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Key factors of service design methodology for manufacturing servitization

Hyeog-in Kwon[1], Bo-Hyun Baek[2], Yong-Su Jeon[3], Ye-Lin Kim[2]* and Hwa-Bin Jung[2]

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*Corresponding author: Ye-lin Kim, Department of Arts and Cultural Management, Graduate School, Chung-Ang University, Seoul, 06974, Korea, +82-2-820-6965
E-mail: Yelinkim728@gmail.com

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Len Tiu Wright, De Montfort University Faculty of Business and Law, Leicester, UK

Additional information is available at the end of the article

Abstract: With progressions in technology and high demand for value, business model designs based on cooperative systems are essential for innovative manufacturing servitization. Previous studies, which focused on product innovation or specific industries, either lacked standardized steps or promoted inconsistent processes and tools. Therefore, an integrated, holistic evaluation for designing and using service design methodologies was essential. Examining previous research, this study derived key factors categorized through focus group interviews with 13 experts. The analytic hierarchy process was used to derive weights for each factor to rank the level of importance. The results revealed the key factors of service design methodology: utility, systematicness, innovation, and convergence. Lower factors included the applicability to reality, ease of use, representation of needs, composition feasibility, customer value scalability, industrial convergence, flexibility, output clarity, collaboration support, and business improvement. The results of this study may be used as a basis for the development and selective adoption of service design methodologies in macroscopic terms. The study provides a direction for innovation and improving business models. It also serves as an academic foundation for industrial service innovation and ecosystem creation.

ABOUT THE AUTHOR

We are confident that platforms promote cooperation and competition among industry stakeholders and plays a role in servicing of product-centered management activities. Thus, we are investigating service design methodology from a macroscopic perspective necessary to expand the traditional business administration sector from an internal perspective to an ecological perspective and promote sustainable industrial convergence.
We developed eco science methodology where ecosystem, platform, service, and strategy are the main keywords, and applied the methodology to various industries in South Korea (lighting, cultural cities, online commerce, games, etc.) in carrying out R&D projects on business model innovation.

PUBLIC INTEREST STATEMENT

With the increasing opportunities and threats from new technologies and demand for a higher level of value proposition, manufacturing companies are focusing on manufacturing-service as an innovation strategy. In conjunction with the emerging role and value of design for building an inter-industry collaboration system, various service design methodologies are being developed in companies or governments. However, the majority of service design methodologies lack standardized steps or are inconsistent. Therefore, this study establishes the standards for designing or using the service design methodology. Based on the theory from preceding research, FGI was conducted for management and consulting experts, and the AHP methodology was used to determine the important rankings for each key factor. The results of this study can thus be selectively used from a macroscopic point of view. It will provide direction for innovating and improving business models as well as an academic foundation for service innovation and ecosystem creation.

Subjects: Sustainable Development; Business, Management and Accounting; Management of Technology & Innovation

Keywords: Analytic hierarchy process (AHP); key factors; manufacturing servitization; industrial service innovation; service design methodology

1. Introduction

Companies worldwide have been constantly facing new environments following rapid changes in the industrial structure since the late 20th century. Conventional manufacturing companies, which regarded production and supply of products as values of utmost importance, or companies that relied only on certain industries, suffered significantly with the introduction of companies in low-cost and low-wage countries. Even the continued survival of conventional blue-chip companies became questionable. Especially with the foreboded prolongation of the COVID-19 crisis, strategies to embrace fundamental problem-solving that address upcoming new situations are urgently needed. This trend has exacerbated the need for new markets and growth engines capable of creating added value, to remain competitive and emerge from deteriorating financial conditions.

As the value of services experienced by consumers was prioritized following a consumer-oriented shift of innovative perspectives, measures to create new customer value became increasingly important, including establishing business models that created added value through inter-industrial convergence. As the industrial paradigm shifted toward manufacturing servitization, service designs that established cooperative systems and created customer experience value, were emphasized. Notable cases of servitization included Apple and Nintendo, which emphasized design as a factor for success. Hence, numerous areas required design-oriented thinking to derive creative and innovative ideas. In response, scholars investigated ways to develop and use service design methodologies, noting its value.

