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Business Innovation based Product-Service System Development Framework

비즈니스 혁신 기반의 제품-서비스 시스템 개발 프레임워크

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이 논문을 공학박사 학위논문으로 제출함

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Abstract

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The manufacturing sector is currently experiencing a significant shift as it transitions from traditional product-centric business models to a more integrated Product-Service System (PSS). PSS is an innovative model that integrates physical products with value-added services, enhancing customer engagement and securing sustained profitability throughout the product lifecycle. This paradigm shift is heavily influenced by rapid advancements in digital technologies, particularly in information and communication fields, revolutionizing the way manufacturers interact with customers. Through PSS, manufacturers can potentially meet the evolving needs of customers with tailored solutions.

Transitioning towards PSS offers immense potential for enhancing customer value and profitability. However, this shift is not without its complexities. It comes with challenges such as accurately understanding customer needs, managing the uncertainty of initial investments, and overcoming resistance from employees accustomed to traditional practices. These hurdles underscore the need for a

strategic PSS implementation, with careful consideration given to business model design and comprehensive evaluation to avoid undesirable outcomes after transformation towards the PSS.

This thesis emphasizes the crucial role of business innovation in the development of PSS, particularly the importance of business modeling and evaluation for successful PSS implementation. The objective is to equip managers and decision-makers in manufacturing companies with practical methodologies to navigate the complexity during the PSS transformation.

The thesis proposes a two-phase approach for PSS development framework: the 'Proposition' phase and the 'Assessment' phase. In the 'Proposition' phase, a novel business modeling methodology utilizing morphological analysis is introduced. Morphological analysis decomposes a complex system into independent and solvable subsystems, enabling the identification of solutions through various combinations of these subsystems. This research involves examining real-world business innovation cases to extract reusable strategies, which are then categorized according to the sub-dimensions of the business model. The practicality and effectiveness of this methodology, termed the 'Morphological Chart' are further illustrated through a case study of a hairdryer manufacturer.

In the 'Assessment' phase, the thesis introduces evaluation templates for the PSS ecosystem, developed using a system dynamics approach. This approach provides a comprehensive framework to analyze the behavior of complex systems over time, considering interconnections, feedback loops, and system configurations. The methodology breaks down the PSS ecosystem into manageable modules, with bespoke templates designed to represent each one. These templates are customized to reflect the specific characteristics and challenges of different PSS types. The effectiveness and practicality of this methodology are validated through its

application in various PSS transformation cases.

Keywords: Product-Service System, PSS development framework, Business model innovation, Morphological analysis, System Dynamics
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Chapter 1

Introduction

The purpose of this study is to propose methodologies for developing Product-Service Systems (PSS) from a business innovation perspective. This chapter presents the background of the research and specific research questions. Section 1.1 facilitates understanding of PSS, which is the main topic of this study, by explaining its status in academia and industry, as well as its utility. Section 1.2 examines the challenges associated with PSS transformation. Lastly, Section 1.3 is dedicated to discussing noble methodologies for addressing these challenges in a business innovation perspective.

1.1 Product-Service System

The term "Product-Service System (PSS)" was initially introduced by Goedkoop et al. (1999), who described it as “a marketable set of products and services capable of collectively satisfying a client's needs.". Since this introduction, the concept of PSS has attracted growing attention from both academia and industry. An increasing number of scholars recognize PSS not just as an innovative offering, but also as a business model in its own right. They have studied its definitions, features, practical uses, and the wider implications of its adoption (Baines et al., 2007; Sundin et al., 2009). In the business landscape, PSS have become increasingly popular as

companies move away from traditional business models that only focus on tangible product sales for its ownership transfer (Miller et al., 2002; Voss, 1992).

Since the PSS was firstly introduced by Goedkoop et al. (1999), the academic landscape has evolved significantly various lenses and approaches. Early on, PSS was closely linked to market propositions and meeting customer needs, as noted by Annarelli et al. (2016). Over time, research widened to encompass various facets such as sustainability, effects on the environment, social aspects and partnerships/networking, and the balance between tangibility and intangibility. Annarelli et al. (2016) ultimately defined PSS as 'a business model geared towards providing a sustainable set of products and services aimed at fulfilling customers' needs economically, socially, and environmentally'. Concurrently, This evolution in perspective underscores the maturation and expansion of the PSS concept. Similar terminologies such as servitization, service-dominant logic, functional sales, industrial PSS (IPSS), sustainable PSS (SPSS), eco-efficiency, and circular economy emerged, further broadening the conceptual domain of PSS (Li et al, 2020; Kirchherr et al., 2017; Haase et al., 2017).

The transition towards PSS across various industries has been significant. According to Neely (2013), servitization levels have escalated to approximately 50% or even higher in specific sectors, including construction and engineering (56.30%), farm machinery (50.88%), heavy electrical equipment (49.25%), and aerospace and defense (49.09%). Recently, digital transformation has played a catalytic role in this trend, making the manufacturing sector more agile in integrating products and services to create new value and enhance customer relationships in the Industry 4.0 era (Coreynen et al., 2017; Pirola et al., 2020). The influence of digital technologies is also evident in industries such as software, energy, and publishing, where companies are increasingly supplementing their core offerings with additional

services (Valtakoski and Witell, 2018; Lütjen et al., 2017; Lexutt, 2019). Here are notable examples of PSS transformation: 1. Xerox's 'Managed print services', which provide management of customer's fleet of printers, supply replenishment, maintenance, and optimization; 2. Rolls Royce's 'Power by the Hour', where customers pay for engine performance rather than the physical product; and 3. Lego, which has expanded its traditional toy manufacturing to incorporate experiences such as 'Legoland theme parks' and customer-involved product design through its 'Lego Ideas platform'.

The rising prominence of Product-Service Systems (PSS) can be attributed to two primary advantages. Firstly, PSS enables companies to deliver greater value to customers by offering tailored, high-quality solutions that align more closely with their needs (Baines et al., 2007). In the competitive market, manufacturers are differentiating themselves by augmenting their products with services, leveraging PSS as a vital strategy for survival. Secondly, PSS contributes to environmental sustainability by minimizing resource consumption and waste generation. In utilizing functionality of a product rather than consuming the product itself, PSS promotes sustainable consumption patterns and lifestyles (Mont, 2002). Especially in the current trend of emphasizing ESG management to companies, PSS is recognized as a vital solution. The paradigm shift towards PSS has become inevitable for manufacturing companies in terms of both customer value and sustainability.

1.2 Challenges in PSS Transformation

The transformation to PSS holds promising potential for creating value for both customers and manufacturing companies. However, navigating the transformation

is often riddled with challenges and not always successful. There is a possibility of misunderstanding customers' needs, and the required investments may not always yield the anticipated higher returns. Additionally, internal resistance within the company can pose a significant hurdle, and conflicts of interest with existing business models may arise. This is not unique to PSS, as demonstrated by an analysis conducted by Bonnet (2020) regarding digital transformation initiatives, which found that a staggering 70-95% fail to achieve their original objectives, averaging around 87.5%. Such failures in both PSS transformations and digital transformations can be attributed to a complex interplay of factors that cover various domains, including market dynamics, organizational challenges, and technological barrier

Extensive research has been conducted on the challenges faced by organizations undergoing the transformation to Product-Service Systems (PSS). As one notable example, Vezzoli et al. (2015) identified barriers for companies and service providers, as well as barriers for customers, and context-related barriers. Similarly, Coreynen et al. (2017) explored internal and external barriers encountered moving into initial and subsequent stages of higher-value added services in the servitization pyramid. Enckell and Isgran (2017) described 34 specific challenges with their consequences. In addition to these, there has been a plenty of other research that has contributed to the literature on challenges in PSS transformation (Kamal et al., 2020; Matschewsky et al., 2018; Alghisi and Saccani, 2015). The results, including a comprehensive classification of the challenges described in the aforementioned studies, are presented in Table 1

This thesis endeavors to develop methodologies that help addressing the challenges in the domain of Business Innovation and Business Model, as outlined in Table 1. The motivation behind this focus raised the current highly competitive

business landscape and the escalating interest in sustainable consumption. Companies are continually striving to provide value to their customers while simultaneously ensuring profitability at the same time through innovative business practices. The existing literature highlights the essential nature of a well-structured business model in the successful transformation to PSS (Reim et al., 2015; Tukker and Tischner, 2006; Richter et al., 2010; Barquet et al., 2013). Companies can create differentiation in their business models even with identical products and services, based on their unique value delivery and revenue generation strategies. Thus, innovation in business models is crucial for companies to overcome current challenges and effectively prepare for future industry changes.

Table 1. Challenges in the transformation towards PSS.

Category	Challenge	Description
Organizational Culture and Internal Change Management	Internal resistance to change	Difficulty in adopting changes within the organization (ex. Shifting from a product-centric culture to a service-oriented culture.)
	Internal conflicts between business functions	The need for collaboration within the organization to efficiently provide services.
	Reluctance to structural change	Success in PSS may require significant organizational structural changes, like an alignment of the organization's hierarchy and inter-functional cooperation with PSS.
	Commitment and Leadership	Top management commitment is essential for a successful transformation.
Business Innovation	Servitization paradox	The burden due to initial and long/medium-term

and Business Model		investments required for transitioning to PSS.
	Economic sustainability of business with unknown cash flow	Uncertainty in revenue streams when transitioning to a service-based model. (ex. new pricing strategies that fit the service model, Accurately estimating costs associated with delivering services, and etc.).
	Change of systems and sources of gaining profit	Transitioning from short-term profits to medium-to-long-term investments.
	Extension of suppliers network	Expanding the network of suppliers to support the service model.
	High uncertainty through extensive contract length	Managing uncertainties in long-term customer contracts.
Customer Relations	Deficient understanding of	A necessity to align mindsets towards service provision and

and Understanding	customer's needs	understand customer needs.
	Lack of customer's understanding of the provider's new role	Convincing customers about the value and role of PSS, and encouraging customers to transition from owning products to utilizing services and accept refurbished products
	Lack of care from the customer's side	Ensuring customers treat leased or rented products responsibly.
	Ensuring customer trust	Building trust is critical in establishing long-term service relationships with customers.
Strategic Planning and Expertise	Strategic vision	Having a clear long-term vision for the role of PSS within the organization.
	Strategic alignment	Aligning business strategy with the requirements of a PSS model and ensuring alignment between the service strategy and overall business objectives.
	Lack of strategic planning	Developing a roadmap for the transition to PSS.

	Lack of expertise	Building expertise in service design and delivery. (ex. experience, technologies, and etc)
Design and Development Challenges	Design of service and product	Developing an integrated product-service offering that meets customer needs.
	Managing development periods and process	Efficiently managing and synchronizing development cycles for designing products, services, and software and creating robust development processes and documentation for PSS.
	Design-to-service	Focusing on the design aspect that facilitates service provision.
Network and Supplier Management	Tensions among the players in PSS ecosystem	Managing conflicts within the network involved in service delivery.
	Weak supplier	Establishing a foundation for collaboration and information sharing between the service provider and its suppliers

1.3 Structure of thesis

The remaining part of this thesis will present the methodologies developed from the perspectives of business models and innovation for a more successful PSS Transformation. As shown in Figure 1, the process of PSS Transformation is divided into two domains: Development and Operation. This thesis targets the Development domain and aims to develop methodologies that can be utilized in each of the proposition and assessment stages within this domain.

The first theme involves developing a Business Modeling Methodology utilizing Morphological Analysis, designed specifically for the Proposition stage within the PSS Development domain. This stage is essential for defining the PSS offerings or customer value offered through PSS transformation, considering customer needs and market evolution. As PSS represents a paradigm shift in business, merely having a great idea is not enough for successful commercialization; a well-suited business

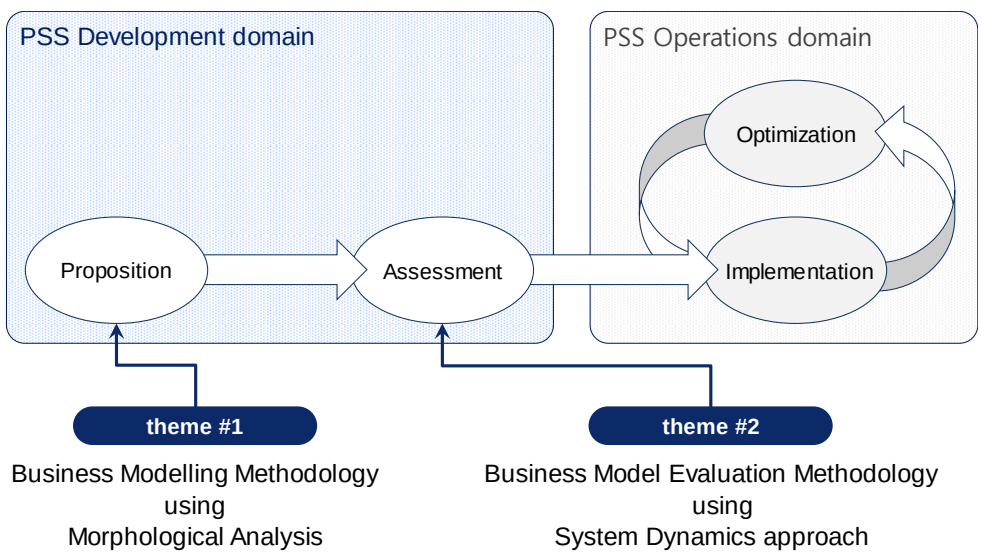


Figure 1. Outline of this thesis.

model is indispensable. Morphological Analysis, which is frequently used in engineering concept design stages, will be utilized for its ability to systematically explore a range of concept alternatives. This is especially valuable in creating diverse and adaptable business models. The methodology involves breaking down business models into various dimensions, and identifying business strategies for each dimension through an investigation of real-world PSS cases. I will demonstrate the applicability and utility of the resulting framework, termed a 'Morphological Chart', through a practical case study. As part of the developed business modeling methodology, the Morphological Chart will enable the generation of various PSS business models and help in constructing their medium to long-term roadmaps.

The second theme of this thesis is the development of a Business Model Evaluation Methodology using a System Dynamics approach. This methodology is crafted for the Assessment stage within the PSS Development domain. A stable PSS provision necessitates a PSS ecosystem that consists of service elements, product elements, various partners, and their interrelationships. Hence, the methodology employed in this stage must be capable of encapsulating the complexity of the PSS ecosystem and concurrently enabling the evaluation of PSS business models. System dynamics provides a comprehensive framework for understanding the behavior of intricate systems over time through computer simulation modeling. Given that simulation modeling can be challenging, this study aims to simplify and facilitate the creation of evaluation models by providing pre-defined templates. To achieve this, the complex PSS ecosystem is divided into several modules, with a basic template formulated for each. Advanced templates, which reflect the distinct characteristics of various PSS types, will also be created. By applying the developed evaluation templates to a real-case study, I will demonstrate the practicality of the methodology. This evaluation process will enable companies to analyze and refine

their business models ahead of PSS implementation.

Chapter 2

Literature Review

In this chapter, previous studies related to the thesis are reviewed from four perspectives. The literature introduced in the first two sections is related to Chapter 3. Section 2.1 presents a review of the concept and nature of business models. Section 2.2 introduces the definition of Morphological Analysis and its applications in numerous fields. The literature introduced in the last two sections is related to Chapter 4. In Section 2.3, the literature on business modeling and its operating mechanisms is introduced. Lastly, Section 2.4 presents the types of PSS and the characteristics of each type.

2.1 Business model

The interest in business models has seen continuous growth with the advent of and the explosion in the number of online companies (Timmers, 1998). In the new environment where the firm should deliver new information services that users often expect to receive without charge (Teece, 2010), firms achieve great success or suffer from failure depending on the changes in their ways of doing business. Observing these changes, the notion of the business model has received lots of attention as a tool for explaining the way of how businesses deliver value to the customer and how they can capture value from providing products and services. To uncover its concept

and nature, the literature has proceeded from two approaches: (1) taxonomy-based approach; and (2) model-based approach.

The objective of the taxonomy-based approaches is to develop a classification scheme of BM by investigating existing business model cases. One of the first attempts was that of Timmers (1998) who developed the taxonomy of the internet business model. He identified the eleven types of business model on the web, such as e-shop, e-auction and third-party. Focusing on the types of revenue model, Afuah and Tucci (2003) proposed the different classification scheme for internet business. Their taxonomy includes seven types of revenue model: commission, advertising, mark-up, production, referral, subscription and fee-for-service. Rappa (2018) refined the categories considering the nature of value proposition as well as the revenue model. Linder and Cantrell (2019) developed a more generalized taxonomy which includes other types of business besides the Internet domain. They classified a certain business model according to two criteria; the firm's core activity including selling, doing channel role or management service and relative position on the continuum of price and value from premium price and high value offerings to low price and standardized value ones. Chen et al. (2018) divided concepts of equipment maintenance business model innovation into two types based on 5 classification criteria respectively and described the connotation of them by combining functions of the equipment maintenance services. Although the taxonomy-based approach provides a good knowledge about emerging business patterns, it is limited in its applicability because it remains at the scope of specific industries and is based only on ex-post cases hence provides no guide in ideation.

The objective of model-based approaches is to propose a logical model of a BM by identifying its architecture or components. Petrovic et al. (2001) defined a business model as a system which consists of resources and activities interacting

with outbound environment such as customers, competitors and technologies. Morris et al. (2005) defined a business model as a set of decision variables of three different layers; generic strategic decisions, tactical decisions and actual quantifiable variables. In addition to this, they also provided predefined set of such decisions which could be used in representing a business model. Zott and Amit (2010) proposed the activity-based model, which insisted that configurations of activities determined a business model. Alternatively, Mahadevan (2000) highlighted the relationship between stakeholders as a major component of a business model. According to him, three different kinds of stream value, revenue and logistic between stakeholders determined a firm's business model. Alt and Zimmermann (2001) proposed the six generic elements which were commonly mentioned in other literature; mission, governance structure, process, revenue sources, technology and legal issue. Osterwalder (2004) developed comprehensive ontologies of the business model. His ontology consisted of basic components along with the identification of all the possible configurations and relationship between components. Although his ontology enables a structured analysis on a business model in a comprehensive manner, the complexity of entire ontology makes it hard for planners to understand the whole picture of a business model.

2.2 Business modelling and operating mechanism in PSS

Business model refers to the logic behind how a company conducts its business (Osterwalder and Pigneur, 2010), and how the company transforms resources and capabilities into economic value (Teece, 2010). Richardson (2005) proposes an integrated perspective on the elements of business models, which includes the value proposition (i.e. the offer and the target customer segment), the value creation and

delivery system, and the value capture system. In light of this, the mechanism of a business model can be understood as the process of discovering novel approaches to create, deliver, and capture value (Casadesus-Masanell and Zhu, 2013).

Business modelling issue has been addressed in some PSS literature. Lay et al. (2009) and Gaiardelli et al. (2014) proposed a typology of service elements that can be offered by the PSS. However, these approaches only focus on business-to-business context and cannot be applied to business-to-customer context. Kim et al. (2012) developed a case-based PSS idea recommendation system which could be applied to more generic business context. Bocken et al. (2014) investigated numerous business models related to environmental sustainability. Reim et al. (2015) systematically classified PSS literature and investigated business model-related topics and possible tactics which could be considered in implementation of PSS business model. Mattos and Albuquerque (2018) empirically deduced 6 business models in circular context by identifying success factors and strategies and linking them from case studies. Although these literatures show various approaches for defining or representing the business model by establishing its taxonomy, constituent architecture or representation model, none of them mainly deals with the structured procedure for business modelling.

Zott and Amit (2010) and Saarijärvi et al. (2013) both attempted to define mechanisms to create, deliver, and capture value, or what can be called the business mechanisms, by clarifying three aspects. Zott and Amit (2010) adopted an activity-based perspective, including the selection of activities ('what'), the activity system structure ('how'), and who performs the activities ('who') to explain the business mechanism. On a similar note, Saarijärvi et al. (2013) argued that, due to the complex nature of value co-creation, both scholars and practitioners should focus more on identifying and understanding what kind of value is co-created for whom,

using what kind of resources, and through what kind of process. Additionally, since the concepts of value creation and value capture within business models are frequently used but rarely well-understood, Ganzarain et al. (2019) clarified them utilizing price, cost, and the concept of willingness to pay. This led to the identification of four key business mechanisms: value proposition (what the company offers), value targeting (to whom it is offered), value delivery (how it can routinely deliver on the promises in a cost-effective way), and value appropriation (how it can ensure sufficient profit). Austin and Seitanidi (2012) emphasized the significance of value co-creation and consolidated the partnership processes such as partner selection, design and operation, and partnership institutionalization, in addition to the partnership outcomes. Hermes et al. (2019) explored the reciprocal impact of business model innovation strategies between companies and stakeholders within the value creation mechanism.

2.3 Types and Characteristics of PSS

Since Goedkoop et al. (1999) first provided a formal definition of Product-Service Systems (PSS), there have been diverse definitions and classifications of PSS in literature (Baines et al., 2007). Mont (2002) categorized PSS into five types, viewing it as a combination of products and services across the product's lifecycle. Subsequently, Tukker (2004) classified PSS into three main categories, diverging in terms of the relationship between the provider and customer and revenue model. More recently, Yang et al. (2017) distinguished PSS into four forms from the perspective of capturing value through business innovation. He introduced the concept of "value uncaptured," which refers to the potential value that could be captured but has not been captured yet through PSS business innovation.

Adrodegari et al. (2015) presented a PSS typology that is grounded in a framework derived from the Business Model Canvas, which two types and three types in the ownership-oriented group and service-oriented group, respectively. The most widely accepted classification is the three categories of Tukker (2004) described above (Barquet et al., 2013), which are used in the other literatures (Manzini and Vezzoli, 2003; Gaiardelli et al., 2014; Barquet et al., 2011; Barquet et al., 2013).

The aforementioned three categories are described below (Barquet et al., 2013):

- Product-oriented PSS: involves traditional product sales where the customer owns the product, while the provider offers additional services such as maintenance, reuse and training, aimed at ensuring product functionality and reducing usage costs.
- Use-oriented PSS: the manufacturer retains product ownership and provides the customer with access through leasing, sharing, or renting. This emphasizes efficient product use, prolonged lifecycles, and maintenance, as the manufacturer bears the maintenance costs.
- Result-oriented PSS: the manufacturer sells a specific outcome or result instead of the product itself. Typically mixed with services, the manufacturer retains ownership of any products involved, and the customer pays for the achieved results.

Researches on the characteristics of different types of PSS have been conducted. Gaiardelli et al. (2014) investigated the characteristics of the primary categories of PSS across ten dimensions and further detailed these categories into 30 types based on PSS offerings. Barquet et al. (2011) highlighted the significance of business considerations and proposed primary characteristics of the PSS types, which were organized according to the nine elements of the Business Model Canvas. In a follow-

up study, Barquet et al. (2013) identified the perspectives of the Business Model Canvas that require adjustments during the transition to PSS and detailed the key consideration necessary for such adjustment, depending on the type of PSS. Reim et al. (2015) discussed the differences among the types of PSS in terms of creating, delivering, and capturing value, which were referred to the mechanism of a business model. Wallin et al. (2013) explored the evolution of business model components during the transition to PSS from traditional settings, using a case study in the aerospace sector. Furthermore, Hara and Arai (2012) investigated functions activated and attributes influenced by humans and machines for each PSS category. Byungun Yoon et al. (2012) conducted an analysis focusing on risk factors, whereas Laperche and Picard (2013) addressed the crucial role of training.

A summary of the characteristics of the various PSS types, as derived from the existing literature and synthesized through the lens of business models, is presented in Table 2.

Table 2. Characteristics of three types PSS according to the business model canvas.

