and aligned with the business model patterns and building blocks established in the previous phases. While technical aspects are critically important, CDL ensures that the customer's perspective remains central throughout the development, ensuring that the final solution meets their evolving goals and needs.

In the solution implementation, the developed SPSS components are deployed and tested for functionality and suitability. At this stage, testing is conducted to ensure that the system meets requirements and works effectively in their ecosystem. In addition, depending on the size of the company, test customers are scaled. CDL emphasises that client feedback is also crucial at this stage to ensure that the implementation addresses their real-world challenges and delivers the expected benefits [15].

The dynamic development is the final phase, where the focus is on the continuous adaptation of the SPSS to the changing needs and digital maturity of the customer. CDL is particularly important at this stage because it requires continuous engagement with the customer to monitor their evolving capabilities and the impact of the SPSS on their ecosystem. The customer's digital maturity is actively tracked as they interact with the system, and as they learn and gain experience, their requirements and expectations change.

The ADEPT-PRO model ensures that new SPSS components are continuously developed and adapted to meet the customer's increasing maturity and changing needs [19]. This phase embodies the essence of CDL, as the evolving role of the customer directly influences the ongoing development and adaptation of the system, ensuring long-term value creation and a sustainable commitment. In addition, this leads to strategic customer development, which reduces the risk for the manufacturer. In addition, the system can be adapted when a change is indicated. This is followed by an active sales process. Through this model, the ADEPT-PRO framework provides packaging machine manufacturers with a structured way to not only develop customer-centric solutions but also ensure their continuous adaptation to dynamic customer requirements. In doing so, it redefines the role of manufacturers as strategic partners within the customer's ecosystem.

4. Validation

As part of the validation of the reference model, experts from the sales, development, product management and business development departments were interviewed. The expert interviews showed that the integration of CDL into the entire development process, particularly in phase 1 (problem discovery) and phase 6 (customer development), is of crucial importance.

In phase 1, the focus is on identifying customer needs and analysing the customer ecosystem. The experts emphasised that a deep understanding of customer insights – i.e. the customer's challenges, goals and environmental conditions – is the key to a successful solution. Analysing the customer's digital maturity level at the beginning of the collaboration has proven to be particularly valuable, as it enables the provider to develop tailored solutions from the outset that are aligned not only with the customer's current needs but also with their future requirements.

Phase 6, the dynamic further development of the SPSS, builds on the insights from phase 1 and ensures continuous adaptation to changing customer requirements and the progress of the digital maturity level. A case study with a medium-sized packaging machine manufacturer confirmed that regularly reviewing and adapting the SPSS based on customer feedback and the customer's digital development could sustainably strengthen customer loyalty.

Furthermore, it became clear that the close link between knowledge of the current digital maturity level and sales activities enabled providers to develop and offer targeted and customer-specific solutions. These customised solutions led to an improved competitive position and strengthened the customer relationship in the long term.

Knowledge of the customer's digital maturity level also served as a valuable resource for sales to support the customer in the development of new business models and solutions. This enabled sales experts to proactively respond to changes in the customer environment and develop tailored offers that not only consider current needs but also future digital developments of the customers. This approach enabled the provider to transform itself from a mere product supplier to a strategic partner in the ecosystem of the customer, enabling long-term value creation.

5. Summary and outlook

This paper presented a CDL-based reference model for the development of SPSS. The key research gap was that CDL theory has not yet been widely adopted in research and has rarely been applied in engineering companies. Traditional models do not consider the dynamic and changing needs of customers to the same extent, which makes it difficult for the provider and customer to establish a long-term partnership.

By integrating CDL into the entire development process, particularly in Phase 1 (Problem Discovery) and Phase 6 (Customer Development), it was possible to show how providers can redefine their role as strategic partners in the customer's ecosystem. In Phase 1, customer insights and the customer ecosystem are analysed in detail to create the basis

for a customer-oriented solution. In phase 6, the dynamic evolution of the SPSS ensures that the solutions are continuously adapted to the customer's changing requirements and digital maturity level. The developed model provides a flexible and dynamic structure that promotes long-term co-creation and strengthens the relationship between provider and customer.

Although initial results demonstrate the effectiveness of the CDL approach, further research is needed to understand the long-term impact and full potential of CDL. Future studies should focus on the implementation and further development of CDL in different industries to evaluate its benefits in different customer ecosystems. In particular, the integration of digital technologies such as AI-based tools or big data analyses could further improve customer development and interaction and support the optimisation of SPSS.

In the long term, it will be crucial for companies to internalise the principles of the customer-dominant logic to react flexibly and adaptably to changing customer needs in an increasingly dynamic market environment. This would not only enable companies to ensure their competitive edge, but also to consolidate their role as a flexible and strategic partner in the customer's value creation process.

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