Despite the increasing business models for innovation capabilities for manufacturing servitization, most companies lack knowledge and experience in service design methodologies or tools for innovation (Kang et al., 2018). Hence, it is necessary to establish standards for determining service design methodologies. While such methodologies are being developed by government projects or consulting firms for industrial servitization, there are no specific guidelines for assisting the methodology. These limitations create confusion in developing steps and tools for each methodology, further corroborating the need for service design methodology's standardized criteria.

Most conventionally developed methodologies focus on deriving services through business model innovation rather than the service implementation process. They overlook the feedback system for service implementation, resulting in decreased effectiveness in practical use. Moreover, most conventional service design methodologies are studied in terms of a single field, such as business administration or industrial engineering, and multi-dimensional industrial approaches have been inadequate. Therefore, there exists an urgent need to develop a methodology that holistically views industries from a convergent perspective and responds to new paradigms. If a methodology applicable to a convergent industry business model is developed, a business ecosystem-oriented evaluation system will be required.

This study derives key factors in service design methodology to support manufacturing servitization and presents criteria that support the development and use of this methodology. To this end, this study determines factors based on a theoretical examination of service design and conducts focus group interviews (FGI) with experts to modify and supplement these factors. A hierarchical decision-making model is established whereby an analytic hierarchy process (AHP) method is used to derive weights for each factor to support the development and use of service design methodologies. It is anticipated that this study will lay the foundation—academically and practically—through an analysis from an industry-comprehensive integrated perspective unconstrained by the derivation of service or the specific area of service design aiming to implement service design based on this study. Additionally, this study offers a specific basis for developing a business model innovation methodology that can drive practical manufacturing servitization.

2. Theoretical background

2.1. Service-dominant logic

Manufacturing has contributed to global economic growth and industry advancement since the 1960s. In a manufacturing-centered society, a good was perceived to create value, and activities and production processes needed to innovate them, were prioritized. This goods-oriented approach is defined by the goods-dominant logic (G-D logic) (Verma et al., 2012). However, manufacturing faces limitations as industrial structure undergoes change, including resource depletion, competition acceleration, and reduced product life cycles owing to technology standardization.

The conventional manufacturing industry required a new growth engine for innovation (Lusch & Nambisan, 2015). Thus, the importance of intangible resources, namely, knowledge, skills, and competencies, increased, and the conversion to services drew attention as a new method for manufacturing industry innovation (Ko et al., 2019). As a result, the manufacturing paradigm shifted from product-based to service-based, placing emphasis on the sales of goods as well as customer experience and value in the consumption of goods (Adrodegari & Saccani, 2017). Thus, academia has attempted to explain the phenomenon of manufacturing servitization through the G-D logic. The service-dominant logic (S-D logic) noted by Vargo and Lusch (Vargo & Lusch, 2011) was the first study to establish the industrial paradigm shift from G-D logic to manufacturing servitization.

G-D logic aimed to improve productivity and maximize sales, recognizing goods as units of exchange and items of value. Therefore, resources for use were limited to physical resources, such as natural resources. Consumers were perceived as having a vertical relationship with goods. Under a goods-oriented mindset, services were recognized as an auxiliary means independent of value creation (Wilden et al., 2017).

In contrast, S-D logic defines service as a broad concept encompassing goods; the objective of all activities is to enhance consumer experience and value. Key resources in S-D logic include both intangible and tangible elements. Hence, intrinsic value is derived by a conversion to services using resources that can be sustainably used, such as technology, knowledge, and networks (Dyer et al., 2018). In this process, interested parties in the business ecosystem engage in mutual exchange to meet the requirements of each company or are desired for integration with other resources. As such, interested parties integrate and exchange various resources to create an inter-industrial cooperative ecosystem and expand value (Vargo & Lusch, 2011; Viglia et al., 2018).

S-D logic notes value is jointly generated by customers and suppliers. In G-D logic, the consumer is a passive subject endowed with value. However, S-D logic asserts that, following the provision of services, value is created by the consumer experience of using goods and services. Therefore, the focus is on the value created in customer interactions rather than on the value of the good itself. Customers are not merely purchasers of goods but active value co-creators (Hansen, 2019). Table 1 summarizes the G-D and S-D logics.