	Product-oriented PSS	Use-oriented PSS	Results-oriented PSS
Customer Segment	• Ownership	• Fine with no ownership (low initial investment)	• Prefer no ownership (flexibility to change products /requirements)
Distribution Channels	• Indirect interface with end client • Marketing for product's strong points	• Quick transitions (simple and cheap product exchange)	• Direct interface with end client • Marketing for trustworthiness
Customer Relationship	• Transactional	• Mix of transactional and relational	• Relational (longer-term contracts)
Revenue Stream	• Fixed product price and additional service fee	• Payments based on the availability • Pricing that can hedge the risks	• Payments based on per-unit time/unit use • Various cash-flows due to

		of having too much products as an asset	distributed payment timing and different contract-period
Value Proposition	• Product is the core of offerings (more than the product's tangible value)	• Functional capability to customer • Cost and risk reduction	• High level of abstraction and risk reduction (only functional outcome or requirements, no specific products or resources involved)
Key Resource	• Material, Information, and Energy • Employees are critical capital	• Inventory and human resource in channels (information on the products and service) • IT infrastructure to monitor the usages	• Employees are critical capital • Interactive persuasion - communication skills (intensive exchange of knowledge/know-hows)
Key Activity	• Large production • Centralized decision-making	• Service management (customer, inventory, maintenance, and etc.)	• Customization of PSS design according to the requirements

Key Partnership	• Outsourcing • Incentives system is required	• Long-term collaboration with suppliers (forecasting, training, R&D, and after-service)	• Organize tasks to be outsourced efficiently • Long-term collaboration with suppliers
Cost Structure	• Traditional production costs (materials, factory, labor and etc.)	• Initial investment to acquire products • Maintenance and operation costs	• Risk Costs and all of lifecycle costs (responsible for kwon /unknown uncertainty)

Chapter 3

Business Modelling Methodology using Morphological Analysis

This chapter aims to establish a structured business modelling methodology for successful implementation of Product-service system (PSS). The morphological analysis is applied in investigating the possible patterns of the PSS business model. To systematically collect the business model patterns, a set of predefined building blocks which can be used in business modelling have collected. These building blocks are collected through investigation of actual PSS business model cases. By mixing and matching various building blocks, various innovative business model alternatives can be designed. To demonstrate the morphological chart, real case example of hair dryer company is illustrated. Moreover, a web-based system is introduced to supports the proposed business model idea generation procedure using morphological chart.

3.1 Introduction

Reduced profit rate due to fierce competition and rapid changes in customer expectations have forced manufacturing companies to shift from the sales of physical products to the sales of functionality delivered by the integration of the product and

related services (Tukker, 2015; Manzini and Vezzoli, 2003). This novel concept is referred to as Product-Service System (PSS). By the provision of integrated service along with the product life-cycle, PSS could enhance the long-term profit by increasing the interaction between customer and companies (Kowalkowski, 2010). PSS also could achieve an improved utilization and reduced environmental impact by accessing customer usage data and providing customized service for each customer (Yang et al., 2017).

Despite of its economic and environmental potential, shifting towards PSS is challenging (Baines et al., 2009) because it involves radical transformation of value chain and organization (Martinez et al., 2010). Kuo et al. (2010) and Gebauer et al. (2005) confirm that many manufacturers do not deliver PSS effectively, due to poorly defined customer requirement and service portfolios. In this regard, literature emphasized that planning of sound business model might be a critical factor for successful PSS employment (Reim et al., 2015; Tukker and Tischner, 2006; Richter et al., 2010; Barquet et al., 2013). Business model is defined as a logical description of how a company will generate revenue and make a profit with its product and service (Johnson, 2010). Even with the same product, a company could differentiate their business model with different configuration of its revenue model, distribution channel or customer segmentation and so forth. Literature shows that in some cases a company's choice on the business model may be more important than the product design (Chesbrough and Rosenbloom, 2002) and business model innovation plays a critical role in overcoming firm's facing challenges and in preparing the industry turbulence of the future (Cheah et al., 2018). Due to its importance, literature attempted to clarify the concept of the business model (Timmers, 1998; Rappa, 2018; Petrovic et al., 2001; Morris et al., 2005). However, there is lack of consensus on the general characterization or classification scheme about the business model (Teece,

2010; Spieth et al., 2014; Evans et al., 2017).

3.2 Research Positioning

In this section, the research gap is identified through the analysis of existing studies, and the contributions that this study aims to make are clearly outlined. To this end, the contents of the study are concisely summarized.

3.2.1 Research Gap

The business model aspect has not received extensive consideration within PSS literature (Kindström, 2010; Meier et al., 2010). Tukker and Tischner (2006) observed that existing PSS research tends to be heavily centered on individual case studies, with business model planning receiving relatively little attention. While there are a few business modeling frameworks that emphasize perspectives for comprehending the PSS business model (e.g., Barquet et al., 2013; Beuren et al., 2013), they fall short in providing a detailed identification of patterns or components that can enable the ideation of PSS business models (Adrodegari et al., 2017).

Morphological analysis is a well-established, qualitative technique that has been widely used in the social sciences. Its key function lies in systematically structuring and investigating the comprehensive set of relationships within multi-dimensional, non-quantifiable problem complexes (Ritchey, 2011). This method achieves this by breaking down a system into independent partial systems and efficiently identifying solutions through the combination of various solutions provided by these subsystems (Liu et al., 2020). Specifically, the core steps of morphological analysis include: 1. structuring dimensions or subsystems, 2. identifying potential solutions, 3.

constructing a morphological matrix, 4. merging solutions of dimensions or subsystems, and 5. evaluating the solutions (Ostertagová et al., 2012; Ritchey, 2011). Since Initially developed by Zwicky in 1969, this method has since found diverse applications across fields such as engineering design, scenario development, technological forecasting, policy analysis, social/cultural modelling, and innovation management (Fargnoli et al., 2014; Ritchey, 2022).

However, in many studies, the Morphological Analysis is utilized as a method to structure a problem rather than to solve it (Liu et al., 2020). A similar pattern can be observed in the field of business design that employs morphological analysis. For instance, Im and Cho (2013) proposed a methodology for creating business alternatives based on a morphological matrix and analyzing them. However, their matrix was specifically tailored for virtual mobile businesses, which limits its boarder application. Seidenstricker et al. (2014) suggested a morphological matrix comprised of five design fields and several options for value proposition, but the design options were conceptual, making it more suited for analyzing derived ideas rather than deriving concrete ones. More specifically related to PSS, Haber et al. (2018) and Haber and Fargnoli (2017) proposed design methods using morphological matrices. But, similar to other studies, they presented alternatives based on a case and lacked more generic alternatives, thus remaining the methods at a conceptual level.

3.2.2 Intended Contributions

This study aims to develop a practical methodology for managers in manufacturing companies who are preparing for a transformation toward PSS. The focus is on creating diverse PSS business models and roadmaps. Recognizing that company

managers or non-experts may feel it challenging to utilize a developed methodology, especially when starting from scratch, this study presents systematically organized business innovation strategies. These strategies can be directly referenced and employed for ideation, serving as a practical resource in the business model development.

To achieve this, morphological analysis is adopted to structure the problem of business modeling into independent partial systems. It constructs a morphological chart by collating business innovation cases and reusable strategies for each subsystem. Since each strategy is derived from actual innovation cases, they are practically applicable and have proven utility. For managers in manufacturing companies, referencing this morphological chart can facilitate the creation of business models and roadmaps tailored to their intended PSS offerings, by recombining various business innovation strategies. To validate the proposed methodology, a case study involving a hair dryer company in South Korea is presented. It presents the procedure to generate diverse and engaging business model alternatives. Additionally, this research introduces BizChef, a web-based system that allows users to explore various business model cases and facilitates the streamlined development of new business models.

3.3 Construction of Morphological Charts

This study aims to systematically collect reusable business innovation strategies that can be utilized in creating new business. Investigating many business innovation cases, I have found that business model strategies that is common in one industry could be an innovative solution to the other industry. For example, advertisement fee is a common revenue model of internet industry. They provide free service or

contents to the users instead charges advertisers who would be attracted by a larger base of free users (Anderson, 2009). Nowadays, advertisement revenue model is also found in offline business. 'Tada copy,' which is a paper copy shop in Japan, designed its revenue structure that puts advertisements on the other side of the copy papers instead of providing the copy service to students for free (Free Love). As shown with this example, numerous interesting business models have emerged by combining patterns of other business models (Linder and Cantrell, 2000).

3.3.1 Decomposing the Business Model

Morphological analysis can spark creative ideas, by referring to and combining the pre-identified solutions across various dimensions and then discovering new relationships that were previously overlooked (Ritchey, 2006). To apply morphological analysis to business modelling in this study, two preliminary steps are necessary: 1. Decomposing a business model into fundamental dimensions, and 2. Identifying reusable elements for each dimension. First, for the decomposition of a business model into fundamental dimensions, the scheme by Osterwalder and Pigneur (2010) is adopted. They broke down the business model into nine perspectives, collectively known as the Business Model Canvas. This is one of the most popular frameworks for describing business models and provides a balanced viewpoint by simultaneously considering financial, customer, and infrastructure aspects. Each perspective is defined as follows:

- Revenue streams: The way a company makes incomes from customer segments
- Cost structure: The cost that is necessary to operate business model and

their structure

- Customer segments: Groups of a company tries to serve throughout providing value proposition
- Customer relationships: Types of relationship a company want to create with their customer segments
- Distribution channel: The path through which product or service travel from the company to customers
- Value propositions: the collection of product/service a business model offers to meet the needs of customers
- Key activities: The most important activities in creating and delivering a company's product/service
- Key resources: Resources that are necessary to execute key activities
- Key partnerships: External companies or Organizations which have a relationship with a company.

3.3.2 Identifying Business Model Strategies

The next step involves identifying reusable elements, business model strategies, for each dimension. In this study, these elemental ideas are referred to as 'business model strategies'. Various real cases of companies that have undertaken business innovation or launched new services were identified and investigated through searches using keywords such as business innovation, new service, startup, venture, and ideas for innovation (listed up in Appendix. A). Primary distinguishing points of each case were then extracted and organized, taking into account the perspectives of the previously mentioned Business Model Canvas. Lastly, each primary distinguishing point, which represents a business model strategy, was aligned with

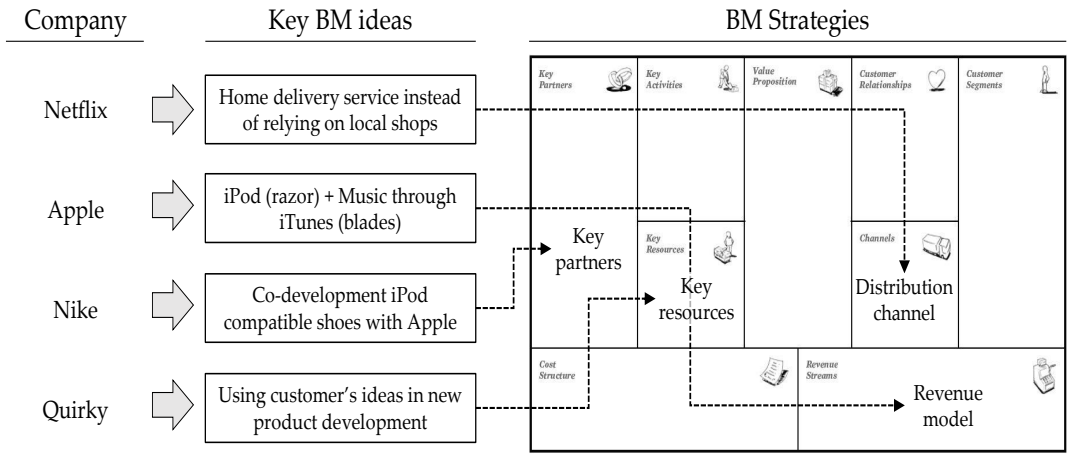


Figure 2. Example of business model strategy identification.

one of the fundamental dimensions or perspectives of the Business Model Canvas.

Figure 2 illustrates how business model strategies were identified. As shown in this figure, one of the cases I collected was Netflix, whose business model involves providing DVDs through home delivery service rather than operating local shops. Consequently, Netflix's approach was defined as the 'delivery' strategy within the distribution channel perspective. Another case, Apple, demonstrates that a firm can generate additional profit by selling complementary products (music through iTunes) alongside an installed-based product (iPod mp3 player). This strategy was defined as the 'razor-blade' strategy within the revenue model perspective. Following the same procedure, I have identified a total of 55 strategies across eight perspectives.

The complete morphological chart of business model strategies is constructed through the above two preliminary steps, and the definitions of each strategy along with its corresponding business model case are illustrated in Table 3. The morphological chart identifies about five to ten strategies for each business model perspective. By examining various combinations of business model strategies in each

perspective, one can generate various business model ideas at PSS planning stage. Also, it is noteworthy that the proposed morphological chart could be continuously updated as new business model strategies are identified.

Table 3. Definitions of the business model innovation strategies (Morphological Chart).

BM perspective	Strategy	Definition	Motivated example
Customer Relationships	Customer participation	allows customers to participate in value creation activities including design, production, delivery	• Lego mindstorm (allows customers to configure or design their own products)
	Reward	rewards customers according to improve customer royalty	• Pepsi (distributes Pepsi stuff point which can purchase variety of merchandise such as MP3)
	Upgrade	upgrade product/service after specific periods of product usage	• Smartphone company (provides OS upgrade service)
	Blockbuster marketing	improves brand awareness throughout massive-scaled marketing event	• Hyundai card (Credit card company hosts famous musician's concert)
	Life-cycle care	provides additional life-cycle service	• Volvo (provides prognostic

		(maintenance, diagnosis, upgrade) after the product has been sold	maintenance service for the vehicle)
	Customization	enables customers to purchase tailored product/service	• Lutron lights (which are programmable so that customers can easily customize the aesthetic effect)
	Education	provides knowledge about efficient product/service usage	• Lockheed martin (provides additional training service)
	Community	creates community where customer can communicate with other customers on product/service information	• Turbotax (creates user community where customer can communicate about tax regulation or software usage)
	Viral marketing	induces word-of-mouth effect by encouraging customers to spread out their products/service	• Groupon (induces customer to advertise specific product throughout SNS)

Distribution Channel	Experience shop	allows customers to experience product/services through distribution channel	• Apple (allows customer to actively use products in their directly managed offline store, Apple store)
	Shop in shop	places small shop within big shop	• Golden nail (sells coffees in nail shop)
	Delivery	delivers product/service to customers directly	• Odin (daily vegetable/fruit delivery service)
	Sales person	uses sales calls in selling product/service	• Woongjin Coway (water purifier company provides additional maintenance service through sales staffs)
	Road shop (Booth)	makes flexible/movable shops which can be placed in anywhere	• Shamak (India movable laundry service)
	Web (mobile)	allows customers purchase product/service through internet	• Bluenile (online jewelry shop)

		connection	
	Indirect channel	uses generic distributors or wholesaler which are not owned by the company	• Dell (begins to sell products in Wall-mart)
	Direct channel	operates direct distribution channel owned and operated by the company	• Apple (sells iPhone through Apple store)
	Channel sharing	uses existing-but-non-traditional infrastructure as distribution channel	• Seven eleven (enables customers to pick-up their packages at store)
Revenue Streams	Pay-per-unit	customer pays for single product/service	• Variety of merchandise
	Subscription	customer pays fees for specific period in exchange of free usage of product/service	• Netflix (provides subscription service for movie/TV contents)
	Razor blade	divides product into single platform (razor) and various complementary	• Philips (separates coffee capsule from coffee maker, which is necessary

		goods (blades)	continuously)
	Ad-based	customer see advertisement instead of paying fees	• Tada copy (provides free copy service to students in exchange of putting ads on the other side of paper)
	Freemium	provides free version of product/service and receive fees when upgrading the product/service	• Skype (free light version + premium version)
	Donation	donates certain amount of revenues for social values	• Toms (donates some portion of shoes to African children)
	Commission	receives certain amount of revenues of product sold	• Google
	Royalty	receives royalty fees from other parties	• Technology-based companies
	Subsidiary	subsidy one party instead of receiving high fees from other part	• Cellphone industry

	Pay as you want	enables customers to set their own fees	• Radiohead (enable listeners to freely set their own price for downloading songs)
	Pay per use	customer pays fees as the exact amount of their usage of products/services	• Zipcar (charges car rental fees according to customer's usage hours)
Customer Segments	Segment expansion	targets different customer segment	• Petsmart (provides accommodation service to pets, not humans)
	Geographical expansion	targets different geographical region	• Alibaba (enter the US market based on the success in the Chinese market)
	Long-tail targeting	sells a large number of unique items with relatively small quantities sold of each	• Lovefilm (focuses on unpopular DVD contents)
	Premium targeting	targets product/service to high-end market	• Louis Vuitton (focuses on a core trade, either a single product or a line

			of closely-related ones)
	Low-price targeting	targets sell product/service to low-end market	• Southwest airline (provides low cost airline service)
	Social targeting	makes business model to improve social responsibility and sustainability	• Grameen bank (develops micro credit service to face with poverty)
	2-sided targeting	targets more than two parties in order to exchange their needs	• Innocentive (provides R&D brokerage services)
Key Resources	Recycle	uses waste product/materials in order to create new product	• Threadless (recycle fabrics to make T-shirts)
	Crowdsourcing	uses an external resources (public, customer, amateur's) to create values	• Quircky (crowdsourcing platform for new product/service development)
	Open source	promotes a partial/universal access to a design or modify the product	• Google (develops open source-based modular cell phone, and each of modules are accessible/modifiable to

			any external developers)
	Outsourcing	reduces costs by transferring portion of work to outside suppliers	• Apple (outsource their manufacturing and supply chain part)
	Alliance	makes coalition or friendship between two or more companies	• Google (develop partnership with Samsung to develop Nexus)
	Brand leverage	uses the power of an existing brand name to support a company's entry into new, but related product category	• Nespresso (use Nestlé's brand equity in launching espresso machine)
Key Activities	Added service	servitizes existing business process	• GE (add engine maintenance service)
	Service productization	productize/automates exist in business process	• Redbox (provide DVD rental service through kiosk)
	Standardization	lowers cost by standardizing business process	• McDonalds (highly standardized menus and recipe)
	Economies-of	makes use of cost advantages due to	• Wal-Mart (can buy enormous bulk,

	-scale	scale of operation	force suppliers to accept low price, and sells at low price to customers)
	Economies-of -scope	makes use of efficiencies by variety of product/service options	• Sony (sells large variety of Walkman series)
	No frill	non-essential features have been removed to keep price low	• Easyjet (cuts down the aircraft fees by eliminating unnecessary in-flight service features)
	Self service	reduces cost by allowing customers to complete most steps in purchasing or using of product/service	• Velov (bike sharing system with unmanned station)
	Peer to peer	enables individuals to distribute, share, and reuse of their excessive capacity with other individuals	• AirBnB (website for people to rent out lodging)
Key	R&D	involves partners in technology	• Coca-Cola + Heinz (collaboration to

Partnerships	collaboration	development	develop more sustainable containers)
	Design collaboration	involves partners in design phase	• Nike (develops iTunes-compatible health signal tracking shoes)
	Joint distribution	makes use of partner's distribution channels	• Netflix (installs DVD rental shop at Wallmart)
	Shared investment	makes co-investment to share risk	• Repsol + Burger King (Collaboration to increase revenue at gas stations)
	Cross promotion	promotes each other's product/service	• Mallskin (develops a diary book which is compatible with Evernote)

3.3.3 Assessing the Comprehensiveness of the Strategies Set

In this section, I assess the comprehensiveness of the strategies within each perspective. Having previously identified various business model strategies, it is crucial to examine their coverage and systematically organize them to effectively utilize the Morphological Charts. It is vital to recognize that the business landscape is ever-evolving, and new strategies can emerge at any time. Therefore, it is realistically challenging to ascertain that all possible strategies have been captured. With this in mind, the approach adopted in this section aims to ensure that the strategy set for each perspective is able to comprehensively cover all areas defined by their key attributes. Through this, not only can the coverage of the currently identified strategy set be validated, but it also establishes a structured framework for understanding and utilizing new strategies that may emerge in the future.

The assessment begins by characterizing each perspective with distinct attributes. For the 'Customer Relationships' perspective of the business model canvas, two key attributes are considered to organize the strategies: 'customer involvement' and 'nature of value'. The 'customer involvement' includes 'active participation' where customers are actively engaged, and 'passive reception' where customers are beneficiaries. The 'nature of value' comprises 'direct benefits', such as discounts or rewards, and 'indirect benefits' like improved customer service. Mapping the strategies reveals that the strategies such as 'Customization', 'Upgrades', and 'Customer Participation' are in the 'active participation and direct benefits' quadrant due to immediate benefits through customer actions. The strategies like 'Community' and 'Viral Marketing' fit into 'active participation and indirect benefits' as involvement is present but takes time to yield relationship-building benefits. The strategies including 'Rewards', 'Education', and 'Life-cycle

Table 4. Coverage of the Identified Strategies in the Customer Relationships.

Customer Relationships		customer involvement	
		active participation	passive reception
nature of value	direct benefits	• Customization • Upgrade • Customer Participation	• Rewards • Education • Life-cycle Care
	indirect benefits	• Community • Viral Marketing	• Blockbuster Marketing

Care' are classified under 'passive reception and direct benefits' where customers receive direct benefits without active involvement. 'Blockbuster Marketing' strategy aligns with 'passive reception and indirect benefits' as it entails long-term benefits such as brand recognition without active engagement from customers.

In the 'Distribution Channels' perspective, two attributes are essential: 'target reach' and 'channel type'. The 'target reach' can be 'broad', aiming for a wide customer base, or 'focused', honing in on specific customers. The 'channel type' is categorized as 'direct', where the company reaches the customer without intermediaries, and 'indirect', involving third parties. Under 'broad and direct', strategies like 'Road Shop (Booth)' are employed, where booths in high-traffic areas aim to reach a mass market directly. For ‘focused and direct', strategies include 'Experience Shops' for direct product experiences, 'Sales Persons' for direct outreach,

Table 5. Coverage of the Identified Strategies in the Distribution Channel.

Distribution Channel		channel type	
		direct channel	indirect channel
target reach	focused reach	• Experience Shops • Sales Persons • Channel Sharing • Delivery	• Indirect Channel
	broad reach	• Road Shop (booth)	• Web (mobile) • Shop-in-Shop

'Channel Sharing' with other companies, and 'Delivery' services catering to specific segments. In the 'broad and indirect' category, strategies such as 'Web (Mobile)' and 'Shop in Shop' are used to reach a wide range of customers through online presence and retail spaces. Finally, 'focused and indirect' encompasses strategies like 'Indirect Channels', which involves selling through third-party retailers that focus on a specific customer segment or area.

In the 'Revenue Streams' perspective of the business model canvas, strategies hinge on 'pricing mechanism' and 'customer engagement'. When 'pricing mechanism' is categorized into 'fixed pricing' and 'variable pricing', and 'customer engagement' into 'one-time transaction' and 'on-going transaction', I can create four discerning categories. For 'fixed pricing' coupled with 'one-time transactions', 'Pay-per-unit' strategy is common, wherein customers pay a fixed price for each unit

Table 6. Coverage of the Identified Strategies in the Revenue Streams.

Revenue Streams		pricing mechanism	
		fixed pricing	variable pricing
customer engagement	one-time transaction	• Pay-per-Unit	• Pay-as-You-Want • Donation
	on-going transaction	• Subscription • Freemium • Razor-Blade • Royalty	• Commission • Pay-per-Use • Ad-based

purchased. In contrast, strategies like 'Subscription', 'Freemium', 'Razor Blade', and 'Royalty' make up 'fixed Pricing' with 'on-going transactions', providing continuous service for a fixed fee. 'Pay as you want' and 'Donation' fall under 'variable pricing' with 'one-time transactions', giving customers flexibility in payment for single transactions. Lastly, 'variable pricing' paired with 'on-going transactions' encompasses strategies such as 'Commission', 'Pay per use', and 'Ad-based' revenue models, where the pricing varies with usage or other variables over time.

Moving on to the 'Customer Segments' perspective, the framework is defined by two critical attributes: 'market breadth' and 'value proposition'. The 'market breadth' is split into 'broad market', which targets a wide range of customers, and 'niche market', which focuses on a specific segment. The 'value proposition' is

Table 7. Coverage of the Identified Strategies in the Customer Segments.

Customer Segments		market breath	
		broad market	niche market
value proposition	premium value	• Geographical Expansion • Segment Expansion	• Premium Targeting • Social Targeting
	cost-efficiency	• 2-Sided Targeting	• Long-tail Targeting • Low-price Targeting

bifurcated into 'premium', for high-value offerings, and 'cost-efficiency', for cost-effective solutions. By mapping the identified strategies onto this framework, I observe that 'Geographical Expansion' and 'Segment Expansion' fall under the 'broad market and premium' quadrant, as they involve expanding business into new areas based on success in existing segments. The 'broad market and cost-efficiency' encompasses strategies like '2-Sided Targeting' that seek products or services efficiently. Under the 'niche market and premium', 'Premium Targeting' and 'Social Targeting' are well-suited as they focus on offering high-value products to a specialized market segment. Lastly, 'niche market & cost-efficiency' includes 'Long-tail Targeting' and 'Low-price Targeting', tailored to address specific customer segments through cost-efficient means.

Shifting focus to the 'Key Resources' perspective, the categorization pivots

Table 8. Coverage of the Identified Strategies in the Key Resources.

Key Resources		type of resources	
		tangible	intangible
origin of resources	internal	• Recycle	• Brand Leverage
	external	• Outsourcing	• Crowdsourcing • Open source • Alliances

around the 'origin of resources' and the 'type of resource'. The 'origin of resources' is classified into 'internal', where resources are sourced from within the organization, and 'external', where they are obtained from outside entities. The 'type of resource' is delineated into 'tangible', for physical assets, and 'intangible', for non-physical assets like brand equity. Analyzing this categorization, ‘internal and tangible' resources feature strategies such as 'Recycling', which involves reusing waste products or materials to create new products. In the ‘internal and intangible' quadrant, 'Brand Leverage' is prominent, exploiting an existing brand's influence to facilitate entry into related product categories. The 'external and tangible' primarily involves 'Outsourcing', whereby portions of work are transferred to outside suppliers to reduce costs. Lastly, the ‘external and intangible' resources consist of 'Crowdsourcing', employing the public or amateurs for value creation; 'Open Source',

Table 9. Coverage of the Identified Strategies in the Key Activities.

Key Activities		activity focus	
		core process	supportive process
operational scope	internal	• Standardization • Economies-of-Scale	• NO Frill • Self-service
	external	• Added Service • Service Productization	• Peer-to-Peer • Economies-of-Scope

promoting open access to a product's design or modification; and 'Alliances', forming coalitions between two or more companies.

Within the 'Key Activities' perspective, strategies are demarcated based on 'operational scope' and 'activity focus'. The 'operational scope' divides into 'internal' and 'external', while 'activity focus' comprises 'core process' and 'supportive process'. The quadrant of 'internal' and 'core process' entails strategies like 'Standardization' and 'Economies of Scale', which streamline internal core processes for efficiency. Meanwhile, 'core process' coupled with 'external' brings in strategies such as 'Added Service' and 'Service Productization', focusing on externalizing core processes as services or products. For 'internal' and 'supportive process', strategies like 'No Frill' and 'Self Service' are prominent, which simplify and allow self-management of internal supportive activities. Finally, in the 'external' and 'supportive process' quadrant, strategies such as 'Peer to Peer' and 'Economies

Table 10. Coverage of the Identified Strategies in the Key Partnership.

Key Partnerships		purpose of partnerships	
		strategic	operational
duration	Long -term	• Shared Investment • R&D Collaboration	• Joint Distribution
	short -term	• Design Collaboration	• Cross Promotion

of Scope' leverage external resources to create diverse and scalable supportive processes.

Lastly, in the 'Key Partnerships' perspective, strategies are classified by 'purpose of partnerships' and 'duration of partnerships'. The 'purpose of partnerships' is either 'strategic' for achieving strategic direction at the management level, or 'operational' for enhancing efficiency at the practical level. The 'duration of partnerships' differentiates between enduring 'long-term' and temporary 'short-term' partnerships. In the 'strategic and long-term', strategies like 'Shared Investment' and 'R&D Collaboration' involve substantial commitments for strategic goals such as market expansion or technology development. The 'strategic and short-term' mainly includes 'Design Collaboration', representing partnerships for a specific, time-bound strategic purpose. In the 'operational and long-term', 'Joint

Distribution' is key, denoting partnerships established for operational efficiency over time, such as shared logistics. Lastly, ‘operational and short-term' features strategies like 'Cross Promotion', for temporary mutual promotional benefits.

To sum up, by systematically organizing the strategies within each perspective of the Business Model Canvas according to key attributes, I can assess the comprehensiveness of the strategy set. This assessment also facilitates the identification and integration of new strategies as they emerge, owing to the structured framework provided by the Morphological Charts.

3.4 Case Application: Hair Dryer Company

This section illustrates how the morphological chart can be used in actual business modelling. Let us take an example of hair dryer manufacturer who actually used the morphological chart in planning their new business model. This company is one of the largest hair dryer manufacturer in South Korea. However, recent growth of Chinese manufacturers made the company to compete with fierce price competition. Moreover, due to the fairly long life-cycle of hairdryers, there is little potential for generating additional profit from existing customers. Therefore, the company try to develop a new PSS concept in order to differentiate their business model from competitor’s in order to avoid price competition and generate new values for customers.

3.4.1 Current business model

In order to find their new business model, a series of workshops were held where the morphological chart was introduced and intensively used in business modelling

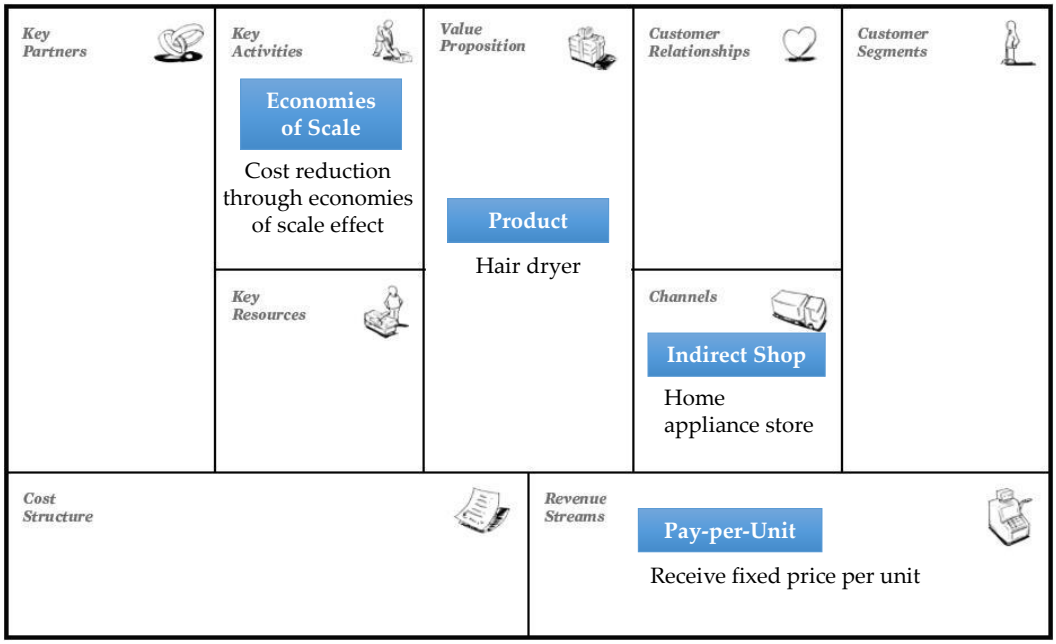


Figure 3. Strategies analysis of current business model.

process (described in Appendix. B). At first, the company's current business model was analyzed with morphological chart. Their major product line has mainly targeted home users. Accordingly, the product has simple function with low price and were distributed through home appliance stores. The combination of strategies of existing business model is shown in Figure 3. As can be seen, the 'sell-per-unit' is chosen as a revenue streams strategy because the firm charges each hair dryer with fixed prices. For the distribution channel perspective, the 'indirect channel' strategy is chosen because they do not operate their own channels. Finally, because they focused on gaining price advantages with large sales volumes, the 'economies of scale' are chosen as their strategies of activity configurations. The remaining perspectives remains empty because no special strategies are identified.

Based on their current business model, all possible strategies for each

perspective are examined in order to find meaningful alternatives. With detail description about each alternative, their representation model is as follows.

3.4.2 Alternative #1: Razor-Blade business model

One limitation of current business model was relatively small size of hair dryer market. Although the company has highest market share in the segment, the sales volume begins to decrease due to fairly long life-cycle and market saturation. Therefore, creating a new sustainable revenue stream was their major concern. In this sense, the 'razor-blade' strategy at revenue model is examined. This strategy aims to separate install-based product and complementary good in order to generate additional profit from complementary goods. Motivated by this strategy, they proposed the idea of ampule-compatible hair dryer. The proposed ampule consists of nutrient which can keeps hair and scalp with healthy state. When the ampule is installed with hair dryer, the nutrient spreads throughout winds generated from the hair dryers. With this strategy, the firm can expect continuous revenue streams by selling ampules to hair-dryer owners.

3.4.3 Alternative #2: Partnership with Chemical Company

Although the first alternative can generate additional revenue streams, the manufacturer has no capability of developing hair-dryer-compatible ampules with their own. One solution to tackle this issue is to develop a partnership with other companies. As a result, one of partnership strategy, the 'design collaboration,' was examined. Accordingly, as a product development partners, the manufacturer can involve famous chemical company which has been famous in hair chemical products.

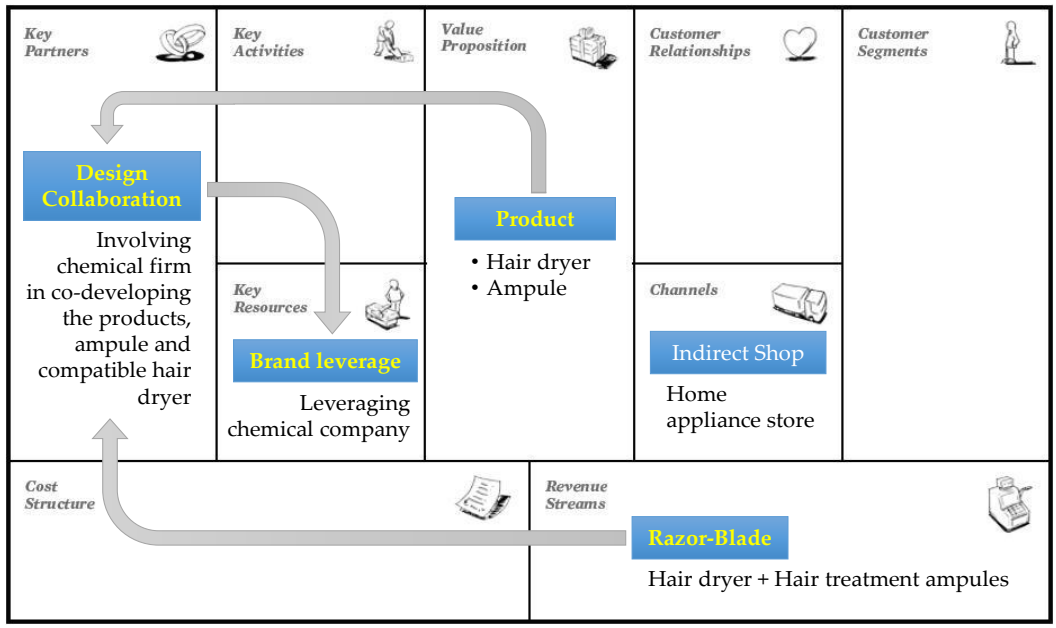


Figure 4. Strategies analysis of the alternative #1 and #2.

Adopting this strategy also can lead to the 'brand leverage' effect than developing the chemical product their own. The chosen business model strategy is described in Figure 4.

3.4.4 Alternative #3: Targeting Professional Markets (B2B)

The third idea was motivated by the 'segment extension' strategy in the customer segmentation perspective. Until now, the manufacturer has only focused on home appliance markets. Instead, ampule-compatible hair dryer may be better used for professional market which consists of hair-shop owners. This idea is more viable because there is little chance that home users continuously use costly the ampules. Furthermore, hair-shops also serve as a good distribution channel for the manufacturer. New customers who are not conscious of the hair dryer and the

ampules would have a good chance to experience the product/services in the hair shop. Therefore, the 'channel sharing' strategy is invoked at distribution channel perspective. Motivated by this strategy, it would be proposed that hair-shops sell the hair dryer and the ampules to customers who shows an interest.

3.4.5 Alternative #4: Developing New Service Packages

In this scenario, the 'added service' strategy at key activities perspective, which servitizes their existing business process, is adopted. That means this business model alternative is motivated with developing a hair-treatment service package which utilizes the ampule-compatible hair dryers. Similar with previous alternatives, the hair-shops become good distribution channels for the product/service provision. In this business model, however, the firm aims to provide more professional service

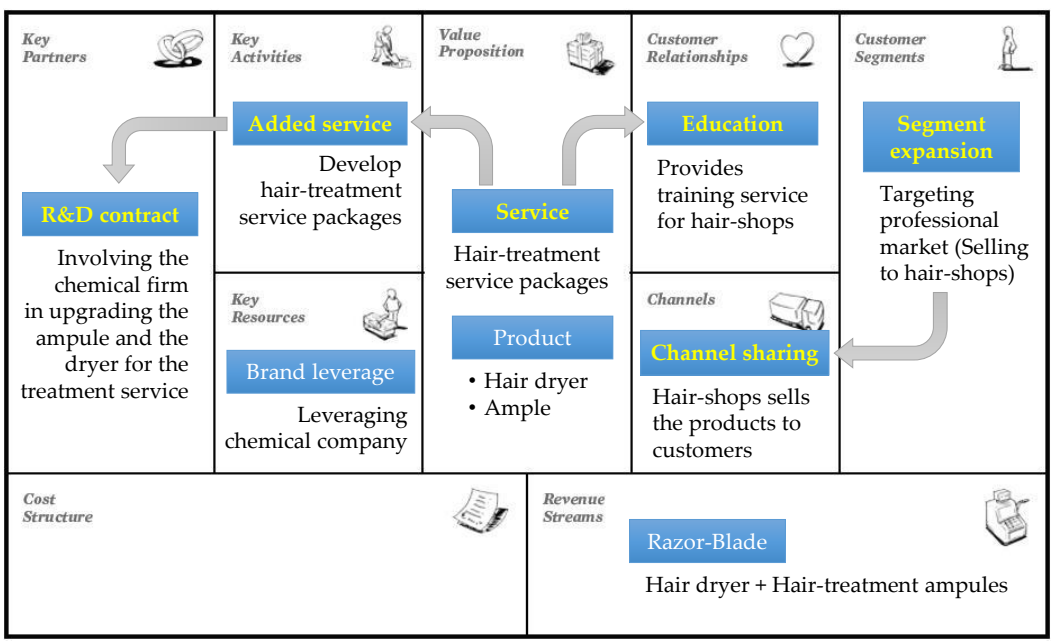


Figure 5. Strategies analysis of the alternative #3 and #4.

packages including diagnosis of scalp and hair and to customize the recipe of ampules for each customer. Furthermore, the 'education' strategy, training the proper use of the product and service, is required in order to offer better professional hair-treatment service. The resulting business model is depicted in Figure 5.

3.4.6 Alternative #5: Productizing the Service Packages

The final alternative is to productize the hair-treatment service, which adopts the 'productization' strategy from the key activities perspective. It aims to develop a product which can automate the service activities performed by humans. Accordingly, a new device for the self-doing the hair-treatment service package, which diagnoses scalp and hair and create a customized care recipe. Moreover, the

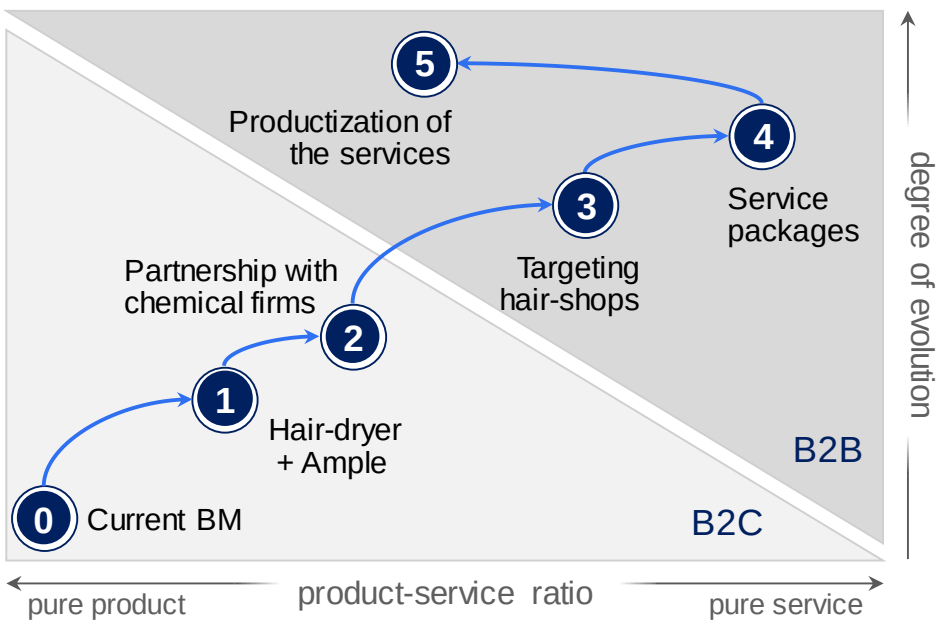


Figure 6. Innovation roadmap of business model alternatives.

'segment extension' strategy, from the professional users to the unprofessional users, is again adopted, because this device is intended for home appliance markets.

Finally wrapping up the business model alternatives above, the business model roadmap which present the innovation path among the business model alternatives is developed (Figure 6). Each business model alternative is mapped along with the degree of servitization, product-service ratio and the time table, degree of business model evolution. Therefore, the firm could have generated a plan when and how to implement each business model.

3.5 BizChef: PSS Business Modelling Support System

In order to facilitate the practical use of the proposed morphological chart, the prototype system, named BizChef, was developed (BizChef). The main objective of this software is to enable a user to explore various business model cases and reuse these cases in generating a new business model ideation. In terms of supporting PSS

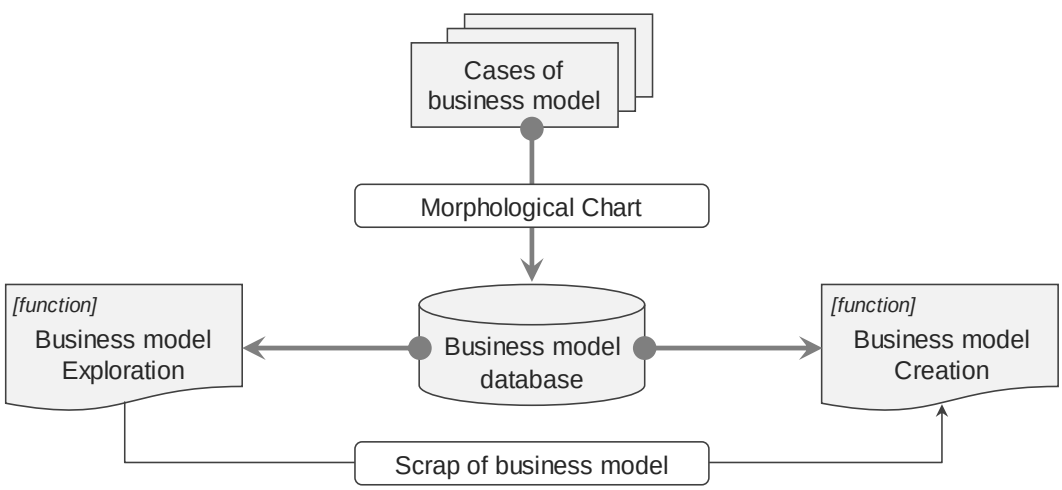
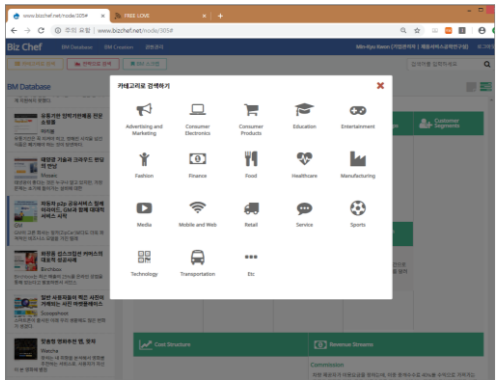


Figure 7. Architecture of the BizChef.

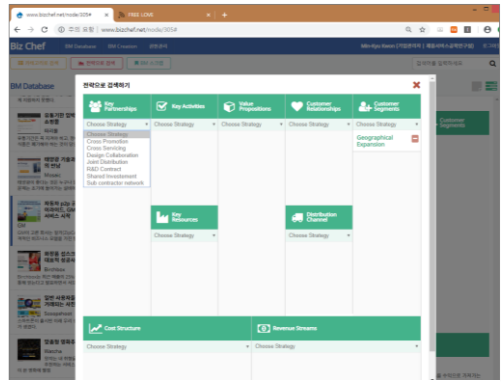
design, a computer-aided design system for PSS have proposed by the literature (Akasaka et al., 2012; Hara et al., 2009; Nemoto et al., 2015). Their system mainly focuses on the detail design of artefact and service process in order to provide a functions that meets the PSS customer requirements. Contrary to this, the system developed as an output of this study focuses on the planning of PSS business models at the strategic level.

The basic architecture of BizChef is illustrated in Figure 7 and it consists of one BM database and two function modules; BM Exploration and BM Creation. In the BM database, real business model cases are analyzed through the morphological chart. Those cases are collected by searching numerous sources including case study article, annual report or website of relevant companies. Each case is then classified according to business model strategies defined over morphological chart. Total 155 business model cases are accumulated in the current version of database. Based on this database, the two functions are provided.

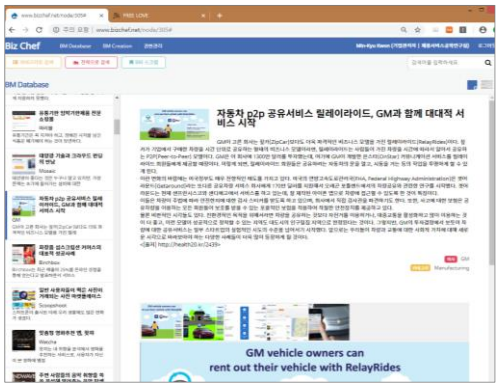
Business model exploration module enables users to search various business model cases. There are two approaches for more efficient search; searching by industry categories (Figure 8a) and searching by the strategies (Figure 8b). If users choose an industry category or a strategy as an input query, a list of relevant business model cases. If users select a specific business model case among the list, detail description and pictures for the case (Figure 8c) as well as the strategies for each perspectives and the reason why each strategy (Figure 8d) is adopted are presented. User can also scrap interested business model cases and strategies (Figure 8e). These scrapped strategies can later be used in creating a new business model.



(a) Innovation cases search by

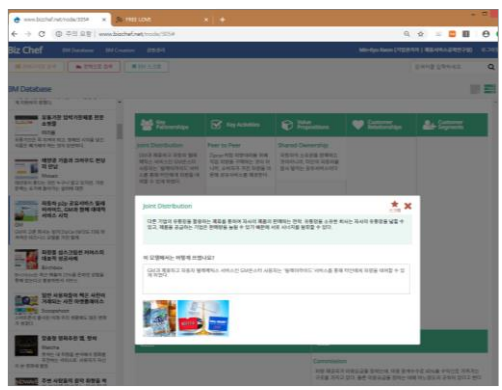


(b) Innovation cases search by strategy



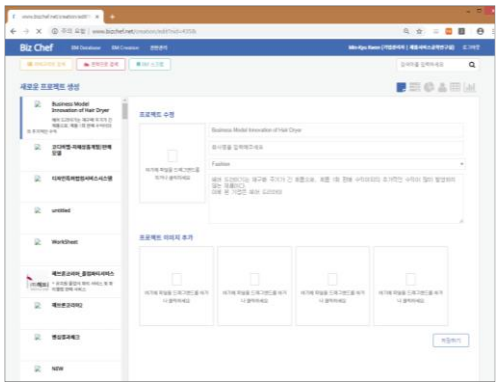
(c) Description of an innovations case

(d) Implemented strategies in a case

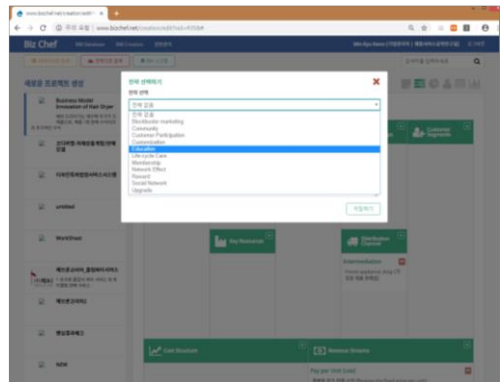


(e) Tagging on a strategy in cases

Figure 8. Screenshots of business model exploration module in BizChef.



(a) Description of creating BM case



(g) Adoption of innovation strategies

Figure 9. Screenshots of business model creation module in BizChef.

Business model creation module enables users to systematically generate and manage their own business models. Figure 8 shows a snapshot of business model creation module; describing details of a business model creation project (Figure 9a) and editing strategies from each perspectives for the project (Figure 9b). In business model creation projects, users can reuse strategies which have been scrapped from the exploration module.

3.6 Summary

Despite of its importance, relatively little attention has been made to business model planning in PSS literature. Present study introduces a procedure for generating various PSS business model ideas. To provide a systematic guideline for business model idea exploration, a morphological analysis was conducted to identify all the possible business modelling ideas. Each idea was derived from in-depth examination of real business model cases. One can enhance ideation process by mixing and

matching pre-defined building blocks. From real case study of hair dryer manufacturer, I have demonstrated the modelling benefit of business modelling using proposed morphological chart. Moreover, a case-based system for supporting business modelling, the BizChef, was introduced. This system consists of database wherein a more than hundreds of real business model cases are analyzed throughout morphological chart. Based on this database, the enables a user to efficiently explore business model cases and use them in actual business modelling process.