2.2. Service-design methodology

Using S-D logic, manufacturing has recognized servitization as a new opportunity (Vargo & Lusch, 2008). As manufacturing services emerge as industrial growth engines based on S-D logic, various countries encourage this growth by introducing innovative manufacturing servitization business models using service design methodologies.

The service design concept was established by Shostack (Shostack), and it aims to increase the empirical value of the customer with a design-oriented approach to the overall process, from design

Table 1. Goods-dominant logic and service-dominant logic

	Goods-dominant logic	**Service-dominant logic**
Objective	Productivity improvement	Consumer value Improvement
Units of exchange	Goods	Services
Resources used	Tangible elements	Intangible elements
Customer relationship	Vertical	Relational
Customer role	Simple consumer	Value co-creator
▼	▼ ▼	▼
Form of manufacturing	***Conventional manufacturing***	***Servitized manufacturing***

to delivery of services, which substantiates the requirements of interested parties. Service design innovates business models from a design-oriented perspective, with an emphasis on how to present unique experiences to customers (Micheli et al., 2019).

"Service design methodology" is a methodology used to design the entire process of a service to maximize the customer's experience value. These are design-thinking, blue ocean strategy, and product-service system (PSS). Thus, the outputs of a service design methodology are derived from different processes. In addition, tools composed of various techniques are presented for each process The tool is a toolkit that specifically documents an idea to develop a service model, and performs the service design methodology process according to the characteristics of the target project.

Traditional manufacturing uses these methodologies to promote servitization. Notable examples include IBM, GE, and Philips. For example, IBM was a hardware-oriented company that led the computer industry with hardware systems like mainframes, but tried to provide a service through design thinking to promote understanding and empathy for customers. As a result, the company shifted its focus to service sectors, such as cloud computing, from hardware sales. Consequently, it created added value, such as productivity, while improving customer experience value. Philips too, combined the technology accumulated over time and design thinking that provides an integrated perspective, to sympathize with various stakeholders. Accordingly, Philips is currently concentrating on building a cooperative system, an integrated strategic partner, to improve service experience and give value to all stakeholders related to the service, such as in the healthcare field, one of its main businesses.

Since around 2000, there has been a trend to innovate services by using creative ideas, methodologies, or tools of design companies, rather than those of companies that traditionally provide management consulting centering on overseas global companies. As a result, there are now companies that specialize in service design that perform service development consulting through design methods. Additionally, according to Neely (Neely, 2008), in 2008, an average of 30% of the world's 13,775 manufacturing companies pursued servitization based on the service design methodology, with higher percentages recorded in the United States (60%) and Finland (53%). These results indicate that manufacturing servitization is not a one-time attempt (Brax and Visintin, 2017), as there have been attempts to develop new service design methodologies applicable to manufacturing servitization. For example, in South Korea, patent applications in the manufacturing servitization methodology sector demonstrated an increase of 132% between 2013 and 2016.

However, there are issues in using the service design methodology for manufacturing servitization. First, service design methodologies are being developed indiscriminately by various R&D projects or private consulting companies. Second, the perspectives, stages, and tools of the service design methodology vary (Table 2). This variance has resulted in confusion in the industry about

Table 2. Concepts and limitations for service-design methodologies

Service design methodologies		Contents
Design thinking (5 stages/57 tools)	Concept	The design thinking methodology is a creative approach to understanding customer needs and for devising various ideas in order to discover innovative solutions for complex problems that need to be resolved (Brown & Wyatt, 2010, Kelley, 2010).
	Limitations	Design thinking focuses solely on developing service models and fails to consider ecosystems, business management strategies, and ICT technologies that promote inter-industrial convergence.
Blue ocean strategy (5 stages/8 tools)	Concept	The blue ocean strategy is a methodology to shift to a new market—the blue ocean—from the existing highly competitive market—the red ocean—by applying unchallenged new ideas or technologies (Kim & Mauborgne, 2005, Kim & Mauborgne, 2019).
	Limitations	Unclear feedback system and lack of ecosystem view for cooperation among interested parties involved in the service.
Product-service systems (5 stages/10 tools)	Concept	The Product-Service Systems (PSS) methodology combines tangible products with intangible services to create innovative and sustainable values to meet customer needs (Goedkoop, 1999, Costa et al., 2016, Lee et al., 2010).
	Limitations	Lack of specific tools or feedback system for evaluating created prototypes.

which service design methodologies to apply and which processes to follow. Consequently, a "service paradox" occurs wherein the qualitative value of the product decreases owing to an unsuitable introduction of service design methodologies as more companies attempt manufacturing servitization.