There are, however, further research issues to explore. Although I have less than 10 strategies for each perspectives of a business model, examining all the possible combinations of them may not be practical. One way to reduce this number is to find inter-relationship between strategies. For example, if strategies are grouped by their similarity or forbidden combinations of strategies are identified in advance, I can narrow down entire solution spaces more efficiently. Therefore, one of future researches is to find such interaction between strategies. Another issue is development of business mode evaluation method. Currently, I have focused on idea generation process. However, in order to compare numerous potential business model alternatives, an evaluation method for business model is also required. In order to develop this method, identifying a balanced set of evaluation criteria should be examined.

Chapter 4

Business Model Evaluation Methodology using System Dynamics approach

Considering the complex nature of the PSS ecosystem, which consists of product components, service elements, and partners, upfront evaluation of the PSS business model is important for a successful transition to PSS. Therefore, this chapter aims to introduce evaluation templates for assessing the viability of a PSS business model before deployment. Initially, the PSS business model is divided into six modules, and a basic template is defined for each module using the System Dynamics approach. Additionally, advanced templates that reflect the characteristics of different types of PSS are developed. By mixing and matching the evaluation templates, manufacturing companies can easily formulate the evaluation model for a PSS business model. The case applications demonstrate the practical effectiveness and utilization of the proposed evaluation templates.

4.1 Introduction

In recent decades, the manufacturing industry has been navigating a substantial paradigm shift, driven by an intensifying competitive business environment and rapid changes in customer demand (Baines et al., 2009). Neely (2008) argued that approximately 30% of manufacturing companies had adopted servitization by

packaging their products with related services in his 2008 study. Then after 5 years in his 2013 study, the level of servitization had grown to around 50% or even higher in certain sectors including construction and engineering (56.30%), farm machinery (50.88%), heavy electrical equipment (49.25%), and aerospace and defense (49.09%) (Neely, 2013). This progression towards more servitization in manufacturing has been catalyzed by the digital transformation (Coreynen et al., 2017). Moreover, companies in other industries such as software, energy, and publishing are increasingly supplementing their core offerings with additional services (Valtakoski and Witell, 2018; Lütjen et al., 2017; Lexutt, 2019).

However, the journey to successful servitization is not always straightforward. For instance, Hanssem, the leading furniture retailer in South Korea, attempted to penetrate the interior service market in anticipation of IKEA's entry into the South Korean market. However, leveraging its existing core competency, its sales agency network, set back this penetration because of the agency's limited capacity for managing distribution channels and offering interior services. Hanssem later attempted to collaborate with local interior companies directly, but this move resulted in conflicts with its existing sales agencies. Ultimately, by redefining the roles of each stakeholder within its distribution channel and balancing profit among them, Hanssem managed to resolve the conflict and successfully enter the interior market (Lee et al., 2011). This case shows the importance of an effective PSS business model and strategy that is aligned with a company's specific circumstances and core competence for successful servitization (Kindström and Kowalkowski, 2014).

Successful transformation to a PSS business necessitates the establishment of a robust PSS ecosystem through strategic partnerships (Lockett et al., 2011; Kowalkowski et al., 2017). As manufacturing companies broaden their business scope

to adopt PSS (Kowalkowski et al., 2015; Story et al., 2017), they encounter the need for competencies in areas such as service design and delivery, solution selling, continuous service innovation, customer relationship management, and crucially, establishing a service culture and leadership (Oliva and Kallenberg, 2003; Baines & Lightfoot, 2013; Smith et al., 2014). Acquiring these competencies can be time-consuming, which underscores the importance of forming partnerships to expedite this process (Parida et al., 2014). These partnerships, in turn, add complexity to the PSS ecosystem (Adrodegari and Saccani, 2017). This complexity complicates the prediction of PSS transformation outcomes, which further emphasizes the importance of upfront evaluation and refinement of the PSS business model during the design stage (Barquet et al., 2013).

4.2 Research Positioning

By investigating existing literature, I identify the research gap and clearly delineate the contributions that this study intends to make. Consequently, the overarching research content will be summarized.

4.2.1 Research Gap

Although the evaluation of PSS business models is very important, there is little research that systematically investigates methodologies for these evaluations (Mourtzis et al., 2016). Considering the complexity of the PSS ecosystem, which arises from interrelated elements like partners, products, and services (Rosa et al., 2021), an inadequate evaluation can lead to poor decisions in the early stages of PSS design. This could have a nagative effect on profitability or sustainability, with

potentially irreversible consequences (Chen et al., 2015). Qu et al. (2016) showed that only 13.6% of the studies (19 out of 139) focused on PSS evaluation, compared to 54.7% on PSS design (76 studies) and 31.6% on PSS operation (44 studies). Furthermore, current PSS evaluation research mainly deals with qualitative assessments of PSS concepts (Rosa et al., 2021; Lee et al., 2015), PSS evaluation criteria (Biege et al., 2012; Mourtzis et al., 2018), and mathematical analyses of market uncertainty (Chen et al., 2015; Geng and Chu, 2012). These approaches do not adequately offer a comprehensive understanding of how changes in one part of the complex PSS ecosystem can impact the entire system's profitability and sustainability from a business innovation perspective.

System Dynamics offers a comprehensive framework for understanding the behavior of complex systems over time through computer simulation modeling, emphasizing interconnections, feedback loops, and system arrangements. It further facilitates the detection of unexpected side effects, intervention leverage points, and the testing of diverse scenarios in a risk-free environment. Key concepts and elements of the system dynamics include:

- Feedback loops: Interactions between variables within a system, which can be positive or negative to each other.
- Time delays: Time it takes for a certain action to produce a result within the system.
- Stocks variable: Accumulations within the system (state of the system)
- Flows variable: Rates at which these accumulations change (the causal relationships among variables surrounding the flow variables determine the changes in the entire system over time.).
- Parameter: Components that connect various variables.

Following the steps of 1. problem definition, 2. conceptual modeling, 3. mathematical modeling, 4. simulation, and 5. policy design and testing, the use of the system dynamics approach is said to be easy (System Dynamics Society, 2023). However, modeling intricate causal relationships and formulating the mathematical equations for computer simulation is not a straightforward process, even for experienced modelers (Richardson, 1986). Particularly, taking into account the complexity of PSS business models (Rosa et al., 2021), even conceptual modeling is challenging.

4.2.2 Intended Contributions

This research aims to provide a methodology that can be practically utilized by managers of manufacturing companies in evaluating the PSS business models they have devised. Specifically, the study proposes an organized set of evaluation templates to enable efficient simulations for quantitative evaluations, intending to serve as initial building blocks. This is similar to how libraries or packages are pre-built in many computer programming languages for easier use by the programmers.

To achieve this, the Divide-and-Conquer approach is applied within the use of the System Dynamics method. The complex PSS business model and the interactions among its components are divided into smaller, manageable modules, and both conceptual and mathematical modeling are conducted for each module to develop the evaluation template. Initially, the sub-modules and their components are defined according to the business operation mechanisms. Then causal relationships among them are depicted. Besides the basic template, advanced templates are also created to evaluate different and various PSS business models. These advanced templates take into account the varying characteristics of different

PSS types. This approach diversifies the set of building blocks available for practical use. Through referencing and combining these evaluation templates, i.e., building blocks, the initial ambiguity can be significantly reduced. The case application in this research demonstrates the practicality, and effectiveness of the proposed methodology.

4.3 Basic Evaluation Templates for Six Modules

The PSS ecosystem is a complex system characterized by multiple players and interconnected relationships that influence business flow and servitization outcomes. Unlike traditional producer-consumer relationships, the PSS ecosystem involves various participants offering different products and services, forming intricate connections over time. To evaluate this complex ecosystem effectively, a methodology capable of tracking changes and causal relationships among components is necessary. Therefore, this study applies a system dynamics method, which entails drawing causal-loop diagrams (CLDs) and formulating simulation models.

Defining and modeling the intricate relationships within the PSS ecosystem can pose challenges, even for experts. To tackle this complexity and facilitate a more systematic analysis of causal relationships while simplifying the simulation modeling process, this study adopts a Divide-and-Conquer approach.

A four-step process was undertaken (Figure.10). The initial step is to divide the PSS ecosystem into multiple sub-modules, based on the underlying mechanisms that govern how PSS business operates. This division takes into account two key aspects: firstly, essential business processes such as value proposition and creation, value

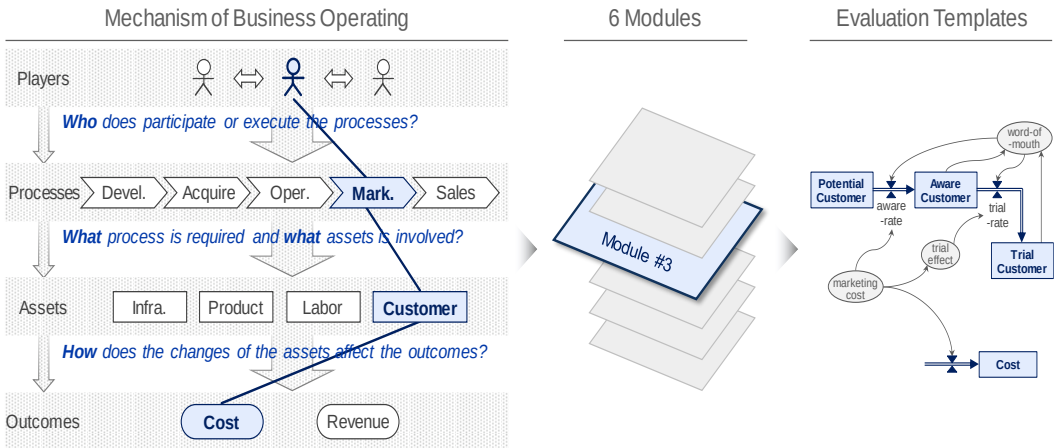


Figure 10. Process to develop the basic evaluation templates.

targeting, value delivery, and value appropriation and capture (Zott and Amit, 2010; Ganzarain et al., 2019); secondly, PSS-specific traits that involve incorporating both product and service elements in the value creation process, as well as accommodating the participation of a diverse range of partners. The second step involves establishing representations for each module by identifying the players involved, outlining the related processes, pinpointing the assets utilized, and documenting the resulting outcomes. As a result, six modules were proposed: Market Creation, Product Sourcing, Channel Establishment, PSS Delivery, Revenue Creation, and Partnership Balancing. In the third step, key variables and parameters are defined based on these representations. The final step consists of establishing links that reflect the causal relationships among these elements, ultimately forming the evaluation template for each sub-module.

The following subsection describes the six modules in detail.

4.3.1 Module #1: Market Creation

The Market Creation module focuses on identifying the target market for the PSS offerings and attracting customers through marketing activities conducted by product producers or service providers. This module encompasses the process of transitioning potential customers into cognitive customers through marketing efforts, incorporating factors such as the "word of mouth effect" and the "marketing effect." Additionally, it considers the "experience effect" that occurs when cognitive customers become trial customers. The marketing cost to induce these effects are added in the total cost.

To effectively model customer behavior in this module, the A-T-A-R model, widely utilized in the marketing field (Crawford and Di Benedetto, 1991), was applied. The A-T-A-R model represents different stages of customer engagement, including Potential Customers within the entire market, Awareness Customers who are aware of the delivering product or service, Trial Customers who are willing to try it, Availability Customers who can make purchases or contracts through established channels, and Repeat Customers who are inclined to reuse the PSS offerings. This concept of the customer behavior is referenced to define the Market Creation module, as well as the Channel Establishment module and the Revenue Creation module of this study.

The evaluation template for the Market Creation module is comprised of several key elements. Firstly, there are stock variables, namely Potential Customer, Aware Customer, and Trial Customer. These represent the system's state by indicating quantities that either accumulate or diminish as time progresses. Secondly, flow variables such as aware-rate and trial-rate play a crucial role. These flow variables directly manage the Stock variables and, through causal relationships with adjacent

values, orchestrate the holistic evolution of the system over time. Lastly, parameters including marketing cost and word-of-mouth come into play, as they exert influence on the fluctuations in the system's variable values. The description of the components and their relationships with other components for the 'Market Creation' module are presented in Table 11, while ones for other modules can be found in Appendix C.

4.3.2 Module #2: Product Sourcing

The Product Sourcing module focuses on securing the necessary inventory of products to provide PSS offerings through procurement or direct production. It involves considering the acquisition process based on the "sourcing policy", and associated cost structure. When acquiring inventory from external sources, it entails the introduction of new or additional purchase criteria, and costs such as "purchase

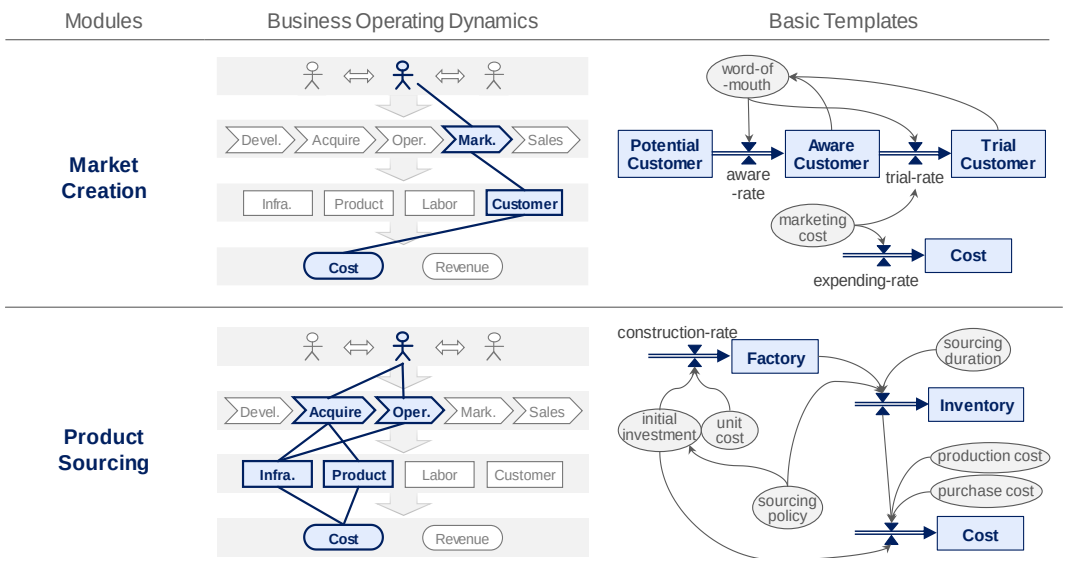


Figure 11. Basic evaluation templates for module #1 and module #2.

cost" and "inventory management cost" are incurred. On the other hand, when opting for direct production, factors like the “initial investment” scale for establishment of production infrastructure (such as factories and warehouse), "production policy", and the resulting "production cost" and "inventory management cost" need to be taken into account.

For the Product Sourcing module, the evaluation template is composed of several principal components. Under the category of stock variables, there are Factory, Inventory, and Cost, which are essential in representing different aspects of the module. Flow variables such as sourcing-rate, construction-rate, and expending-rate are also pivotal in illustrating the dynamics of the system. Finally, key parameters that need to be specified include initial investment and sourcing policy. These parameters play an instrumental role in tailoring the module to specific scenarios and objectives. The basic evaluation templates for Market Creation module (#1) and Product Scouring module (#2) are described in Figure 11.

Table 11. Descriptions of the Components in the 'Market Creation' module'.

Component	Type	Description
Potential Customer	Stock variable	Total size of the market that is considered a target for PSS offerings, regardless of whether or not they are aware of PSS or currently using PSS. - impacted by... - impacting on... aware-rate, Aware Customer
Aware Customer	Stock variable	Size of the customer base that is aware of PSS, and is realistically target for to request the PSS. - impacted by... Potential Customer, aware-rate - impacting on... trial-rate, Trial Customer, word-of-mouth
Trial Customer	Stock variable	Customers who have experienced the PSS offering (included only if there is an additional trial service in the PSS). - impacted by... Aware Customer, trial-rate - impacting on... word-of-mouth

aware-rate	Flow variable	Rate at which "Potential Customer" become aware of the PSS and convert to "Aware Customer". - impacted by... word-of-mouth, marketing cost, Potential Customer - impacting on... Aware Customer
trial-rate	Flow variable	Rate at which "Aware Customer" have a hands-on experience with the PSS and convert to "Trial Customer". - impacted by... word-of-mouth, trial cost, Aware Customer - impacting on... Trial Customer
marketing cost	parameter	Expenses invested initially during the PSS launch phase and periodically throughout the course of PSS provision. - impacted by... - impacting on... aware-rate, trial-rate, delivery-rate, expending-rate, Cost
word-of-mouth	parameter	Marketing effect achieved through communication and information sharing among customers. - impacted by... Aware Customer, Trial Customer, Served Customer - impacting on... aware-rate, trial-rate, delivery-rate

4.3.3 Module #3: Channel Establishment

The Channel Establishment module focuses on securing and operating stores to meet customer demand in the field. The number of channels directly impacts customer exposure and experience, which is referred to as the "experience effect" mentioned in the Market Creation module, thereby influencing the rate of trial customer growth. However, expanding these channels results in increased "initial investment" costs for establishing the service channels as well as "operating costs", such as expenses related to "labor cost" for service staff and rent for them. Consequently, it becomes imperative to carefully consider the optimal size of the service channels to strike a balance between customer reach and operational efficiency.

In the Channel Establishment module, the evaluation template consists of

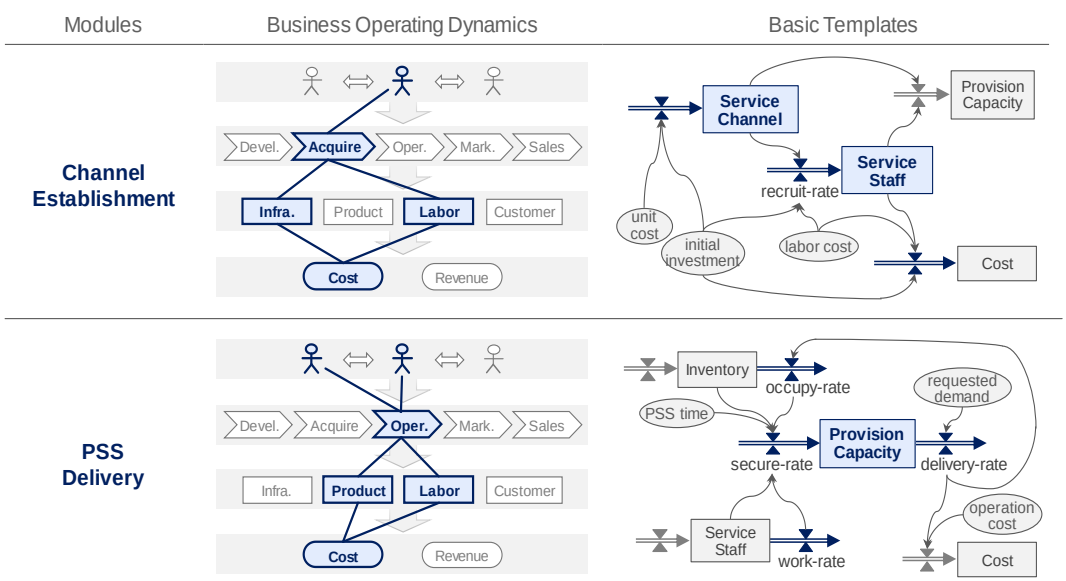


Figure 12. Basic evaluation templates for module #3 and module #4.

various critical elements. Among the stock variables, Service Channel and Service Staff stand out as core components. In terms of flow variables, establishment-rate, recruit-rate, and expending-rate are included, depicting the dynamics and flow within the system. To round out the template, essential parameters such as initial investment and labor cost must be detailed. These elements work together to form a comprehensive picture of the Channel Establishment module. The basic evaluation templates for Channel Establishment module (#3) and PSS Delivery module (#4) are described in Figure 12.

4.3.4 Module #4: PSS Delivery

The PSS Delivery module plays a pivotal role in providing PSS to customers by efficiently utilizing the product inventory operated by the service staff within the Channels. This module establishes a causal relationship with the three previously discussed modules: The Market Creation module, Product Sourcing module, and Channel Establishment module. To deliver PSS in accordance with customer demand as expressed in the Market Creation module, it is crucial to have an adequate stock of necessary products acquired through the Product Sourcing module, and the service staff derived from the Channel Establishment module must be available for deployment. However, expanding the PSS provision capacity results in an escalation of several costs mentioned earlier, including initial investment costs, labor costs, rent, production costs, purchase costs, inventory management costs, and taxes. As a result, the overall cost per unit of service increases when combined with the "offering cost" and "operation cost" associated with PSS provisioning. It is essential to carefully consider these cost implications, as they directly impact the financial feasibility and profitability of delivering PSS offerings to customers.

For Module #4, the PSS Delivery Module, the evaluation template is composed of key elements. The stock variable is streamlined to Provision Capacity alone, but it remains closely interlinked with other stock variables such as Inventory and Service Staff from other modules. Flow variables, including secure-rate, delivery-rate, occupy-rate, and work-rate, capture the dynamic changes in Provision Capacity. Furthermore, the template incorporates critical parameters such as PSS time, operation cost, and requested demand, which play a pivotal role in refining and characterizing the module.

4.3.5 Module #5: Revenue Creation

The Revenue Creation module encompasses the operational aspects of service provision and revenue generation. It takes into account various factors, including the "provision capacity" of the service provider, "market demand", and "service pricing". While "marketing activities" by the companies and "word-of-mouth" by customers create demand, it is crucial to assess the “provision capacity”, the service provider's product inventory and available service staff, to ensure effective service delivery. This module plays a vital role in formulating the overall profit structure by considering elements such as service pricing, its impact on market demand, and the timing and duration of sales generated.

The evaluation template for the Revenue Creation module is built around vital elements. Served Customer and Revenue are the stock variables, accounting for the accumulative facets of the module. To depict the dynamics and flows, variables like delivery-rate and earning-rate are used. Additionally, price and requested demand are among the crucial parameters integrated into the template, playing a central role in fine-tuning and guiding the process of revenue creation. Figure 13 describe

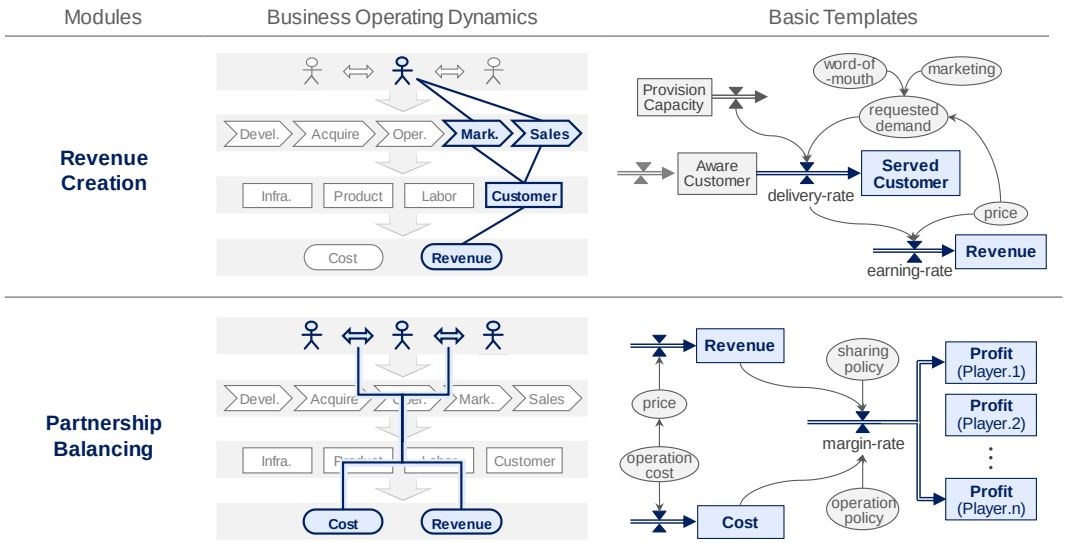


Figure 13. Basic evaluation templates for module #5 and module #6.

the basic evaluation templates for Revenue Creation module (#5) and Partnership Balancing module (#6).

4.3.6 Module #6: Partnership Balancing \

The Partnership Balancing module focuses on the process of effectively distributing costs and profits among the various partners within the PSS Ecosystem. Establishing partnerships with specialized companies becomes essential to enhance expertise in areas that traditional manufacturers may lack, such as service planning, marketing, service channels, personnel operations, service delivery, and customer relationship management. In this module, it is necessary to discuss the 'operation and sharing policy' to determine how partners will jointly bear the costs incurred during these activities (e.g., initial investment cost, marketing cost, labor cost, operating cost, and cost of providing PSS). Additionally, the division of revenue

generated from PSS (e.g., PSS delivery revenue, product sales revenue, separate service provision revenue) needs to be addressed. Various approaches for the 'operation and sharing policy' can be considered, such as compensating participating companies for their specific activities while the host company retains all the final PSS sales, or jointly bearing the costs of each activity and sharing the revenue from final PSS sales among all participating companies.

In the Partnership Balancing module, the evaluation template is framed around essential elements. Stock variables such as Revenue, Cost, and Profit are integral in assessing the module's accumulative attributes. Additionally, balance-rate serves as the flow variable, monitoring the dynamic balance adjustments. The template further includes parameters like sharing policy and operating policy, which are indicative representations requiring further concretization for practical evaluation.

4.4 Advanced Templates reflecting PSS types

In this section, I discuss advanced evaluation templates designed to adeptly integrate the unique characteristics of various PSS types within the framework of the basic templates established earlier. It's crucial to recognize that all of PSS are not homogeneous, and their business structures can vary considerably. Aspects such as customer clusters, product ownership, and payment mechanisms differ among PSS, naturally giving rise to diverse business structures. Therefore, to accurately present and assess the multiplicity of PSS, the basic templates need adjustments and fine-tuning to align with the specific attributes of each PSS type. Among the PSS classifications available, Tukker's classification is particularly noteworthy and widely accepted (Barquet et al., 2013). It categorizes the PSS into product-oriented PSS, use-oriented PSS, and results-oriented PSS, based on the emphasis placed on

product and service elements.

4.4.1 Advanced Templates reflecting Product-oriented PSS

The Product-oriented PSS holds significant importance as it centers around the product itself. The key distinguishing factor of this PSS type, setting it apart from the others, is the transfer of product ownership to the customer. At the time of product purchase, customers have the option to establish a contract that includes service provisions or engage in separate contracts solely for services related to the product when they need later, while retaining ownership and usage rights exclusively for the product.

In essence, the characteristics of Product-oriented PSS is summarized as follows:

- Ownership of the product rests with the customer.
- Service providers are not required to maintain their own inventory of products. Instead, their focus is primarily on providing services for products that customers already own.
- The numbers of occupied and available service staff members need to be managed, as the service cannot be delivered without the service staff.
- Service staff members will be available for the another service cases only after completing the current service delivery.
- The service provider may differ from the product seller since separate contracts can be established for service provision.
- Revenue is derived from two sources: product sales and service provision, reflecting the dual nature of the PSS offering within this type.

These characteristics highlight the unique business perspective of Product-

oriented PSS, emphasizing the integration of product ownership and service provisions.

The basic evaluation templates of three modules such as the Market Creation, PSS Delivery, and Revenue Creation need to be modified considering the characteristics of Product-oriented PSS. The Market Creation module requires enhancements through Advanced Evaluation Templates, which include stock variables such as Purchased Customer, Requested Customer, and Served Customer. Corresponding flow variables like purchase-rate, request-rate, and service-rate should be incorporated. Additionally, parameters such as usage pattern and satisfaction are integrated to influence these variables. As for the PSS Delivery module, the addition of a stock variable named Staff in-Service is essential to represent service personnel actively providing PSS. This is accompanied by the introduction of flow variables - service-rate and return-rate, representing the deployment and return of service staff. A parameter named delivery time is also included to represent the time taken for PSS delivery. The Revenue Creation module, the last module in need of modification, captures two revenue streams, including product sales and service provision. The stock variable remains labeled as Revenue, while flow variables are expanded to include service-rate and purchase-rate. Parameters such as service price and product price are also incorporated to facilitate these changes.

The Advanced Evaluation Templates for the modified Market Creation module, PSS Delivery module, and Revenue Creation module reflecting the characteristics of Product-oriented PSS are depicted in Figure 14.

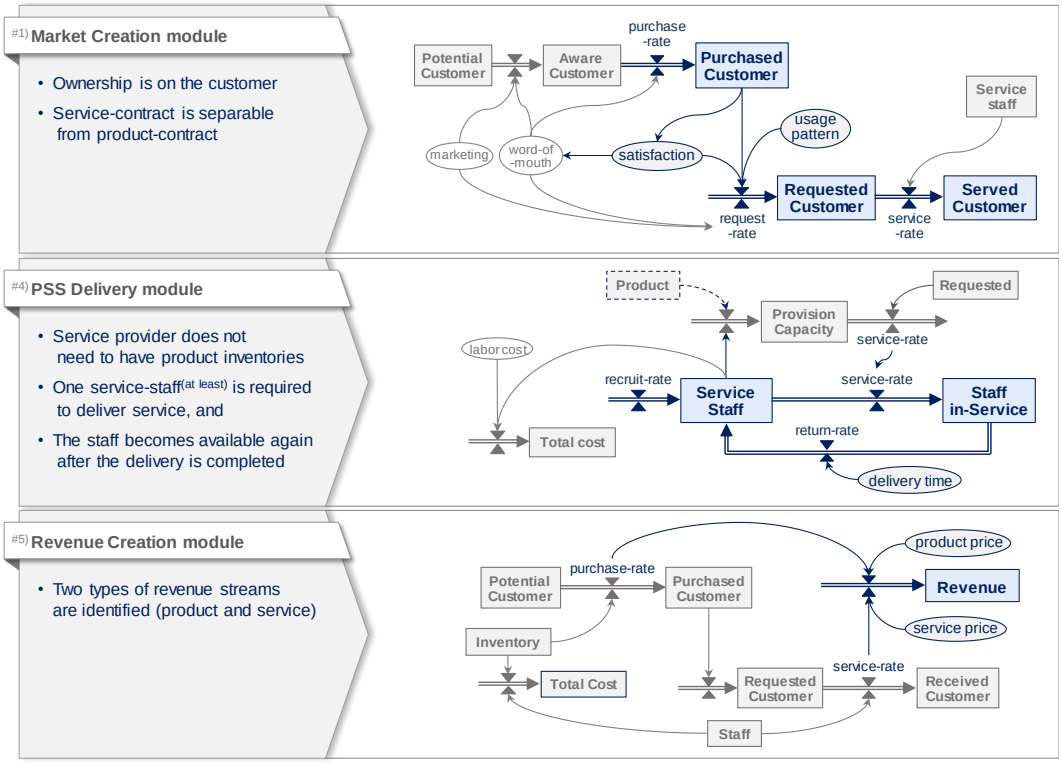


Figure 14. Key characteristics and advanced evaluation templates for product-oriented PSS

4.4.2 Advanced Templates reflecting Use-oriented PSS

In the Use-oriented PSS, the service provider owns the product and the customer signs a contract for the usage rights of the product. This necessitates the service provider to maintain sufficient product inventory in the service channel as well as manage and maintain the products for stable service provision. And the customer is required to pay the service price to occupy and utilize the product.

The main characteristics of Use-oriented PSS include:

- Ownership of the product belongs to the service provider.
- The service provision depends on product availability within the service channel.
- Acquisition, management, and maintenance of the product inventory within service channels are the responsibilities of the service provider.
- The customer can utilize the product multiple times within the agreed-upon terms.
- At the end of the contracted period, the customer is required to return the used products to the service channel.
- The price of the service is influenced by the cost of acquiring or purchasing the products.

In this type of PSS, product leasing, rental, sharing, and pooling are included. With leasing, the lessee pays a regular fee for unlimited and exclusive use of the product. In rental services, customers have sole use of the product for a limited period. Sharing solutions involve sequential use of the product by different customers, while product pooling allows simultaneous use by multiple customers.

The modules that need adaptation are the Product Sourcing module, Market Creation module, Partnership Balancing module, and Channel Establishment module, when considering the characteristics of Use-oriented PSS. For the Product Sourcing module, the Advanced Evaluation Templates have been extended to include a stock variable named Product in-Service, essential for managing the inventory of products held for PSS provision. Along with this, a flow variable called return-rate, accounting for products being returned after use, and a parameter called occupation time representing the duration a customer owns and uses the product, have been added. In the Market Creation module, it has been enhanced by including

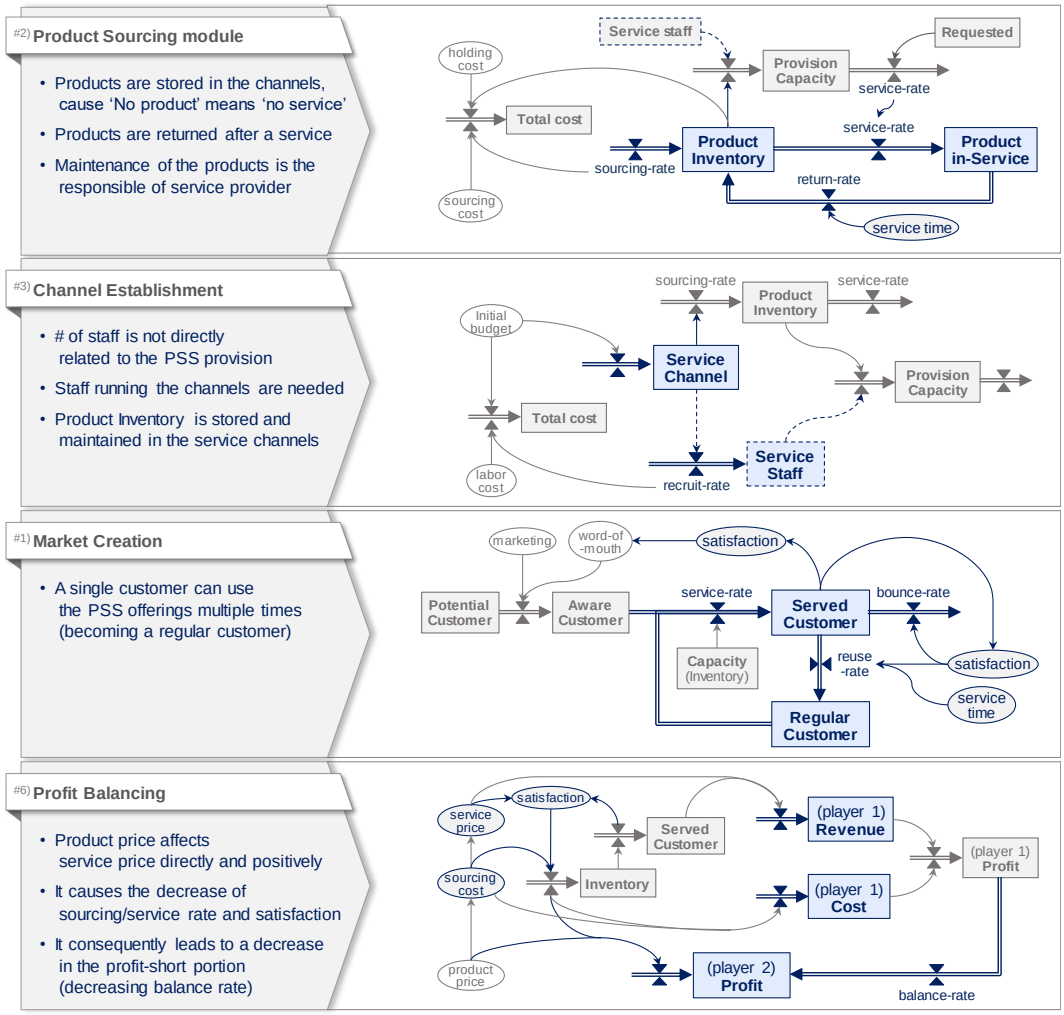


Figure 15. Key characteristics and advanced evaluation templates for use-oriented PSS

a stock variable called Regular Customer due to the attribute that a single customer can utilize the PSS multiple times. Additionally, flow variables such as reuse-rate representing customers reutilizing PSS and bounce-rate accounting for customers not reusing and deviating from the service, have been integrated. While there is no significant alteration in the components of the Channel Establishment module, it's

highlighted that it may not be necessary to consider the value of the Service Staff stock variable depending on the PSS offering. Lastly, reflecting the fact that different participants can be responsible for products and services, Profit has been segregated into a stock variable for each participant. Also, it is crucial to contemplate the relationship with parameters like sourcing cost, service price, and satisfaction that can influence the PSS request-rate of customers and, eventually, the balance-rate flow variable.

Figure 15 describe the Advanced Evaluation Templates reflecting the characteristics of Use-oriented PSS.

4.5 Case applications: Wheelchair manufacturer

This section exhibits the practical application of the evaluation templates developed in this study, highlighting their use in evaluating real-world PSS business model.

The case company manufactures and sells customized wheelchairs for children with cerebral palsy. Given their complex bodily function disorders such as balance disorders and systemic stiffness, these children require wheelchairs customized to their personal physical conditions and symptoms. However, as they grow and their symptoms progress, their wheelchairs need continual adjustments. And this often leads to a significant financial burden due to the necessity of purchasing new wheelchairs. To address this issue, the company offers a 'wheelchair re-adjustment service'. They modify the size and stability mechanisms of the child's current wheelchair to ensure its continued usability. This proposed PSS business model aims to provide both cost-effectiveness and user convenience for customers.

4.5.1 Analysis of the 'wheelchair re-adjustment service'

In order to evaluate each company's provisional PSS business model, a series of workshops was employed. Initially, the evaluation methodology was introduced and the companies' potential PSS offerings and main business strategies were discussed in the context of the six-module framework. Subsequently, I identified and summarized the key participants, influencing factors, as well as decision factors that build their PSS ecosystems, which is a vital step to formulate the simulation model using this evaluation methodology. The most appropriate templates were then selected for each module, and variables, parameters and links necessary for simulation were determined based on the previously summarized participants, factors and their relationships. Finally, assumptions and values for each variable and parameter necessary for running the evaluation simulation model were identified through intensive discussions.

The PSS business model is to readjusts wheelchairs to extend their lifecycle for customers who previously purchased them. The primary service targets are a subset of its existing customers who have re-adjustment needs, so the existing sales channels and personnel are leveraged to strengthen customer relationships and identify potential PSS needs. Furthermore, factory workers, traditionally involved in producing new customized wheelchairs, are also tasked with the re-adjustment work for PSS. This means no additional participants are added to the PSS ecosystem since the company utilizes its own existing resources, such as channels, factories, and personnel. However, coordination in scheduling between the creation of new wheelchairs for product sales and the re-adjustment of customers' wheelchairs for PSS is necessary, as both processes rely on the same company resources.

The analysis of its PSS business model, in the context of the six modules defined

in this study, yields the following characteristics:

- Market Creation: A subset of existing customers who own wheelchairs and require re-adjustment.
- Product Sourcing: Wheelchairs that customers have already purchased and own.
- Channel Establishment: Existing sales channels and personnel of the company.
- PSS Delivery: Existing factory and personnel who have previously designed and produced new customized wheelchairs.
- Revenue Creation: Two revenue streams, one from new wheelchair sales and the other from the re-adjustment services (PSS business model).
- Partnership Balancing: No need for additional company participation in the PSS ecosystem.

4.5.2 Evaluation of the 'wheelchair re-adjustment service'

Based on the aforementioned analysis, the advanced evaluation templates for the product-oriented PSS type were adapted to most of modules. However, the basic evaluation template was applied for the 'Product Sourcing' module since there is no need for internal management of product inventory for PSS provision. Additionally, the 'Partnership Balancing' module was not considered because no additional participants were involved, and the stock variables such as revenue, cost, and profit of the company were formulated. The entire simulation model, which was constructed using the proposed templates, is depicted in Figure 16.

One of the important flows, where requested customers receive the PSS and

become the 'Received Customers', is described as follows. Customers were initially divided into two groups: those purchasing new wheelchairs and those needing re-adjustment of their existing wheelchairs. Within the first group ('Purchased Customers'), customers whose product lifecycle had expired were modeled to transition to the re-adjustment requesting customers ('Request Customers'). The PSS 'request rate' was modeled to increase with the customers' 'satisfaction' for the products and the 'marketing effect' as well as the sizes of sales channels and personnel. Moreover, PSS 'Request Customers' could only transition to become PSS 'Received Customers' when there was sufficient PSS provision capacity, which meant having available employees capable of executing wheelchair readjustment work. The

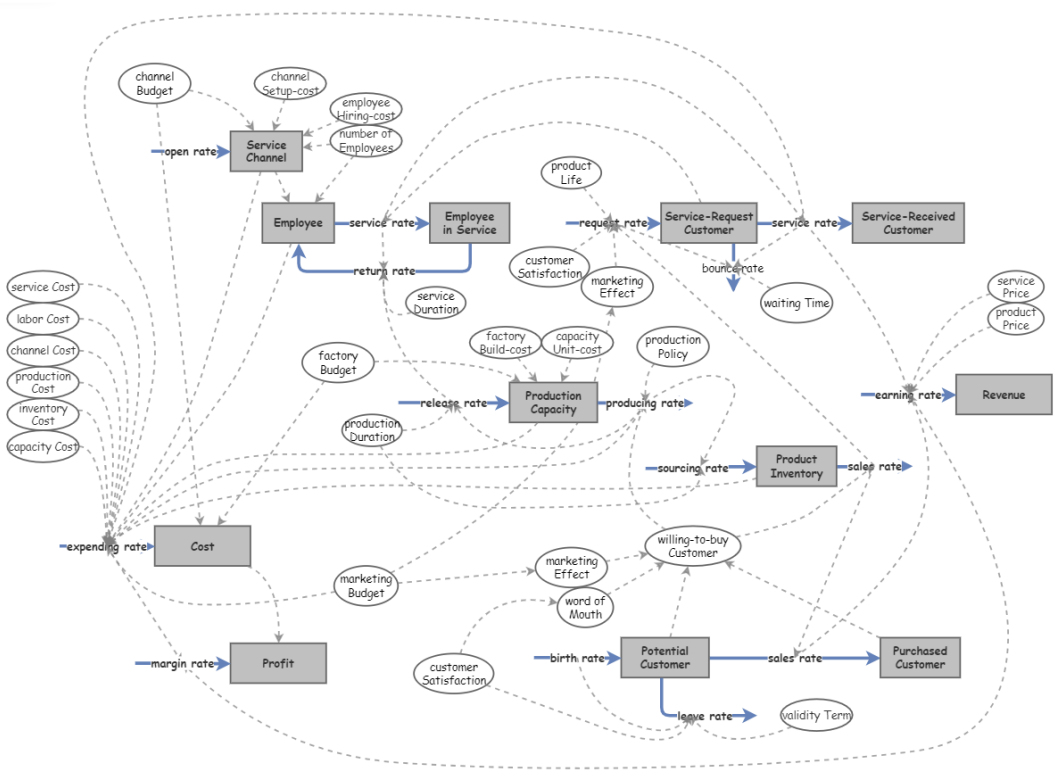


Figure 16. Simulation model for the 'wheelchair re-adjustment service'.

PSS provision capacity was influenced not by 'Product Inventory', but solely by the availability of 'Employees'. Each employee was modeled to return to an available status after the 'service duration' had passed, representing a flow from 'Employee in-Service' to 'Employee'. However, since new product sales also necessitated customization by the same worker, the PSS provision capacity was decreased in line with the new product 'producing rate'. When both new product production and PSS re-adjustment requests arose concurrently, the priority for the new production was set higher considering the potential lock-in effect this could have for future PSS. The set of simulation equations representing this flow is precisely defined in Table 12, and the rest of equations is presented in Appendix. D.

The system dynamics model of the 'wheelchair re-adjustment service' for evaluating profitability was simulated. The simulation was conducted using Insight Maker, a tool for modeling and simulation. Insight Maker is a free, open-source tool developed with web-based technologies and supports graphical model construction through the use of multiple paradigms (Fortmann-Roe, 2014).

As depicted in Figure 17, the results are organized into changes of three types of key variables. Observing the changes in the key variables associated with profitability (a), the business endures losses owing to the initial investment costs despite generating revenue, until it reaches profitability in the 92nd week. In a scenario where the simulation model was adjusted to reduce the initial investment costs under the assumption that existing infrastructures such as service channels and production factories were utilized more actively, the time frame for reaching profitability was shortened. The second set of results (b) shows the changes in the 'Request Customers' and the 'Employee in-Service'. While the changes in the 'Request Customers' are generally followed by changes in the 'Employee in-Service', there are certain points at which the number of the 'Employee in-Service' is higher.

This is attributed to the production of new products or the provision of service for accumulated unprocessed requests. The final result (c) illustrates the changes in flow variables such as sales-rate, request-rate, and service-rate. Given that a certain period is required for the purchased wheelchair to become too small for the child, the request-rate first emerges at week 84, and the service-rate commences from week 87 in Figure 17 (c). The pattern seems stable, with the service-rate following the request-rate and generally remaining lower than the others. The observed pattern displays a cyclical sequence of highs and lows, primarily due to the fixed the PSS 'service Duration' set at three weeks and 'Employee' count of 25. The 'Employees' are assigned to PSS service delivery simultaneously, which leads to highs in the 'service rate'. However, new PSS service deliveries cannot be initiated during their service provision, resulting in lows in the 'service rate' and a noticeable increase in the 'request rate'. This pattern seems to repeat cyclically, correlated with the PSS 'service Duration'.

Table 12. Equations used in the process of converting 'Request Customer' to 'Received Customer' (partial excerpt).

Components	Variables	Equations
Request Customer	Stock	∑([request rate]-[service rate]-[bounce rate])
Received Customer	Stock	∑([service rate])
Employee	Stock	[Service Channel]*[number of Employees] + ∑([return rate]-[occupation rate])
Employee in-Service	Stock	∑([occupation rate]-[return rate])

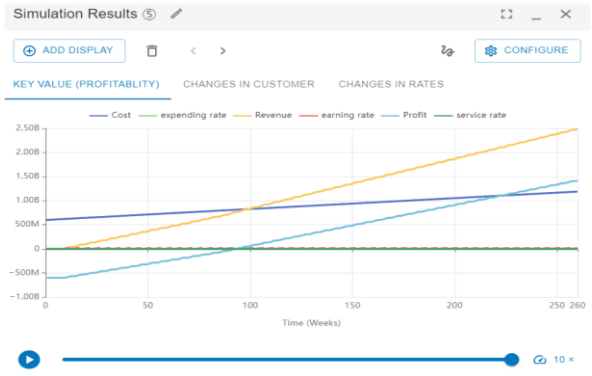
request rate	Flow	If time( ) < [product Life] Then
		0
		Else
		[sales rate]{time( )-[product Life]}*[customer Satisfaction]*(1+[marketing Effect])
		End If

service rate	Flow	If time( ) = 0 Then
		0
		Else
		Min([Employee], [Service-Request Customer]{time( )-1})
		End If

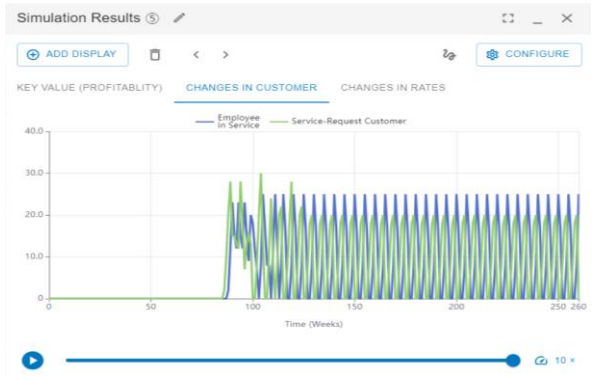
occupation rate	Flow	∑([service rate]+[producing rate])

return rate	Flow	If time( ) < Min([production Duration], [service Duration]) Then
		0
		Else
		[service rate]{time( )-[service Duration]+2} + [release rate]
		End If

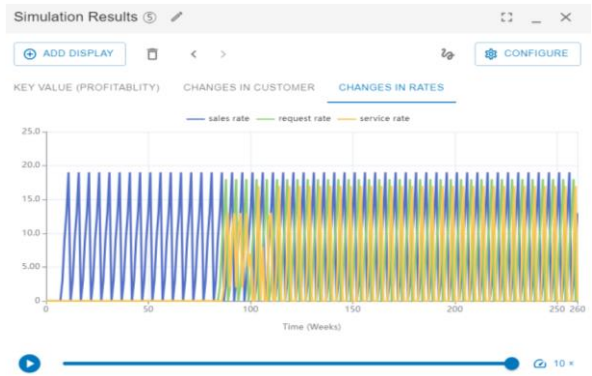
release rate	Flow	If time( ) < [production Duration] Then
		0
		Else
		[producing rate]{time( )-[production Duration]+2}
		End If



(a) Changes in key variables associated with profitability.



(b) Changes in 'Request Customers' and 'Employee in-Service'.



(c) changes in sales-rate, request-rate, and service-rate (flow variables).

Figure 17. Results of the simulation.