In addition, the requirements of companies that want to design a new business model through the recent manufacturing servitization are diversifying, and the demand for the development of a methodology from a design perspective in which multidisciplinary fields, such as manufacturing, service, and ICT, cooperate is increasing. However, despite the diversification of demand for service design depending on the applied industry, the service design methodology previously developed focuses on a microscopic perspective that can only be applied to specific industries. In this context, it is necessary to develop a methodology capable of deriving a broad and comprehensive strategy that is not limited to a specific field by approaching it multidimensionally.

When evaluating the overall methodology process, such as the steps and tools of the service design methodology, the criteria are not specifically presented, or the evaluation tools or systems are absent. Therefore, in most cases, service quality and process evaluation or evaluation cases are adopted from other fields. Since it is difficult to cope with the new paradigm with the existing evaluation system, a criterion that can flexibly apply and evaluate the convergence-based service design methodology is required that is line with the current trend. Therefore, it is necessary to determine standardized key elements that may be applied to the use or design of service design methodologies (Adrodegari & Saccani, 2017; Yu & Sangiorgi, 2018).

The ultimate purpose of manufacturing servitization based on the S-D logic must be to link the implementation of concepts to corporate performance alongside establishing academic foundations. In other words, it must not remain an abstract concept but bear specificity, enabling an immediate introduction to industries. Therefore, this study derives key elements of service design methodologies for the pursuit of manufacturing servitization based on previous research. The results of this study will serve as a basis for the selection of appropriate service design methodologies by companies or responsible consultants pursuing manufacturing servitization and may serve as a basis for private or public consulting firms in formulating such methodologies.

2.3. Key elements of service design methodology

This study collected and classified previous studies related to service design to prepare the criteria for determining service design methodology for manufacturing servitization.

Lee et al. (Lee & Park, 2015) noted the insufficient handling of the user experience in existing product-service design processes and methodologies. Thus, a study was conducted to develop toolkits that emphasized the importance of user experience analysis in the product-service design framework and methodology, which enabled manufacturers or service companies to provide users with expanded experiences. Lee et al. (Lee & Park, 2015) identified the value of toolkits for usability, clarity, and differentiation through expert evaluation. As a result, a guide for applying the methodology was provided, making it of practical significance. However, it only conducted an expert evaluation on toolkits developed through simulation.

Choi (Choi, 2018) extracted common factors from the framework of the four areas of business model development, new product development, new service development, and service design, and then the “4E model” was established based on the checklist for servitization support in the manufacturing industry and the requirements based on the practical experience of the researcher. The “4E model” is a consulting framework that supports manufacturing services, and consists of the following four steps: (i) “Evaluate” for company diagnosis and evaluation, (ii) “Experience” for experiencing and analyzing customer value, (iii) “Explore” for discovering ideas and exploring ways to service them, (iv) “Expand” for deriving and simulating the concept of service. There are 20 detailed items and guidelines for them. Accordingly, Choi (Choi, 2018) developed consulting frameworks to support manufacturing servitization, namely, processes, specific items, and guidelines. Verification was performed through interviews with experts for on-site applicability of the 4E Model, a framework that supports manufacturing servitization, and for quantitative evaluation based on six target items: necessity, suitability, systematicness, usability, creativity, and uniqueness. Choi (Choi, 2018) is significant, as it provides practical guides to support servitization for manufacturing companies. However, the items for evaluation were limited, as they did not include those that allowed identification on an integrated basis relative to the processes established under a macroscopic and complex framework.