4.6 Summary

While upfront evaluation is critical for successful business innovation, the PSS literature has seen a paucity of studies focusing on business model evaluation. Addressing the research gap, this research develops PSS business model evaluation templates encompassing both a basic template and an advanced template. The basic template is composed of six modules, each explicitly defined based on the components and mechanisms of a PSS business, while the advanced template is customized to reflect the characteristics of different types of PSS. Manufacturing companies planning a PSS transformation can systematically and efficiently assess the viability of their PSS business model prior to deployment by combining and customizing the developed PSS business model evaluation templates. The case application demonstrates the practical effectiveness and practicality of the proposed evaluation templates. By utilizing the basic and advanced templates according to their desired PSS business model, manufacturing companies can make informed decisions, allocate resources effectively, and adapt to the changes brought about by PSS transformation. Ultimately, leveraging the evaluation templates can help manufacturers succeed in the dynamic and competitive market environment.

In further research, two research directions will be explored to enhance the practical applicability of the PSS business model evaluation methodology presented in this research. Firstly, a diversification of perspectives in template development is planned. Since the advanced templates in this research are solely based on the characteristics of the PSS types, engaging in several workshops was necessary to model the distinct characteristics of companies' planned PSS offerings or business strategies. Consequently, by refining the templates through the lenses of the 30 PSS

offerings (Gaiardelli et al., 2014) or 55 PSS business model strategies (Kwon et al., 2019), it will be possible to not only reduce time and effort but also significantly improve the ease of practical application.

The second research direction is to develop a methodology that evaluates feasibility from the standpoint of PSS delivery and operations within individual PSS channels. While the current study predominantly targets the evaluation of the PSS Business model's viability through broader structural perspectives like the PSS ecosystem, it is constrained in capturing the specific details of individual operational settings. Consequently, an evaluation methodology that considers the circumstances of individual PSS channels, including factors such as delivery capabilities and constraints, demand dynamics, and their service scenarios, is necessary. Furthermore, the integration of this operational approach with the structural evaluation methodology presented in this study will promise to yield a more comprehensive and systematic framework for PSS business model evaluation.

Chapter 5

Conclusions and Future Works

The thesis proposed the Product-Service Systems (PSS) development framework from the perspective of business innovation. This chapter summarizes the conclusions of this thesis, revealing contributions of the methodologies, and thoughtfully discusses its potential future research directions.

5.1 Summary of Conclusions

In this research, methodologies for the development of PSS have been developed, with a particular emphasis on business innovation. The successful transformation towards a PSS involves a wide array of challenges, such as understanding market and customer needs, generating innovative customer value and PSS offerings, business modelling, managing internal and external changes, and building expertise. Among these challenges, business innovation is especially critical as it is a key factor in ensuring the sustainability of PSS by providing a broad range of differentiations in delivering value to customers and in generating revenue with the same products and services. Furthermore, since PSS involves a multitude of stakeholders, executing significant changes or innovations during operations can be highly complicated. In this regards, it is crucial to carefully design the PSS business model and assess its

feasibility during the development phase, before proceeding with the implementation phase.

The first contribution of this thesis is the proposal of a structured business modelling methodology tailored for PSS. It effectively employs morphological analysis and develops a 'Morphological chart'. This equips manufacturing companies with the flexibility and creativity needed to design innovative business models by referring to business strategies, which serve as building blocks in the chart, and combining them in various ways. This approach is not only theoretical but also grounded in practicality, as the business strategies are collected from real-world PSS cases. Furthermore, the study demonstrates the practical implications of the methodology through a case study, underscoring its capacity to generate a range of business model alternatives.

As the building blocks of the Morphological chart, another contribution is that various business innovation practices and strategies have been investigated and curated. Through rigorous literature review and case study analysis, the study compiles and synthesizes a wide range of patterns and possibilities relevant to PSS business models. This collective knowledge serves as a resourceful toolkit for practitioners and researchers, offering insights into potential strategies that can be adapted and integrated into future business model innovations. In addition, the web-based system, named 'BizChef', enhances accessibility, allowing users to efficiently navigate various business model cases. This enables the research as an instrumental guide in PSS proposition.

The final contribution of this thesis is the development of pre-structured evaluation templates using the System Dynamics approach, which considerably streamlines the evaluation of PSS business models. System Dynamics, as the adopted approach, is effective at representing complex systems and intricate causal

relationships therein. By dividing the PSS business model into six manageable modules, this study introduces basic and advanced templates that can be efficiently adapted to different types of PSS. Notably, the advanced templates are designed to reflect the unique attributes of various PSS types, adding flexibility and diversity to the analysis. This methodology allows manufacturing companies to efficiently establish the architecture for evaluation modeling, consequently enabling well-informed decision-making in the preliminary stages of PSS development and enhancing the likelihood of a successful transition to PSS.

5.2 Limitations and Further Research Directions

To advance this study, there are two major directions for further research: strengthening the continuous applicability through ensuring diversity, and reinforcing the validation of the effectiveness of the developed methodologies.

Expanding the scope of the research presents the first promising direction for further investigation. Specifically, this expansion can be articulated through three detailed aspects. the first aspect is to extend the research domain from PSS Development to PSS Operations. As PSS Development primarily focuses on evaluating business viability, it has limitations in analyzing the performance of individual service channels. Developing a methodology that models and analyze the specific circumstances of service channels and PSS delivery methods can support the evaluation of the operational feasibility and sustainability of each service channel. The second aspect is to vary the evaluation templates in order to enhance their practical utility. For instance, creating evaluation templates tailored to specific business strategies within the Morphological Chart, or developing templates based on the types of PSS offerings, could facilitate more efficient and relevant analysis.

The last one is to prescribe the inter-relationships among the building blocks within the Morphological Chart. This could significantly reduce the number of potential combinations of building blocks, resulting in a more efficient use of the chart and enabling more realistic business modeling.

Secondly, the proposed methodologies should be further validated. Although the thesis demonstrates the methodologies' applicability through case studies, this does not guarantee improvements such as time efficiency or diversity of outcomes in PSS development. In practice, multiple workshops were required for the case applications, which implies the effectiveness of the methodologies might be fluctuated according to the engagement and the proficiency of participants. Therefore, further research should aim to substantiate the efficacy of the methodologies through more quantitative analyses. For example, one could compare the time spent and diversity of outcomes in PSS development between groups that are aware of the methodologies and those that are not. Moreover, sensitivity analyses could be employed to evaluate changes in the viability of business models in response to variations in configuration settings. Such quantitative analyses will be instrumental in affirming the robustness and reliability of the methodologies presented in this thesis.

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Appendix. A

Investigated business innovation cases and the identified business strategies

This appendix shows the 127 real business innovation cases investigated in the 'Business Modelling Methodology using Morphological Analysis' along with their sources, and the business innovation strategies derived from the analysis. The cases were searched using keywords such as business innovation, new service, startup, venture, and ideas for innovation. The primary distinguishing points were extracted for each case, and then organized considering the perspectives of the Business Model Canvas.

Table 13. Investigated business innovation cases and Identified strategies.

No	Company	Innovative business	Sources	Identified strategies
1	2Spaghi	QR코드를 활용한	https://www.xtmotion.co.uk/best-	Added Service Crowdsourcing

		레스토랑 가이드북	example-of-a-qr-code/	Internet (mobile)	Product Servitization
2	8020 Media	고객참여 온라인 매거진	https://dbr.donga.com/article/view/1202/article_no/1926/ac/magazine	Customer Participation Community Crowdsourcing	Product Pay per Unit (use)
3	Adidas	달리기 용품 전문 매장 운영	https://www.trendhunter.com/trends/adidas-runbase	Education Pay per Unit (use) Niche Targeting	Product Service
4	Adobe Systems	문서 보기/수정 소프트웨어	https://www.forbes.com/sites/petercohan/2011/12/07/adobe-executives-tutorial-on-freemium-pricing/?sh=69d74842535e https://headchannel.co.uk/blog/trends-in-business-freemium/	Freemium Network Effect Product	
5	Afreeca TV	개인 인터넷 방송국	http://weekly.chosun.com/news/articleView.html?idxno=5428 https://zdnet.co.kr/view/?no=20150724145750	Service Platform Reward	Crowdsourcing Peer to Peer

6	Adzookie	주택을 이용한 광고	https://money.cnn.com/2011/04/05/technology/adzookie/index.htm https://techland.time.com/2011/04/06/adzookie-will-pay-your-mortgage-in-exchange-for-your-self-respect-home/	Commission 2-sided Targeting	Service Matching Platform
7	Airbnb	숙박 중개 사이트	https://medium.com/@feinima/disruptive-innovation-a-case-study-of-airbnb-450c75d5c910 https://incitrio.com/airbnbs-successfully-captures-the-three-rules-of-innovation/	Matching Platform Internet (mobile)	Commission Peer to Peer
8	Amazon	인터넷 종합 유통 쇼핑몰	https://channelkey.com/how-to-leverage-amazon-marketing-and-promotions-to-drive-business-forward https://www.personadesign.ie/branding-amazon-3-lessons-to-learn-for-your-brand-success/	Joint Distribution Added Service Reward	Brand Leverage Internet (mobile)
9	Blizzard Starcraft II	Software게임 온라인 판매	https://playkey.net/en/game/Starcraft2 https://www.yna.co.kr/view/AKR20100624172000017	Internet (mobile) Subscription	Disintermediation Network Effect
10	Autonetze	P2P 자동차 공유 서비스	https://ecosummit.net/award/eco12/star	Matching	Commission

	r		tups/autonetzer	Platform Internet (mobile)	Customer Participation Peer to Peer
11	better place	베터리 대여 전기자동차	https://www.wired.com/2009/05/better-place/ https://www.greencarreports.com/news/1076134_better-place-electric-car-battery-swapping-live-report https://www.npr.org/2012/08/21/159355676/dont-charge-that-electric-car-battery-just-change-it	Design Collaboration Pay per Unit (use)	Life-cycle Care Geographical Expansion
12	Birchbox	화장품 샘플의 정기 배송	https://www.birchbox.com/ https://www.tallahasseemagazine.com/enjoy-a-monthly-box-of-samples-from-birchbox/	Education Subscription Alliance	Delivery Service
13	Blue Nile	다이아몬드 온라인판매	https://www.bluenile.com/jewelry/necklaces/all	Internet (mobile) Product No Frill	Disintermediation Pay per Unit (use)

14	Business Idea	지하철 우산 대여	https://www.mk.co.kr/news/economy/1622963 https://www.hani.co.kr/arti/area/area_general/64541.html	Shared Ownership Channel Sharing	Sub-contractor network
15	Buttler for Hire	편리한 피크닉 물품 대여		Road Shop (Booth) Service	Pay per Unit (use)
16	Chamak	고급세탁기를 이용한 길거리 서민 빨래방	https://chamakdhamak.com/about-us/ https://www.mbaskool.com/business-articles/marketing/5212-village-laundry-service-a-story-of-the-start-up.html	Road Shop (Booth) Pay per Unit (use)	Low-price Targeting Service Niche targeting
17	Crowdbands	투표권 판매를 통한 회원 참여 유도	https://en.crowdband.life/ https://www.allaccess.com/net-news/archive/story/86066/crowdbands-offers-interactive-artist-development	Community Service	Subscription Customer Participation
18	Eggzy	온라인 달걀 직거래 플랫폼	https://eggzy.in/ https://www.forbes.com/sites/daniellegould/2011/08/08/eggzy-developing-a-transparent-local-egg-distribution-network/?sh=717c74945c05	Membership Commission Matching Platform	Disintermediation Niche Targeting

19	EFO	중고 명품의류 중개 플랫폼		Commission Matching Platform	2-sided Targeting Recycle
20	Easygym	하루 단위 이용이 가능한 피트니스 클럽	https://www.easygym.co.uk/ https://londinimum.wordpress.com/2012/05/03/the-rise-of-budget-gyms/ https://www.marketingweek.com/gyms-tone-up-to-take-on-their-new-low-cost-rivals/	Pay per Unit (use) Brand Leverage	Niche Targeting Service No Frill
21	Eletrolux	제품 지식을 바탕으로 한 솔루션 제공	https://www.electroluxprofessional.com/your-business/self-service-laundries/laundromats/	Loyalty Product Servitization	Subscription Added Service Education
22	Est Soft	광고가 포함된 무료 백신 프로그램	https://www.etnews.com/200710310227 https://blog.estsoft.co.kr/632	Internet (mobile) No Frill	Ad-based Product
23	Evernote	Freemium 전략을 활용한 고객 유치	https://evernote.com/intl/ko/compare-plans https://www.makeuseof.com/tag/evernote-free-plan/	Freemium Network Effect	Service

24	Extrabanca	외국인 전용 은행	https://theworld.org/stories/2013-12-16/italy-bank-where-immigrants-can-turn-get-loan https://thebanks.eu/banks/15984	Customization Niche Targeting	Education Service
25	Facebook	소셜 네트워크 서비스	https://ko-kr.facebook.com/ https://www.venturesquare.net/3478	Customer Participation Ad-based	Internet (mobile) Service Productization
26	FedEx	신속한 글로벌 운송 서비스	https://www.nutmeg.com/nutmegonomics/running-a-fedex-day-a-24-hour-ship-something-new-a-thon/ https://techwireasia.com/2020/02/how-fedex-uses-technology-to-delight-customers-in-the-digital-era/	Lean-Manufacturing Customization	Merge & Acquisition Service
27	Golfzon	가상 골프 시뮬레이션	http://company.golfzon.com/GFZ/Default.aspx https://www.mk.co.kr/economy/view.php?sc=50000001&year=2010&no=65745 https://news.mt.co.kr/mtview.php?no=2010021715433776129	Service Productization Loyalty	Community Franchise Customer Participation

28	Flattr	인터넷을 통한 소액 기부 시스템	https://www.inference.vc/flattr_should_we_use_it_in_academia_/ https://blog.p2pfoundation.net/flattr-introduces-voluntary-social-micropayments/2010/02/13 https://venturebeat.com/media/crowdfunding-startup-flattr-now-lets-you-pay-for-content-by-just-by-using-twitter-vimeo-instagram-other-sites/	Niche Targeting Commission	customer participation
29	GAP	패션 스파 브랜드	http://www.businessfor2030.org/gap-inc https://www.gapinc.com/en-us/articles/2018/09/three-ways-gap-inc-is-using-scale-to-speed-up-its- https://www.tinnews.co.kr/3704	Responsiveness Standardization Outsourcing reward	Vertical Integration Experience shop Internet (mobile)
30	Google's Adsense	광고 중개 플랫폼	https://www.marketingterms.com/glossary/adsense/ https://www.bigskyfishing.com/Internet_Business/adsense.php	Advertising Platform Customization Commission	Internet (mobile) 2-sided Targeting
31	Patientlikeme	환자간 질병정보 공유 커뮤니티	https://www.yoonsupchoi.com/2013/03/05/patientslikeme-the-patients-sns/	Customization Crowdsourcing	Segment Expansion

32	Grannies, Inc.	할머니가 만든 맞춤 손뜨개 상품 제공	https://www.nesta.org.uk/feature/20-shades-startup/grannies-inc/	Customization Commission Matching Platform	Internet (mobile) Niche Targeting
33	GS 25	기존 매장을 활용한 1회용 DVD 판매	https://www.sedaily.com/NewsView/1HWSYUOOA4 https://ebn.co.kr/news/view/440182	Pay per Unit (use) Service Productization	Channel Sharing
34	H&M	패션 스파 브랜드(H&M)	https://d3.harvard.edu/platform-rctom/submission/hm-how-fast-fashion-translates-into-low-prices-and-success/ https://www.therichest.com/rich-powerful/how-hm-became-one-of-the-largest-fast-fashion-brands-in-the-world/	Responsiveness Outsourcing Experience shop	Vertical Integration Low-price Targeting
35	IKEA	원가 절감을 위한 반조립 가구 생산/판매	https://d3.harvard.edu/platform-rctom/submission/ikea-worlds-most-successful-furniture-retailer/ https://hyyoche.tistory.com/entry/IKEA-이케아-역사-및-성공-요인-DIY-조립식-가구와-대량-생산-방식으로-원가-절감	No frill Low-price Targeting	Vertical Integration Experience shop

36	Hilti	통합공구관리 시스템	https://www.hilti.com/content/hilti/W1/US/en/business/business/equipment/fleet.html https://m.blog.naver.com/businessinsight/221385344252	Product Servitization Added Service	Life-cycle Care
37	ING Direct	온라인 은행 서비스	https://macleans.ca/economy/business/ing-direct-scrambles-to-reinvent-itself/ https://macleans.ca/economy/business/ing-direct-scrambles-to-reinvent-itself/	Service No Frill	Internet (mobile)
38	Intuit	세금신고 정보 교환 커뮤니티 제공	https://www.bain.com/insights/the-measure-of-success/ https://d3.harvard.edu/platform-digit/submission/turbotax-by-intuit-taxes-dont-have-be-taxing/	Community Service Productization	Product Pay per Unit (use)
39	KAI(한국항공우주산업)	조종사 훈련 프로그램	https://www.korea.kr/briefing/policyBriefingView.do?newsId=148712796 https://unikorea21.com/?p=10623	Education Added Service	Premium Targeting Service
40	Luette Leihen	저렴한 가격의 유아복 대여	https://www.trendhunter.com/trends/baby-clothes-rental https://biznara.tistory.com/72	Membership Subscription	Delivery Low-price Targeting

41	Kodak	인터넷 사진현상 서비스	https://en.wikipedia.org/wiki/Kodak_Gallery https://www.cioinsight.com/enterprise-apps/big-data-how-kodak-gallery-sees-the-big-picture/ https://www.cnet.com/tech/services-and-software/shutterfly-bids-23-8-million-for-kodak-gallery-customers/	Pay per Unit (use) Customization	Delivery Product
42	LEGO	고객이 직접 설계하는 조립식 블록 완구	https://www.lego.com/en-us/themes/mindstorms?consent-modal=show 박용삼(2015.04.22)_10년새 매출 5배, 레고의 비밀, POSRI report https://www.ideaconnection.com/open-innovation-success/Lego-Success-Built-on-Open-Innovation-00258.html	Customer Participation Matching Platform	Long-tail Targeting
43	Li&Fung	네트워크를 활용한 생산 중개 서비스	https://theferrarigroup.com/li-fung-ltd-a-supply-chain-competency-success-story/ http://www.shippersjournal.com/news/article.html?no=1613	matching platform Sub-contractor Network	Customization Commission

44	Metro	출근길 시민에게 제공하는 무료 신문	https://www.ft.com/content/5f5b781e-0340-11e7-ace0-1ce02ef0def9 https://sajithpai.com/free-newspapers-free-translates-profits/	Ad-based Product	Niche Targeting
45	NBC	다이어트 지원 커뮤니티 운영	https://www.freedieting.com/biggest-loser-club https://www.today.com/popculture/biggest-losers-share-their-success-secrets-wbna23784898	Subscription Community Service	Customization Brand Leverage
46	Netflix	우편 시스템을 활용한 DVD 대여	https://www.mbaknol.com/management-case-studies/case-study-how-netflix-took-down-blockbuster/ https://blockbustervsnetflix.weebly.com/successes-and-failures.html https://www.businessmodelsinc.com/en/inspiration/blogs/netflix-how-a-dvd-rental-company-changed-the-way-we-spend-our-free-time	Subscription Service	Delivery Alliance
47	Netjets	소형 전세 항공기 공유	https://d3.harvard.edu/platform-rctom/submission/netjets-pioneer-in-private-business-travel/	Shared Ownership Subscription	Membership Low-price Targeting

			https://businessmodelanalyst.com/netjets-business-model/ https://www.forbes.com/sites/douggollan/2020/12/10/a-brief-history-of-netjets-and-how-it-plans-to-stay-on-top/?sh=22338d4969fb		
48	Nike	음악감상 및 운동량 측정(Nike + iPod kit)	https://www.apple.com/newsroom/2006/05/23Nike-and-Apple-Team-Up-to-Launch-Nike-iPod/ https://www.cnet.com/reviews/nike-plus-ipod-sport-kit-review/	Product Joint Distribution Intermediation	Design Collaboration Razor Blade
49	NTT Docomo	옥외 미디어 (디지털 사이니지)	http://sptoday.com/bbs/print_view.php?wr_id=46511&p=1&bo_table=article https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201010sf1.html http://www.sptoday.com/bbs/board.php?bo_table=article&wr_id=52700&sop=and&sca=%C6%F7%C5%E4%B4%BA%BD%BA	Advertising Platform Ad-based	Road Shop (Booth) Platform Utilization

50	Odin	유기농 야채/과일 정기 배달	https://www.iamexpat.nl/lifestyle/lifestyle-news/where-find-bags-fresh-fruit-and-vegetables-straight-farm https://www.odin.nl/	Subscription Customization	Delivery Niche Targeting Alliance
51	OTG Management	공항 음식 주문 및 배달 서비스	https://www.itworld.co.kr/tags/6266/1/79807 https://www.nrn.com/latest-headlines/airport-restaurant-operator-otg-management-builds-tablet-based-future	Pay per Unit (use) Internet (mobile) Niche Targeting	Delivery Customization Channel Sharing
52	Outstanding in the field	대도시 근교 웰빙 식사	https://outstandinginthefield.com/about-us/ https://www.mauimagazine.net/outstanding-in-the-field/	Pay per Unit (use) Community Alliance	Membership Niche Targeting Shared Investment
53	P&G	외부 아이디어 수용을 통한 신제품 개발	https://news.pg.com/news-releases/news-details/2013/PG-ConnectDevelop-Launches-New-Open-Innovation-Website/default.aspx https://blog.naver.com/bizhospital/150127555669	Economies of Scale & Scope Blockbuster Marketing	Open Innovation Product

54	Parkingspot.com	공항 주차 공간 중개	https://www.nytimes.com/2011/05/08/technology/08parking.html https://cnbc.com/id/100518153 https://www.parking.net/parking-news/fasttrack-airport-parking-becoming-the-parking-spot	Freemium Internet (mobile) Membership	Platform Utilization Peer to Peer Pay per use
55	Paywithatweet	SNS를 활용한 마케팅 플랫폼	https://davidcantone.com/marketing-viral-twitter/ https://drschwenke.de/pay-with-a-tweet-gesetzliche-regeln/ https://socialcommercetoday.com/brilliant-kelloggs-opens-pay-with-a-tweet-pop-up-shop-in-soho-photos/	Social Network Advertising Platform	Platform Utilization
56	PC닥터	온라인 원격 수리	http://1599-8272.com/www/bbs/board.php?bo_table=contact_us&wr_id=11 https://ko.wikipedia.org/wiki/%EC%98%A4%ED%88%AC%EC%94%A8%EC%95%A4%EC%95%84%EC%9D%B4	Pay per Unit (use) Customization	Internet (mobile)

57	Petsmart	애완동물 호텔	https://petcarepricing.com/petsmart-hotel/ https://www.eastvalleytribune.com/get_out/petsmart-opens-a-dog-cat-hotel-with-all-the-amenities/article_ba9b7f3f-204c-5757-8a75-c1c373ffa4e9.html	Pay per use Niche Targeting Service	Premium Targeting Segment Expansion
58	Philips	신개념 커피메이커	https://katiabaddur.wordpress.com/2013/04/09/senseos-initial-competiive-advantage-through-an-alliance-of-philips-and-douwe-egberts/ https://www.petersimoons.com/why-would-you-partner-in-strategic-alliances/ https://www.interempresas.net/Distribucion-cocina/Articulos/53967-Senseo-de-Marcilla-y-Philips-supera-en-Espana-los-100-millones-de-tazas-de-cafe-consumidas.html	Product Razor Blade	Design Collaboration Intermediation
59	Playplanit	유아 이벤트 모음 사이트	http://bizion.com/bbs/board.php?bo_table=insight&wr_id=838&device=pc	Ad-based Platform Utilization	Internet (mobile) Education Customization

60	Photoboxi	즉석 사진 촬영 및 업로드 서비스	http://www.bizion.com/bbs/board.php?bo_table=startup&wr_id=262&page=24 https://www.trendhunter.com/trends/photoboxi https://www.prnewswire.com/news-releases/photoboxis-interactive-social-marketing-tool-sustains-corporate-events-long-after-the-partys-over-101960038.html	Social Network Service Productization	Road Shop (Booth) Ad-based
61	Podtime	도심내 캡슐 휴식 공간	http://www.talesofinterest.net/podtime-sleep-throughout-the-workday-in-comfort-and-security/ http://bizion.com/bbs/board.php?bo_table=startup&wr_id=471&sst=wr_good&sod=desc&sop=and&page=2&device=pc	Pay per use Segment Expansion	Social Network Niche Targeting
62	Samsung	시스템 에어컨	https://www.sedaily.com/NewsView/1HTJQKZKFZ https://news.samsung.com/kr/삼성전자-시스템에어컨-2016-대한민국-에너지대전	Razor blade Added Service	Customization

63	Radiohead	기부 바탕 음원 판매	https://content.time.com/time/arts/article/0,8599,1666973,00.html https://www.themarketingjack.com/post/pay-what-you-want-a-case-study-by-radiohead https://binodpanda66.medium.com/radiohead-case-study-pay-what-you-want-pwyw-strategy-622569d29ac8	Donation Customer Participation	Internet (mobile) Disintermediation
64	Red Box	무인 대여기를 통한 DVD 대여 서비스	https://contentbiz.tistory.com/entry/레드박스의-키오스크-비디오게임-대여-서비스-시작 https://cusee.net/2462876 https://www.wikihow.com/Rent-Movies-from-Redbox	Service Road Shop (Booth)	Pay per Unit (use) Service Productization
65	RedMoon Custom Petfood	애완동물 건강식 맞춤 사료 제작	https://petsweekly.com/dogs-101/dogs/product-reviews/customize-pet-food-red-moon-pet/ https://dogtime.com/dog-health/general/7203-custom-pet-food-for-dogs-and-cats-by-redmoon	Pay per Unit (use) Customer Participation	Internet (mobile) Alliance

66	Reference-tree	챕터별 교과서 구독	https://m.blog.naver.com/PostView.nhn?isHttpsRedirect=true&blogId=igonayou&logNo=122561216&categoryNo=12&proxyReferer=	Pay per Unit (use) Alliance Customization Alliance	Commission Internet (mobile) Low-price Targeting No Frill
67	Renac	공학용 계산기 대여	https://opengovca.com/corporation/7591357	Pay per use Low-price Targeting Outsourcing	Internet (mobile) Niche Targeting Platform Utilization
68	Rolls-Royce	항공 엔진 대여 및 Total Care 서비스	https://www.rolls-royce.com/media/our-stories/discover/2017/totalcare.aspx https://leehamnews.com/2015/01/22/rolls-royce-and-the-leasing-market/ https://www.journal-aviation.com/en/news/36835-how-rolls-royce-is-dealing-with-the-future-growth-in-maintenance-activities	Added Service Product Servitization	Pay per use Life-cycle Care

69	Royal Ahrend	사무가구 제조 및 배치 컨설팅	https://ahrend.ro/about_us https://archive.ellenmacarthurfoundation.org/case-studies/bringing-office-furniture-full-circle https://blog.naver.com/willtopia3/222095121080	Product Servitization Added Service	customization
70	Safaricom	모바일 금융 서비스 (M-PESA)	https://www.investopedia.com/terms/m/mpesa.asp https://www.kbanker.co.kr/news/articleView.html?idxno=54255 https://www.si.re.kr/node/65328	Membership Internet (mobile) Alliance	Commission Segment Expansion
71	XM Radio	위성 라디오 방송	https://en.wikipedia.org/wiki/XM_Satellite_Radio https://www.edaily.co.kr/news/read?newsId=01115206586478128&mediaCodeNo=257 https://insight.stockplus.com/articles/5481	Customization Joint Distribution	Channel Sharing Subscription
72	SK Telecom	MP3 스트리밍서비스 (멜론)	https://www.newswire.co.kr/newsRead.php?no=16214	Shared Ownership	Subscription Internet

			https://dbr.donga.com/article/view/1901/article_no/191 https://www.etnews.com/20200615000122	Niche Targeting	(mobile)
73	Social Print Studio	소셜 미디어 사진 인화 서비스	https://www.filestack.com/case-studies/social-print-studio/ https://www.pcmag.com/news/inside-the-start-up-that-brings-your-instagram-pics-to-life	Customization Long-Tail Targeting	Platform Utilization Product
74	Spotify.com	무료 음악 스트리밍 서비스	https://www.mk.co.kr/economy/view.php?sc=50000001&year=2018&no=274019 https://www.pocket-lint.com/what-is-spotify-and-how-does-it-work/	Freemium Ad-based Internet (mobile)	Joint Distribution Service
75	The HUB	공동 작업공간 제공	https://m.blog.naver.com/PostView.naver?isHttpsRedirect=true&blogId=impactsquare&logNo=161700453	Community Service Commission	Customer Participation Razor blade
76	Urban organic	유기농 채소/과일의 정기 배달	https://www.urban-organic.co.uk/what-we-do	Niche Targeting Subscription Alliance	Delivery Service

77	Vélo'v	프랑스 공공 자전거 셀프 대여	https://www.benefit4transport.eu/wiki/index.php?title=Case_Studies:_V%C3%A9lo%E2%80%99v,_France	Self Service Shared investment	Road Shop (Booth) Service
78	What can I make for you?	맞춤 제품 제작자와 고객의 연결 플랫폼		Customization Long-Tail Targeting	Commission Matching Platform
79	Wordy	맞춤형 전문가를 찾아주는 문서 교정 서비스	https://www.wordy.com/ https://arcticstartup.com/wordy-professional-editing-gets-wordier-multiple-file-uploads-and-new-pricing/	Service Productization Matching Platform	Internet (mobile) Pay per use Customization
80	Zara	패션 스파 브랜드(Zara)	https://swifterm.com/the-secret-of-zaras-success-customer-creation/ https://thestrategystory.com/blog/zara-swot-analysis/	Responsiveness Low-price Targeting	Vertical Integration Experience shop
81	골든네일	네일 아트 및 커피, 헤어 서비스	https://www.edaily.co.kr/news/read?newsId=01551446596384712&mediaCodeNo=257 http://news.kmib.co.kr/article/view.asp?arcid=1328786764&code=14131201&sid1=al	Service Loyalty	Shop in Shop

82	그루폰	SNS를 활용한 제품 홍보	https://www.bloter.net/news/articleView.html?idxno=11532 http://www.itdaily.kr/news/articleView.html?idxno=41955 https://www.reuters.com/article/venture-groupon-idUSN0128167420101201	Social Network Commission Matching Platform	Internet (mobile) 2-sided Targeting Platform Utilization
83	까페베네	커피숍에서 우산 대여	https://news.mt.co.kr/mtview.php?no=2011062200460033787 http://www.jbnews.com/news/articleView.html?idxno=392035	Shared Ownership Membership	Subcontractor network
84	대교	방문을 통한 눈높이 교육	https://www.etoday.co.kr/news/view/456682 https://www.sedaily.com/NewsView/1HVLRS5W6S	Sales Person Customization	Subscription Standardization
85	다이소	저가/균일가 판매 유통	https://magazine.hankyung.com/business/article/202102260699b https://biz.chosun.com/site/data/html_dir/2017/09/13/2017091301123.html https://www.ceoscoredaily.com/page/view/2023041315440973396	Low-price Targeting Pay per Unit (use)	Franchise Lean-Manufacturing Channel Sharing Outsourcing

86	메가스터디	교육 컨텐츠 온라인 서비스	https://www.etoday.co.kr/news/view/206566 https://m.cafe.daum.net/shimssam/HEK7/19?q=D_hSLIfnTlt550&	Low-price Targeting Service Productization	Alliance Internet (mobile) Pay per use
87	몰스킨	에버노트 연계 스마트 수첩	https://gizmodo.com/evernote-smart-notebook-by-moleskine-review-a-digital-5950017 https://www.moleskine.com/en-gb/shop/moleskine-smart/smart-writing-system/smart-notebooks/	Product Servitization Design Collaboration	Cross Promotion Added Service Niche Targeting
88	서울바이크	대한민국 공공 자전거 시스템	https://www.bikem.co.kr/article/read.php?num=7918 https://www.bikeseoul.com/	Shared Ownership Subscription	Self Service Pay per Unit (use)
89	아라빈드	창의적 수익구조를 통한 무료시술	https://socialbusinessdesign.org/aravind-business-model-case-study/ https://bmtoolbox.net/stories/aravind https://d3.harvard.edu/platform-rctom/submission/aravind-eye-care-system-mcdonaldization-of-eye-care/	Standardization Pay as you Want	Niche Targeting Donation

90	오마이뉴스	시민 참여형 인터넷 신문	https://www.sisajournal.com/news/articleView.html?idxno=104426 http://www.okinews.com/news/articleView.html?idxno=22542 https://www.onlinejournalism.co.kr/m/1196230837?category=89596	Service Crowdsourcing	Internet (mobile) Donation
91	웅진코웨이	CODI 정기 방문 서비스	https://www.coway.com/cowayservice/service_story	Life-cycle Care Product Servitization	Sales Person Added Service Subscription
92	청정원	커뮤니티 운영을 통한 브랜드 홍보	https://www.newswire.co.kr/newsRead.php?no=398645 https://www.thinkfood.co.kr/news/articleView.html?idxno=28841	Community Service	Crowdsourcing
93	Lulu	주문형 고객 출판(Print on-demand) 서비스	https://yourbusinessneeds.lulu.com/ https://www.reuters.com/article/lifestyle-longtail-lulu-dc-idUKL3038196620061212 https://www.launchmybook.com/the-most-popular-self-publishing-platforms-pros-cons/	Internet (mobile) Service Platform	Long-Tail Targeting Service Productization

94	넥슨	카트라이더 온라인게임	https://www.hankyung.com/it/article/2012011252381 김태경 외 3인(2009.2월), Reorganization and Challenge of Online Game Business: A Study on Nexon, Korea Business Review. http://www.goodkyung.com/news/articleView.html?idxno=197573	Service Freemium	Cross Promotion Segment Expansion
95	티켓몬스터	소셜 쇼핑	https://www.edaily.co.kr/news/read?newsId=01193926606091216&mediaCodeNo=257 https://www.edaily.co.kr/news/read?newsId=01193926606091216&mediaCodeNo=257	Advertising Platform Social Network	Internet (mobile)
96	셔츠매거진	셔츠의 정기구독서비스	https://www.nocutnews.co.kr/news/4286441 https://m.blog.naver.com/PostView.naver?isHttpsRedirect=true&blogId=oz29oz&logNo=130149949876 https://magazine.hankyung.com/job-joy/article/202102187272d	Subscription Brand Leverage	Internet (mobile) Customization

97	Thredless	크라우드 소싱을 통한 의류 판매 플랫폼	htpp://www.besucess.com/2013/08/everyoneisaartist_threadless/ https://ducttapemarketing.com/how-threadless-nailed-the-crowdsource-model/ https://medium.com/@nidhi.titus/threadless-crowdsourcing-creativity-a61e0ce02dc	Internet (mobile) Crowdsourcing Pay per Unit (use)	2-sided Targeting Matching Platform
98	현대카드	슈퍼콘서트 개최를 통한 고객 유치	https://dive.hyundaicard.com/web/content/contentView.hdc?viewSpaceType=Y&contentId=4723&cookieDiveWeb=Y https://www.hankyung.com/economy/article/202208182232i	Blockbuster Marketing Service	Premium Targeting
99	Kickstarter	크라우드 펀딩을 통한 창업지원 플랫폼	http://logiseconomy.tistory.com/720 https://help.kickstarter.com/hc/en-us/articles/115004996453-What-is-Kickstarter- https://avada.io/resources/kickstarter-success-story.html	Internet (mobile) Matching Platform	Crowdsourcing Commission

100	LEGO	Design by me 프로젝트	https://www.lego.com/en-us/themes/mindstorms?consent-modal=show 박용삼(2015.04.22), 10년새 매출 5배, 레고의 비밀, POSRI report. https://www.ideaconnection.com/open-innovation-success/Lego-Success-Built-on-Open-Innovation-00258.html	Internet (mobile) Crowdsourcing Pay per Unit (use)	Customer Participation Service Productization
101	Howstuffworks.com	사물의 작동 원리를 wiki로 모음	https://www.howstuffworks.com/ https://www.ajc.com/entertainment/celebrity-news/useful-trivia-drives-success-atlanta-howstuffworks-com/upjVheHnHvYzKTYzmkOwAP/ https://www.adexchanger.com/ad-exchange-news/howstuffworks-gets-15-million-series-spins-off-independent-podcast-network/	Internet (mobile) Ad-based	Service Productization Pay per Unit (use)
102	Tile	크라우드 소싱을 이용한 분실물 찾기 프로젝트	http://www.ciokorea.com/news/17821?page=0,1 https://trenddiary.tistory.com/376	Crowdsourcing Product	Pay per Unit (use) Service

103	Duolingo	크라우드 소싱을 통한 외국어교육 서비스 제공	https://www.dailypop.kr/news/articleView.html?idxno=46711 https://uxdesign.cc/how-duolingo-pushes-users-from-freemium-to-premium-4b9fe8bbb21a	Internet (mobile) Matching Platform	Crowdsourcing 2-sided Targeting
104	바로풀기	스마트폰을 통한 빠른 피드백, 스마트 러닝 서비스	https://www.junggi.co.kr/article/articleView.html?no=2108 https://biz.chosun.com/site/data/html_dir/2016/04/18/2016041801837.html	Internet (mobile) Joint Distribution	2-sided Targeting Social Network Subscription
105	Amazon	AutoRip	https://www.theguardian.com/commentisfree/2013/jan/11/amazon-autorip-great-service-strings-attached https://organicmedialab.com/2013/07/03/amazon-kindle-killed-physical-books/	Subsidiary Reward	Razor Blade
106	Quirky	크라우드 소싱 아이디어 상품개발 플랫폼	http://digxtal.com/insight/20120428/쿼키quirky-크라우드소싱-아이디어-상품-개발-플랫폼 https://m.blog.naver.com/PostView.naver?isHttpsRedirect=true&blogId=gkenq&logNo=10189715806	Internet (mobile) Community Sharing	Crowdsourcing Pay per Unit (use)

107	Innocentive	R&D와 혁신의 크라우드소싱 연계 플랫폼	https://www.bloter.net/news/articleView.html?idxno=3191 https://d3.harvard.edu/platform-digit/submission/innocentive-incentivizing-innovation/ https://m.blog.naver.com/iky59/220939359642	Crowdsourcing Commission Service	Matching Platform Internet (mobile)
108	미미박스	한국형 화장품 정기구독 서비스의 탄생	https://www.hani.co.kr/arti/economy/consumer/541153.html https://www.mk.co.kr/news/special-edition/5639849 https://www.venturesquare.net/821491	Internet (mobile) Social Network	Delivery Subscription Ad-based
109	Gramble	모바일 소셜 게임도 하고, 기부도 함께	https://www.venturesquare.net/523556	Internet (mobile) Donation	Service Platform Social Network
110	Woofound	개인 성향 분석해 진로 상담을 도와주는 플랫폼	http://www.venturesquare.net/523231 https://techcrunch.com/2013/08/13/image-based-personality-assessment-platform-woofound-raises-2m-to-guide-students-unemployed-to-careers/	Service Pay per Unit (use) Freemium	Internet (mobile) Joint Distribution

111	로컬 모터스	오픈 소스로 디자인하고, 소비자가 직접 조립하는 크라우드 소싱 자동차의 탄생	https://www.azcentral.com/story/money/business/2014/10/25/local-motors-printing-car-chandler/17941815/ https://medium.com/@nidhi.titus/steering-the-drive-with-co-creation-local-motors-case-study-b4fefe7a1ffe https://www.insider-trends.com/local-motors-mitch-menaker-on-open-source-innovation-and-the-power-of-ideas/	Crowdsourcing Customer Participation	Long-Tail Targeting No Frill Community
112	Linked-in	최고의 글로벌 비즈니스 인명 사전	https://www.etnews.com/20140707000005 https://news.mt.co.kr/mtview.php?no=2019103114483199558 https://maily.so/productlab/posts/c08a6f51	Internet (mobile) Service Platform Freemium Ad-based	Network Effect Matching Platform 2-sided Targeting Customization Social Network
113	Slice	나의 구매내역을 한눈에, 온라인 구매내역 관리 플랫폼	http://www.venturesquare.net/523842	Service Platform Ad-based	Internet (mobile) Joint Distribution

114	Soundwave	주변 사람들의 음악 취향을 쏙쏙 분석해 알려주는 음악 탐색 앱	https://www.irishexaminer.com/business/arid-20252163.html http://verticalplatform.kr/archives/1625	Internet (mobile) 2-sided Targeting Channel Sharing	Service Platform Service Customization Social Network
115	Watcha	맞춤형 영화 추천 앱,	http://platum.kr/archives/10377 http://www.mediatoday.co.kr/news/articleView.html?idxno=213261 https://maternalgrandfather.tistory.com/entry/넷플릭스-왓챠-장단점-및-가격-비교	Internet (mobile) Customization	Service Joint Distribution
116	Mosaic	태양광 기술과 크라우드 펀딩의 만남	https://www.venturesquare.net/519868 https://m.blog.naver.com/PostView.naver?isHttpsRedirect=true&blogId=haezoom&logNo=220430120685 정성삼(2016.11.07), 사회적 금융을 활용한 신재생에너지 보급 촉진 사례 분석, 세계에너지시장 인사이트 제16-40호, 에너지경제연구원	Internet (mobile) Matching Platform	Crowdsourcing Commission

117	떠리몰	유통기한 임박기한제품 전문 쇼핑몰	https://www.jobkorea.co.kr/starter/interview/View/11282 https://mnews.jtbc.co.kr/News/Article.aspx?news_id=NB10857733 http://m.newstap.co.kr/news/articleView.html?idxno=17185	Product Internet (mobile)	Low-price Targeting Delivery Pay per Unit (use)
118	Speakaboos	월 정액 인터렉티브 스토리북	http://techneedle.com/archives/12370?utm_source=feedly https://jamonkey.com/5-ways-to-get-your-kids-interested-in-reading-speakaboos-review/	Service Internet (mobile)	Subscription Shared Investment
119	코리아트립	미스터리딜식 호텔 예약서비스	https://www.venturesquare.net/523745	Service Matching Platform	Internet (mobile) Commission
120	Birchbox	화장품 서브스크립션 커머스의 대표적 성공사례	https://www.birchbox.com/ https://techcrunch.com/2015/07/13/beauty-product-subscription-service-birchbox-is-opening-more-brick-and-mortar-retail-stores/ https://mashable.com/review/birchbox-beauty-subscription-box	Internet (mobile) Social Network	Delivery Subscription Ad-based

121	Scoopshoot	일반 사용자들이 찍은 사진이 거래되는 사진 마켓플레이스	http://verticalplatform.kr/archives/1615	Matching Platform Commission Internet (mobile)	2-sided Targeting Crowdsourcing Customization
122	Typeform	모바일 기기에서도 호환되는 예쁜 설문조사 제작 플랫폼	http://www.venturesquare.net/523914 https://www.windwardstudios.com/blog/typeform-review	Service Platform Subscription	Internet (mobile)
123	IFTTT	웹2.0시대의 반복 작업의 자동 수행 서비스	https://www.venturesquare.net/521981 https://www.businessnewsdaily.com/4919-ifttt-for-business.html	Service Freemium Community	Internet (mobile) 2-sided Targeting
124	Lyft	차의 남는 좌석을 제공하는 승차공유서비스	http://www.venturesquare.net/519363 https://techboomers.com/t/what-is-lyft	Shared Ownership Commission	Peer to Peer Internet (mobile)
125	KnowRe	맞춤형 수학교육 솔루션 제공	https://www.venturesquare.net/516165 https://www.sciencetimes.co.kr/news/수학it로-글로벌-진출에-성공하다	Service Internet (mobile) Channel sharing	Subscription Customization 2-sided Targeting

126	RelayRide	자동차 Peer-To-Peer 공유 서비스 (GM과 함께 대대적 서비스 시작)	https://venturebeat.com/business/relayrides-launches-first-peer-to-peer-carsharing-service/ https://www.shareable.net/google-invests-in-p2p-car-sharing-service-relayrides/	Shared Ownership Joint Distribution	Peer to Peer Internet (mobile) Commission
127	Pickn' tell	패션 쇼핑몰을 위한 IT기반 온 오프라인 통합 솔루션	https://www.besuccess.com/pickn-tell/ http://kor.theasian.asia/archives/83794 http://weekly.khan.co.kr/khnm.html?mode=view&code=116&artid=201405201622081&pt=nv	Service Internet (mobile) Social Network	Community Product Franchise

Appendix. B

Workshops for Case Application

This appendix describes the workshops that were conducted for the application of each case study. Table 4 describes five workshops that were held to design various business innovation alternatives for the hair dryer manufacturing company in Chapter 3. Table 5 and Table 6 present a series of workshops for evaluating the PSS business of the wheelchairs manufacturing company and the premium vehicle remodeling company, respectively.

Table 14. Series of workshops for case study of Hair dryer company.

Workshop #1	
Objectives	To understand the methodology and the company's concerns
Participants (excl. myself)	- Case company: Manager and two working-level staffs of New Business Planning Team. - Service Planning Partner: CEO and one working-level staff.
Agenda	- Explanation of the current situation. - Description of the developed methodology. - Understanding the requirements for business innovation.
Results	- Situation: Facing pressure to reduce prices due to low-cost products

	from China and reduced potential for additional revenue from existing customers due to the long product's life-cycle. - Requirements: Business innovations that can leverage the company's current strengths, and create a stable revenue stream.
Workshop #2	
Objectives	To generate business innovation ideas
Participants (excl. myself)	- Service Planning Partner: CEO, manager and three working-level staff.
Agenda	- Discussion on consumer trends and market research findings. - Business innovation ideation considering the requirements.
Results	- High interest and willing-to-pay of consumer in hair care. - Propose a business model that sell the hair dryer with added nutrient ampoules, by inspired by the razor-blade business model. - List-up the necessary strategies in other perspectives such as product (re)design.
Workshop #3	
Objectives	To discuss the first ideation and the further innovation direction.
Participants (excl. myself)	- Case company: Manager and two working-level staffs of New Business Planning Team. - Service Planning Partner: CEO and manager.
Agenda	- Briefing the business innovation ideas.

Results	- Satisfied with the idea that sell the hair dryer with added nutrient ampoules, because the sales of ampoules can be the stable revenue stream even after the sales of hair dryers. - Requirement added: Roadmap for continuous evolution.
Workshop #4	
Objectives	To generate business innovation ideas and make the roadmap
Participants (excl. myself)	- Service Planning Partner: CEO, manager and three working-level staff.
Agenda	- Discussion on market research findings and other business cases. - Business innovation ideation that can continue to evolve.
Results	- Propose business innovation ideas such as partnership with chemical company for upgrading the quality of ampoules, and brand leverages for marketing, targeting the professional market, developing it as a service in the hair shop, and etc..
Workshop #5	
Objectives	To discuss the first ideation and the further innovation direction.
Participants (excl. myself)	- Case company: Managers and working-level staffs. - Service Planning Partner: CEO and manager.
Agenda	- Briefing the business innovation ideas and the roadmap.
Results	- Understood all of business innovation alternatives and satisfied with the roadmap of them.

	- Preparation of detailed business plans and internal reporting.

Appendix. C

Components of the basic and advanced templates

This appendix provides descriptions of the components of the business evaluation templates. It includes the names, types and definitions of each component, and their relationships with other components.

Table 15. Components of "Market Creation" in the basic templates.

Component	Type	Description
Potential Customer	Stock variable	Total size of the market that is considered a target for PSS offerings, regardless of whether or not they are aware of PSS or currently using PSS. - impacted by... - impacting on... aware-rate, Aware Customer
Aware Customer	Stock variable	Size of the customer base that is aware of PSS, and is realistically target for to request the PSS. - impacted by... Potential Customer, aware-rate - impacting on... trial-rate, Trial Customer, word-of-mouth
Trial Customer	Stock variable	Customers who have experienced the PSS offering (included only if there is an additional trial service in the PSS). - impacted by... Aware Customer, trial-rate

		- impacting on... word-of-mouth
aware-rate	flow variable	Rate at which "Potential Customer" become aware of the PSS and convert to "Aware Customer". - impacted by... word-of-mouth, marketing cost, Potential Customer - impacting on... Aware Customer
trial-rate	flow variable	Rate at which "Aware Customer" have a hands-on experience with the PSS and convert to "Trial Customer". - impacted by... word-of-mouth, trial cost, Aware Customer - impacting on... Trial Customer
marketing cost	parameter	Expenses invested initially during the PSS launch phase and periodically throughout the course of PSS provision. - impacted by... - impacting on... aware-rate, trial-rate, delivery-rate, expending-rate, Cost
word-of-mouth	parameter	Marketing effect achieved through communication and information sharing among customers. - impacted by... Aware Customer, Trial Customer, Served Customer - impacting on... aware-rate, trial-rate, delivery-rate

Table 16. Components of "Product Sourcing" in the basic templates.