Lee (Lee, 2019) derived key factors in service design methodologies affecting the innovative performance of companies applying service design. Service design management factors were established, such as intercorporate cooperation, process suitability, research and development cooperation with external agencies, external partner collaboration, and consumer interaction-oriented strategies. The study provided academic implications in its presentation of service design factors that may affect corporate innovation performance. However, factors that can predict the performance derived from the business model to which service design is applied, are limited by the lack of visibility of the service design development process and the suitability thereof.

Park et al. (Park et al., 2015) presented the dimensions that must be prioritized in the servitization of manufacturing companies, productization of service companies, and PSS design for companies with PSS attributes. The study presented seven dimensions to be considered in PSS design: equitable usability, flexibility of use, simplicity, intuitiveness, tolerance for errors, minimal physical effort, and accessibility. Park et al. (Park et al., 2015) provided academic implications for understanding the properties of PSS. However, this contribution is limited, as it is not suitable for areas applying service designs other than PSS, given that the prioritized factors have been derived only from PSS.

Jung et al. (Jung et al., 2017) proposed an entrepreneurial business process modeling methodology that enabled efficient management of external resources and interested parties needed by start-up companies. Using business process research, this study presented property-specific metrics such as ease of use, attributes and understandability of corporate operations, accuracy, suitability, standardization, work efficiency, and information accessibility. The study is significant in practice, as it can be used by start-up companies seeking to develop business models through improvements to existing business process modeling techniques. However, there is a limitation: It emphasizes specific, rather than general, business modeling methodologies.

Park (Park, 2013) objectively verified the scan, focus, approach, and touch process, based on service empirical design thinking. Based on the three properties of the creative product semantic scale—novelty, problem-solving, and style—four experimental investigations were conducted for factors of surprise, originality, usefulness, logic, value, understandability, organic composition, refinement, and skill. Park (Park, 2013) is significant in practice, as it objectively verified systematized processes and provided guidelines for building systems in various industries through conventional methodologies. However, it is limited, as, in the course of evaluation, it failed to gather opinions from personnel likely to use the methodology; rather, it tended to derive attributes that may only be applied to a particular methodology.

The Korea Institute of Design Promotion (Korea Institute of Design Promotion (KIDP), 2015a) classified an evaluation scale for research on the status of service design education and the development of educational methods based on a study by Stevick (Stevick, 1972). Stevick, in turn, composed evaluation metrics with the following characteristics: suitability to student needs, realism of material, usability, consistency of material, and conciseness of structure. Based on these characteristics, the study derived five keywords: structure, clarity, suitability, diversity, and connectivity. Creativity, a factor underlying service design elements, was added to these five keywords, and subsequently applied to the evaluation of the toolkit composition and details. Hence, these items were used as the criteria for the evaluation of the service design toolkit in the Survey of Overseas Service Design Status (Korea Institute of Design Promotion (KIDP), 2015b). This application of evaluation examples from other fields to the analysis of service design tools demonstrates practical significance. However, this study is limited, as the evaluation criteria were not derived from a service design perspective. The key factors and scope of research on servitization and service design derived from previous studies are presented in Table 3.

A review of previous studies demonstrates that some differences may be present, depending on the target industry's development direction or business model subject to application, but the factors emphasized are generally similar. Thus, the key factors that the service design methodology used for manufacturing servitization must bear are: systematicness, utility, innovation, and convergence.

Previous studies significantly helped identify key factors for the vitalization and success of industries and verified the services and research results derived from corporate or government projects. However, because different existing service design methodologies have different stages, tools, evaluation and verification tools, feedback systems, and targets for innovation, there are limitations in reviewing whether design tools or appropriate methodologies have been used based

Table 3. Key factors based on previous studies

Upper factors	Lower Factors	Previous Studies						
		1	2	3	4	5	6	7
Systematicness	Sequence feasibility	○	○	○			○	
	Composition feasibility	○	○	○			○	
	Theoretical basis	○	○				○	○
	Output	○	○					○
Utility	Accessibility	○	○		○	○	○	○
	Complementarity				○	○		
	Flexibility		○	○	○	○	○	
	Degree of reality	○	○				○	
Innovativeness	Technical perspective	○						
	Business perspective		○		○	○		
	Instrumental perspective						○	○
Convergence	Collaboration support	○	○	○				
	Industrial convergence support			○				
	Representation of needs	○		○				

1. Lee et al. (Lee & Park, 2015)
2. Choi (Choi, 2018)
3. Lee (Lee, 2019)
4. Park et al. (Park et al., 2015)
5. Jung et al. (Jung et al., 2017)
6. Park (Park, 2013)
7. Korea Institute of Design Promotion (Korea Institute of Design Promotion (KIDP), 2015a)

on the key elements derived. A new level of methodology that extends beyond the rapidly changing industrial paradigm and the conventional service design methodology is required. It is urgent to prepare the evaluation standards thereof, which are currently insufficient. Therefore, this study derives the key elements of service design methodologies based on previous studies.

3. Research design and method

To derive evaluation factors to establish the criteria for determining which service design methodology to design or select, this study interviewed consulting experts, who are interested parties in the industry, and analyzed the relative importance of the evaluation factors recognized by the group. Expert FGIs and an AHP were conducted sequentially. In this study, research subjects were recruited based on the list of members registered with the Korea Smart Consulting Association, where 470 consulting service organizations in each field, including strategy, marketing, manufacturing innovation, design, and IT service, are subscribed. Research subjects were selected using Purposeful sampling. The criteria for the selection of subjects were established: (1) a degree in business administration and (2) a career in practical consulting spanning 10 years or longer to enhance the expertise of responses. FGIs were conducted on experts who met these selection criteria with the intention to widen the expertise of responses. In fact, there were a total of 13 interviewees who participated in the FGIs, and the contents related to each interviewee are shown in [Table 4].

Table 4. List of experts

No.	Expert	Affiliation	Major fields
1	A	GKTM Co., Ltd.	Marketing, technical commercialization
2	B	Value Search Co., Ltd.	Management strategy, manufacturing innovation
3	C	Cheongpyeong Co., Ltd.	Technical commercialization
4	D	Korea Institute of Science and Technology Information	Technology Value evaluation, Policy Study
5	E	Netbiz World Co., Ltd.	Marketing, management strategy
6	F	CSD Consulting	Technical strategy, technical commercialization
7	G	Bizlaw Management Institute	Management strategy, marketing, franchising
8	H	Myung Consulting	Management strategy, commercialization strategy, marketing
9	I	STS Management Research Institute	Management strategy, marketing
10	J	BNU Partners Co., Ltd.	Management strategy, marketing, business model development
11	K	Glonet Investment Consulting Co., Ltd.	Management strategy, commercialization strategy
12	L	Namu Consulting Group Co., Ltd.	Management strategy, HR
13	M	YJC Co., Ltd.	Commercialization strategy, marketing

3.1. Focus group interview

FGI is a sentiment-based survey method that induces responses through free discussion to gather awareness or ideas on a particular subject (Lederman, 1990). Discussions are conducted in a comfortable atmosphere, enabling interactions, beneficial ideas, or opinions among participants. It is used when quantitative data renders analysis difficult, or to identify perceptions of new areas (Kim et al., 2018).

To facilitate the smooth progress of the interview and improve the quality of information, interview questionnaires were emailed to the interviewees in advance to familiarize them with the questions. At the outset of the interview, an introduction to the study and the operational definitions of relevant terms were provided. Subsequently, the upper and lower factors derived from previous research were presented, and opinions on the addition, modification, and deletion thereof, were freely requested. Subsequently, the factors were refined based on expert opinions, and the hierarchical analysis structure for the AHP was designed.

3.2. Analytical hierarchy process

AHP is a sentiment-based analysis method that stratifies problems into main factors and subfactors, and calculates their weight based on the results of pairwise comparisons conducted by experts (Satty, 1976). Since rational identification is difficult for individuals when there are too many evaluation factors that comprise a problem, the AHP methodology is used to systematically evaluate problems for which there are multiple criteria or when differentiated evaluation values are required for individual criteria.

In the AHP methodology, hierarchical structuring occurs in four stages through the dismantling of the decision-making structure (Middlehurst et al., 2018).

First, the problem is stratified into a hierarchical structure, where comprising factors are divided into main factors and subfactors, usually spanning three to seven levels.