Component	Type	Description

Inventory	Stock variable	Quantity of products in stock that are necessary for provision of the PSS. - impacted by... sourcing-rate, sourcing duration - impacting on... Provision Capacity
Factory	Stock variable	Production facilities or capacities of products needed for the PSS provision (included only if producing in-house according to the "sourcing policy"). - impacted by... sourcing policy, initial investment, construction-rate - impacting on... sourcing-rate
Cost	Stock variable	Expenses incurred in operating and delivering the PSS. - impacted by... sourcing-rate, initial investment, purchase cost, production cost - impacting on...
sourcing-rate	flow variable	Rate at which product inventory is secured through in-house production or purchase. - impacted by... sourcing duration, sourcing policy, Factory - impacting on... expending-rate
construction-rate	flow variable	Rate at which the in-house production facilities or capacities are secured (needed to decide whether subsequent expansions are allowed). - impacted by... initial investment, unit construction cost - impacting on... Factory
expending-rate	flow variable	Rate at which expenses incurred for product sourcing increase. - impacted by... sourcing-rate, production cost, purchase cost

		- impacting on... Cost
sourcing policy	parameter	Policy decision for product sourcing, with options such as in-house production, external purchasing, or etc. - impacted by... - impacting on... Initial investment, sourcing-rate, duration
initial investment	parameter	Investment costs for establishing the service channel or capacities. - impacted by... - impacting on... establishment-rate, recruit-rate, expending-rate, Cost

Table 17. Components of "Channel Establishment" in the basic templates.

Component	Type	Description
Service Channel	Stock variable	Size of the service stores or spaces dedicated to the provision of PSS. - impacted by... initial investment, establishment-rate - impacting on... recruit-rate, Provision Capacity, aware-rate, trial-rate
Service Staff	Stock variable	Personnel or the number or the personnel working at service stores for the PSS provision. - impacted by... recruit-rate, initial investment - impacting on... Cost, Provision Capacity
establishment -rate	flow variable	Rate at which "Service Channel" is secured (needed to decide whether only one-time establishment is allowed initially or subsequent expansions are allowed).

		- impacted by... initial investment, unit establishment cost - impacting on... Service Channel
recruit-rate	flow variable	Rate at which "Service Staff" are hired for working at "Service Channel" in PSS provision (needed to decide whether only one-time recruit is allowed initially or subsequent recruits are allowed). - impacted by... Service Channel, initial investment, labor cost - impacting on... Service Staff
expending-rate	flow variable	Rate at which expenses are incurred regularly for the operation of "Service Channel" and "Service Staff". - impacted by... Service Staff, labor cost, initial investment - impacting on... Cost
labor cost	parameter	Labor cost associated with employing one Service Staff member. - impacted by... - impacting on... recruit-rate, expending-rate, Cost
initial investment	parameter	Investment costs for establishing the service channel or capacities. - impacted by... - impacting on... establishment-rate, recruit-rate, expending-rate, Cost

Table 18. Components of "PSS Delivery" in the basic templates.

Component	Type	Description

Provision Capacity	Stock variable	Scale at which PSS can be provided to requesting customers. - impacted by... secure-rate, Inventory, Service Staff - impacting on... delivery-rate
secure-rate	flow variable	Rate at which the "Provision Capacity" is secured (service staff's return or product's return after a PSS delivery is needed to be considered) - impacted by... Inventory, Service Staff, occupy-rate, work-rate, duration - impacting on... Provision Capacity
delivery-rate	flow variable	Rate at which PSS is actually provided among the PSS requests utilizing the "Provision Capacity". - impacted by... Provision Capacity, requested demand - impacting on... Revenue
occupy-rate	flow variable	Rate at which the "Inventory" is occupied or decreased for the PSS provision - impacted by... Inventory, delivery-rate - impacting on... secure-rate, Provision Capacity
work-rate	flow variable	Rate at which the "Service Staff" is deployed or decreased for the PSS provision - impacted by... Service Staff, delivery-rate - impacting on... secure-rate, Provision Capacity
PSS time	parameter	Duration time of one PSS provision or usage. - impacted by... - impacting on... secure-rate, Provision Capacity
operation	parameter	Operating expenses required for stable PSS provision (incl.

cost		direct and indirect costs). - impacted by... - impacting on... expending-rate, Cost
requested demand	parameter	Number of customers who have requested PSS provision. - impacted by... Aware Customer, marketing cost, word-of-mouth, price - impacting on... delivery-rate

Table 19. Components of "Revenue Creation" in the basic templates.

Component	Type	Description
Served Customer	Stock variable	Customers who have received or utilized PSS offerings. - impacted by... Aware Customer, delivery-rate - impacting on... word-of-mouth
Revenue	Stock variable	Sales generated through the provision of PSS. - impacted by... earning-rate, delivery-rate, price - impacting on⋯
delivery-rate	flow variable	Rate at which PSS is actually provided among the PSS requests utilizing the "Provision Capacity". - impacted by... Provision Capacity, requested demand - impacting on... earning-rate, Revenue
earning-rate	flow variable	Rate at which revenue is generated through the provision of PSS. - impacted by... delivery-rate, price - impacting on... Revenue

price	parameter	Price paid by customers for utilizing the PSS. - impacted by... - impacting on... earning-rate, Revenue, requested demand
requested demand	parameter	Number of customers who have requested PSS provision. - impacted by... Aware Customer, marketing cost, word-of-mouth, price - impacting on... delivery-rate

Table 20. Components of "Partnership Balancing" in the basic templates.

Component	Type	Description
Revenue	Stock variable	Sales generated through the provision of PSS. - impacted by... earning-rate, delivery-rate, price - impacting on... margin-rate, Profit
Cost	Stock variable	Expenses incurred in operating and delivering the PSS. - impacted by... sourcing-rate, initial investment, purchase cost, production cost - impacting on... margin-rate, Profit
Profit	Stock variable	Earnings of participants after adjusting PSS provision "Revenue" and "Cost" according to pre-agreed "sharing policy" and "operation policy". - impacted by... Revenue, Cost, sharing policy, operation policy, balance-rate - impacting on...

balance-rate	flow variable	Rate at which the total "Revenue" and "Cost" generated during the PSS provision is distributed among participants. - impacted by... Revenue, Cost, sharing policy, operation policy - impacting on... Profit
sharing policy	parameter	Pre-agreed rules for distributing the revenue from PSS provision (incl. if necessary). - impacted by... - impacting on... balance-rate, Profit
operating policy	parameter	Pre-agreed rules regarding roles & responsibilities and cost allocation in the process of PSS provision (incl. if necessary). - impacted by... - impacting on... balance-rate, Profit

Table 21. Components of "Market Creation" in the advanced templates.

Component	Type	Description
Purchased Customer	Stock variable	Customers who have purchased the product related to the PSS offerings. - impacted by... Aware Customer, purchase-rate - impacting on... satisfaction, request-rate, Requested Customer
Requested Customer	Stock variable	Customers from the "Purchased Customer" who have requested the service of PSS offerings. - impacted by... Purchased Customer, satisfaction, usage pattern, request-rate - impacting on... service-rate, Served Customer

Served Customer	Stock variable	Customers who have received or utilized the service of PSS offerings. - impacted by... Requested Customer, Provision Capacity, service-rate - impacting on... word-of-mouth, satisfaction
purchase-rate	flow variable	Rate at which the "Potential/Aware Customer" purchase the product related to the PSS offerings and convert to the "Purchased Customers". - impacted by... Potential/Aware Customer, marketing cost, word-of-mouth, Inventory - impacting on... Purchased Customer
request-rate	flow variable	Rate at which the "Purchased Customer" request the service of the PSS offerings and convert to the "Requested Customer". - impacted by... Purchased Customer, satisfaction, usage pattern, - impacting on... Requested Customer
service-rate	flow variable	Rate at which the "Requested Customer" actually receive the service of the PSS offerings and convert to the "Served Customer". - impacted by... Requested Customer, Provision Capacity, Service Staff, Inventory - impacting on... Served Customer, Staff in-Service, Product in-Service
usage pattern	parameter	Pattern of the PSS product usage leading up to the service request (ex. duration of use, request frequency, and etc.). - impacted by... - impacting on... request-rate

satisfaction	parameter	Level of customer satisfaction regarding the product or services of the PSS offerings. - impacted by... Purchased Customer, Served Customer, delivery time, price - impacting on... word-of-mouth, request-rate, reuse-rate

Table 22. Components of "PSS Delivery" in the advanced templates.

Component	Type	Description
Staff in-Service	Stock variable	Workforce among the "Service Staff" that is engaged in providing the PSS service. - impacted by... Service Staff, service-rate - impacting on... return-rate, Service Staff
service-rate	flow variable	Rate at which the "Service Staff" is deployed for providing the PSS service, transitioning into the "Staff in-Service". - impacted by... Requested Customer, Provision Capacity, Service Staff, Inventory - impacting on... Served Customer, Staff in-Service, Product in-Service
return-rate	flow variable	Rate at which the "Staff in-Service" completes the PSS provision and returns to being part of the "Service Staff". - impacted by... Staff in-Service, delivery time - impacting on... Service Staff
delivery time	parameter	Time taken by the "Service Staff" to provide the service of PSS offerings. - impacted by...

		- impacting on... return-rate

Table 23. Components of "Revenue Creation" in the advanced templates.

Component	Type	Description
Revenue	Stock variable	Sales generated through the provision of PSS including sales of PSS products and delivery of PSS service. - impacted by... service-rate, purchase-rate, service price, product price, earning-rate - impacting on...
service-rate	flow variable	Rate at which the "Requested Customer" actually receive the service of the PSS offerings and convert to the "Served Customer". - impacted by... Requested Customer, Provision Capacity, Service Staff, Inventory - impacting on... Served Customer, Staff in-Service, Product in-Service
purchase-rate	flow variable	Rate at which the "Potential/Aware Customer" purchase the product related to the PSS offerings and convert to the "Purchased Customers". - impacted by... Potential/Aware Customer, marketing cost, word-of-mouth, Inventory - impacting on... Purchased Customer
service price	parameter	Price paid by customers for using the PSS service. - impacted by... - impacting on... request-rate, earning-rate, Revenue

product price	parameter	Price paid by customers for purchasing the PSS product. - impacted by... - impacting on... earning-rate, Revenue

Table 24. Components of "Product Sourcing" in the advanced templates.

Component	Type	Description
Product in-Service	Stock variable	Products from the "Product Inventory" that are being used or occupied by customers during the PSS provision process. - impacted by... Product Inventory, service-rate - impacting on... return-rate, Product Inventory
return-rate	flow variable	Rate at which the "Product in-Service" are returned to the "Product Inventory" after the customer has finished using or occupying them. - impacted by... Product in-Service, occupation time - impacting on... Product Inventory
occupation time	parameter	Time during which a customer uses or occupies a product for PSS utilization. - impacted by... - impacting on... return-rate

Table 25. Components of "Market Creation" in the advanced templates.

Component	Type	Description
Regular	Stock	Customers among the "Served Customer" who have the

Customer	variable	intention to use PSS again after their initial utilization. - impacted by... occupation time, satisfaction, reuse-rate, Served Customer - impacting on... service-rate
reuse-rate	flow variable	Rate at which "Served Customer" express intention to reuse PSS and convert to "Regular Customer". - impacted by... occupation time, satisfaction, Served Customer - impacting on... Regular Customer
bounce-rate	flow variable	Rate at which Served Customers become dissatisfied with the PSS and leave. - impacted by... satisfaction, Served Customer - impacting on...

Table 26. Components of "Partnership Balancing" in the advanced templates.

Component	Type	Description
Profit (player 1)	Stock variable	Earnings of participant1 after balancing with according to pre-agreed "sharing policy" and "operation policy". - impacted by... Revenue, Cost, sharing policy, operation policy, balance-rate - impacting on...
Profit (player 2)	Stock variable	Earnings of participant2 after balancing with according to pre-agreed "sharing policy" and "operation policy". - impacted by... Revenue, Cost, sharing policy, operation policy, balance-rate

		- impacting on...
balance-rate	flow variable	Rate at which profits are redistributed or shared among participants according to a pre-agreed arrangement. - impacted by... Profit of player 1, request-rate, sourcing-rate, service price, sourcing cost - impacting on... Profit of player 2
sourcing cost	parameter	Costs incurred in procuring the products necessary for the PSS provision - impacted by... product price - impacting on... service price, sourcing-rate, Cost of player 1
service price	parameter	Price paid by customers for using the PSS service. - impacted by... sourcing cost - impacting on... satisfaction, request-rate, Revenue of player 1
satisfaction	parameter	Level of customer satisfaction regarding the product or services of the PSS offerings. - impacted by... service price - impacting on... sourcing-rate, request-rate

Appendix. D

Equations in System Dynamics Simulation for the PSS Business Evaluation Case Application

This appendix presents the equations of all component formulated for the PSS business evaluation case application. The model is composed of a total of 12 stock variables, 14 flow variables, and 26 parameters, all of which have interrelated influences on each other, either directly or indirectly. The simulation was carried out using Insight Maker, an open-source modeling and simulation tool developed with web-based technologies. According to the notation used in the Insight Maker, the current value of a component is denoted as "*[component]*", while the value at a previous point in time is denoted as "*[component]{time( )}*".

Table 27. Equations formulated for the PSS business evaluation case study.

Components	Type	Equations
Potential Customer	Stock var.	∑([birth rate]-[sales rate]-[leave rate])
Purchased Customer	Stock var.	∑([sales rate])
Request	Stock var.	∑([request rate]-[service rate]-[bounce rate])

Customer		
Received Customer	Stock var.	∑([service rate])
Production Capacity	Stock var.	(([factory Budget]-[factory Build-cost])/[capacity Unit-cost])) + ∑([release rate]-[producing rate])
Service Channel	Stock var.	[channel Budget]/([channel Setup-cost]+[employee Hiring-cost]*[number of Employees]) + ∑([open rate])
Employee	Stock var.	[Service Channel]*[number of Employees] + ∑([return rate]-[occupation rate])
Employee in-Service	Stock var.	∑([occupation rate]-[return rate])
Product Inventory	Stock var.	∑([sourcing rate]-[sales rate])
Revenue	Stock var.	∑([earning rate])
Cost	Stock var.	∑([expending rate])
Profit	Stock var.	∑([margin rate])
birth rate	Flow var.	RandNormal(12, 5)
sales rate	Flow var.	Min([willing-to-buy Customer], [Product Inventory])

leave rate	Flow var.	If time( ) < [validity Term] Then
		0
		Else
		[birth rate]{time( )-[validity Term]+1}*(1-[customer Satisfaction])/2

		End If

request rate	Flow var.	If time( ) < [product Life] Then
		0
		Else
		[sales rate]{time( )-[product Life]}*[customer Satisfaction]*(1+[marketing Effect])
		End If

service rate	Flow var.	If time( ) = 0 Then
		0
		Else
		Min([Employee], [Service-Request Customer]{time( )-1})
		End If

occupation rate	Flow var.	∑([service rate]+[producing rate])

return rate	Flow var.	If time( ) < Min([production Duration], [service Duration]) Then
		0
		Else
		[service rate]{time( )-[service Duration]+2} + [release rate]
		End If

open rate	Flow var.	0

producing rate	Flow var.	If time( ) < [production Policy]+1 Then
		0
		Else
		Min([willing-to-buy Customer]{time( )-[production Policy]}, [Production Capacity])
		End If

release rate	Flow var.	If time( ) < [production Duration] Then
		0
		Else
		[producing rate]{time( )-[production Duration]+2}
		End If

sourcing rate	Flow var.	If time( ) < [production Duration] Then
		0
		Else
		[producing rate]{time( )-[production Duration]+2}
		End If

expending rate	Flow var.	Roundup([marketing Budget]+[capacity Cost]*[Production Capacity]+[channel Cost]*[Service Channel]+[production Cost]*[producing rate]+[inventory Cost]*[Product Inventory]+[service Cost]*[service rate]+[labor Cost]*[Employee])
earning rate	Flow var.	Round([sales rate]*[product Price]+[service rate]*[service Price])

margin rate	Flow var.	Round([earning rate]-[expending rate])

marketing Effect	parameter	If [marketing Budget] ≤ 600000 Then
		0.05 + [marketing Budget]*2/100,000,000
		Else If [marketing Budget] ≤ 1,200,000 Then
		0.1 + [marketing Budget]*2/100,000,000
		Else If [marketing Budget] ≤ 1,800,000 Then
		0.25 + [marketing Budget]*2/100,000,000
		Else If [marketing Budget] ≤ 2,400,000 Then
		0.35 + [marketing Budget]*2/100,000,000
		Else
		0.4
		End If

word-or-Mouth	parameter	If [customer Satisfaction] ≤ 0.3 Then
		0.08 + [customer Satisfaction]/10
		Else If [customer Satisfaction] ≤ 0.6 Then
		0.16 + [customer Satisfaction]/10
		Else If [customer Satisfaction] ≤ 0.9 Then
		0.24 + [customer Satisfaction]/10
		Else
		0.35
		End If

customer Satisfaction	parameter	0.7

marketing Budget	parameter	2,000,000

willing-to-buy Customer	parameter	If time( ) < 2 Then
		0
		Else If time( ) = 2 Then
		Min([Potential Customer]{time( )}, [Potential Customer]{time( )}*[marketing Effect]+([Purchased Customer]{time( )}-[Purchased Customer]{time( )}-1)*[word of Mouth]))
		Else
		Min([Potential Customer]{time( )}, [Potential Customer]{time( )}*[marketing Effect]+([Purchased Customer]{time( )}-[Purchased Customer]{time( )-1})*[word of Mouth]+([Purchased Customer]{time( )-1}-[Purchased Customer]{time( )-2})*[word of Mouth]*0.5))
		End If

validity Term	parameter	10
factory Budget	parameter	350,000,000
factory Build-cost	parameter	130,000,000
capacity Unit-cost	parameter	5,000,000

production Policy	parameter	0
production Duration	parameter	5
channel Budget	parameter	250,000,000
channel Setup-cost	parameter	35,000,000
employee Hiring-cost	parameter	2,000,000
number of Employees	parameter	5
service Duration	parameter	3
product Life	parameter	78
waiting Time	parameter	12
service Cost	parameter	5,000
labor Cost	parameter	5,000
channel Cost	parameter	5,000
production Cost	parameter	5,000
inventory Cost	parameter	5,000

capacity Cost	parameter	5,000
service Price	parameter	300,000
product Price	parameter	1,000,000

국문 초록

최근의 제조 산업은 치열한 경쟁과 급변하는 고객의 요구로 인해 중요한 비즈니스 패러다임의 변화를 겪고 있다. 제조기업들은 이익률 하락에 대응하기 위해 생산한 제품만을 판매하는 것에서 판매 제품에 서비스 가치를 더하여 제품-서비스 시스템(Product-Service System, PSS)을 제공하는 것으로 전환하고 있다. PSS는 제품 수명주기 전반에 걸쳐 고객과의 상호 작용을 강화함으로써 제조기업의 장기적으로 안정적인 수익을 창출할 수 있도록 한다. 초기에는 건설, 항공우주, 중공업, 기계장비 등의 기업간 비즈니스 시장에서 많았으나, 최근에 들어서는 모빌리티, 홈 가전, 프린터 등의 기업과 개인 간의 비즈니스 시장에서도 활발해지고 있다. Neely (2013)의 연구에 따르면, 조사 기업의 50% 이상이 이미 PSS를 도입하고 있다고 하였다. 이러한 제조기업의 PSS 전환 추세는 최근의 디지털 전환 흐름 속에서 ICT 기술을 활용한 고객 서비스 개발과 적용이 가능해짐에 따라 더욱 가속화되고 있다.

이러한 제조기업의 PSS로의 전환은 고객 가치 창출 및 수익성 개선의 측면에서는 큰 잠재력을 보유하고 있지만, 성공적인 PSS 전환을 위해서는 해결해야만 하는 과제도 여럿 있다. 예를 들어, 고객의 요구에 대한 잘못된 이해, 초기 투자에 대한 불확실성 등 시장 또는 고객 측면의 이슈들과 기존 사업 영역과의 자기 잠식(Cannibalization), 혁신에 대한 저항 등 기업 내부 측면의 어려움 등이 있다. 그 중에서도 PSS 전환으로 인해 제조 기업이 가치를 창출하여 고객에게 제공하는 모든 과정이 변경된다는 측면에서 최적의 비즈니스 모델 혁신은 가장 중요한 요소 중의 하나이다. 동일한 제품과 서비스에 기반하여 PSS를

제공하더라도, 그 가치를 전달하고 수익을 창출하는 전략에 따라 기업의 비즈니스 모델은 차별화될 수 있는 것이다. 특히 서비스 기업과의 협조 또는 협업으로 인해 그 과정이 더욱 복잡해질 PSS 분야에서 비즈니스 모델 관점의 중요성은 더욱 증가할 것이다. 그러나 지금까지 PSS 분야에서의 비즈니스 모델의 설계와 평가에 대한 관심은 많지 않았다. PSS 개발 초기의 적절하지 못 한 비즈니스 모델 설계와 이에 대한 충분하지 않은 평가는 추후, PSS 전환 이후에 오히려 안 좋은 결과를 초래할 수 있다.

이에, 본 연구는 성공적인 제조기업의 PSS 전환을 위해 비즈니스 혁신의 관점에서 PSS 개발에 집중하였다. 앞에서 언급한 바와 같이, 제품 기능 및 서비스 요소의 개발 못지 않게 비즈니스 모델의 설계 또한 중요하다. 그렇기에 PSS 개발 영역을 "제의(Proposition) 단계"와 "평가(Assessment) 단계"로 구분하여 각 단계에서 필요한 비즈니스 모델링 방법론과 비즈니스 모델 평가 방법론을 개발하였다.

첫 번째 주제에서는 현실성 있는 다양한 비즈니스 모델 개발의 위해 형태학적 분석(Morphological analysis)을 사용하는 새로운 비즈니스 모델링 방법론을 개발하였다. 형태학적 분석은 다양한 컨셉의 대안을 만드는데 효과적인 방법으로, 공학 설계 등 다양한 분야에서 적용되어 왔다. 본 연구에서는 이러한 형태학적 분석 방법의 특징을 활용하여 다양한 PSS 비즈니스 모델 방안을 생성하고, 이를 기반으로 비즈니스 모델의 진화 방안, 즉 로드맵 작성에 까지 활용할 수 있는 "Morphological Chart"를 작성하였다. 이를 위해, 우선 기본의 문헌 연구에 기반하여 하나의 비즈니스 모델을 여러 개의 영역으로 정의하였다. 그리고 실제 비즈니스 혁신 사례를 분석하여 사용된 비즈니스 혁신 전략을 도출하고, 앞서 정의한 하위 영역별로 각 전략을 정렬하였다. 본 연구에서 개발한 방법론과 "Morphological Chart"를 대한민국의 헤이 드라이어기 제조기업의 PSS 전환 사례에 적용하여, 개발한 방법론의 활용성 및 효율성 등을 검증하였다. 또한 분석한 실제 비즈니스

혁신 사례와 개발한 방법론을 웹 기반의 시스템(BizChef)으로 개발하여, 누구나 어디서든지 혁신 사례를 조회할 수 있고, 개발한 비즈니스 모델링 방법론을 활용할 수 있도록 하였다. 두 번째 주제에서는 시스템 다이나믹스 접근법(System Dynamics approach)에 기반하여 복잡한 PSS 비즈니스 모델을 평가하는 방법론을 개발하는데 초점을 두었다. PSS 전환에는 제품, 서비스, 그리고 파트너사 등 다양한 요소들이 필요하고, 이들이 복잡한 상호 영향 관계(Casual loop)를 갖는다. 예를 들어, 제품 가격의 인상은 제조기업의 수익을 증가 시킬 수 있으나, 이는 서비스 가격의 인상과 이에 따른 서비스 이용자 수의 감소를 야기하여 오히려 전체 수익 분배 규모를 감소시킬 수 있다. 시스템 다이나믹스 접근법 이와 같이 다양한 구성 요소 간에 복잡한 상호 영향 관계를 가지는 시스템이 시간의 흐름에 따라 어떻게 변화하는지 분석하는데 유용한 방법이기에, 본 연구에 도입하였다. 우선 복잡한 PSS 에코시스템을 비즈니스 운영 구조(mechanism)을 고려하여 6개의 세부 모듈로 분리하고, 각 모듈을 표현하기 위한 기본 템플릿(basic template)을 개발하였다. 그리고 PSS 유형에 따른 특성을 반영하여 기본 템플릿을 변형시킨 고급 템플릿(advanced template)을 개발하였다. 다양한 PSS 전환 사례에 개발한 방법론을 적용하여, 실용성과 효율성을 보여주었다. 본 연구에서 개발한 방법론을 활용한 체계적인 PSS 비즈니스 모델의 평가는 성공적인 PSS 전환을 위한 효율적 자원 배치 및 운영 시나리오 등의 의사 결정에 도움이 될 것이다.

주요어: 제품-서비스 시스템(Product-Service System), PSS 개발 프레임워크, 비즈니스 모델 혁신, 형태학적 분석법(Morphological analysis), 시스템 다이나믹스
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