Second, evaluation criteria are then set on a nine-point scale (1 = similar to 9 = very important), and the relative importance of the evaluation criteria is estimated using the Eigenvalues for the data collected based on pairwise comparison.

Third, the absolute importance is determined based on the importance of the higher factors. Hence, the evaluation and verification of consistency are conducted based on the lowermost factors of each level. Consistency of the weights derived is a value for comparing importance and enhances rationality in its use as an objective decision-making indicator. Therefore, to evaluate the consistency of responses, the consistency ratio (C.R.) is used to verify the reliability of responses (Morgan, 2017).

In general, based on previous AHP studies in the field of social sciences, if the C.R. is less than 0.1, the respondent's response results are considered reasonable and consistent, and if the C.R. value is less than 0.2, the responses are considered acceptable. However, if the C.R. value is more than 0.2, the responses are judged to lack logical consistency, and the decision making process should be reviewed (Satty, 1976). Therefore, in this paper, the acceptance criterion was set to a C.R. of 0.2 or less.

Fourth, weights are aggregated for stratified elements, and hierarchy is derived (Middlehurst et al., 2018). In this study, Microsoft Excel was used to analyze the results of the survey for AHP analysis.

4. Results

4.1. FGI results

Among the key factors of service design methodology, participants suggested that the concepts of sequence and composition feasibility overlapped among lower factors for systematicness. Hence, sequence feasibility was removed and integrated with composition feasibility. Additionally, participants suggested establishing criteria for the extent to which the output was consistently derived when performed using the same design methodology and composition thereof. Thus, evaluating whether the output had been derived in a verifiable form using the service design methodology. Integrating these opinions, two new factors were added. Ultimately, the systematicness factor was composed of five lower factors.

Participants suggested that, among the upper factors derived, the term "utility" was deemed more appropriate for noting the degree of service design methodology usage and application facility as a consulting tool; therefore, "usability" was revised to "utility." Among the lower factors, "accessibility" was deemed to overlap with concepts such as "flexibility" that may be used to indicate adaptable application for each situation. Thus, participants suggested that the term be modified to "ease of use," indicating convenience and ease of use. "Complementarity" was deemed to imply the degree to which continuous modification was possible while using the methodology. The degree of reality, a factor indicating the degree of suitability for use at practical levels, was included among the final factors after revising the term modifiability and applicability to reality, respectively, in consideration of terms more easily understood.

The "technical perspective" factor among the lower factors of innovation was modified to "technical representation," which more adequately indicated the degree to which ICT technology was represented in the service design process. The "business perspective" factor was modified to "economic feasibility," as the term was to be understood as the idea of reducing the time and cost for the business model design or business process improvement, by reducing economic costs. The "instrumental perspective" factor was modified to "creativity," as the use of methodological instruments facilitated the generation of creative ideas.

In addition, as technical, business, and instrumental perspectives are factors from the supplier's perspective, participants suggested that factors presenting customer value and experience were needed. Additionally, participants suggested factors indicating the degree of improvement for conventional products, services, or service models, which were represented among the final factors as customer "value scalability" and "business improvement." The final results of the FGI are presented in Table 5. A hierarchical decision model based on these results was designed to enable pairwise comparisons, as presented in Figure 1.

4.2. AHP results

The AHP analysis was performed based on the hierarchy finalized using the FGI. The C.R. values for each of the respondents' individual upper and lower factors were found to be under 0.2, thus the respondent's response results were judged to be reasonable and logically consistent. The combined weights of all factors were calculated using the geometric mean, the results of which are presented in Table 6. (Detailed upper and lower factors analysis results are included in the appendix.)

The priority sequence found in the priority analysis was as follows: applicability to reality (0.155) > ease of use > representation of needs (0.105) > composition feasibility (0.103) > customer value scalability (0.073) > industrial convergence (0.053) > flexibility (0.052) > clarity of output (0.046) > collaboration support (0.038) > business improvement (0.037) > creativity (0.036) > modifiability (0.035) > theoretical feasibility (0.034) > economic feasibility (0.031) > contextual consistency (0.030) > technical representation (0.027) > verifiability (0.025). This study explicates these outcomes based on the 10 factors of topmost priority.

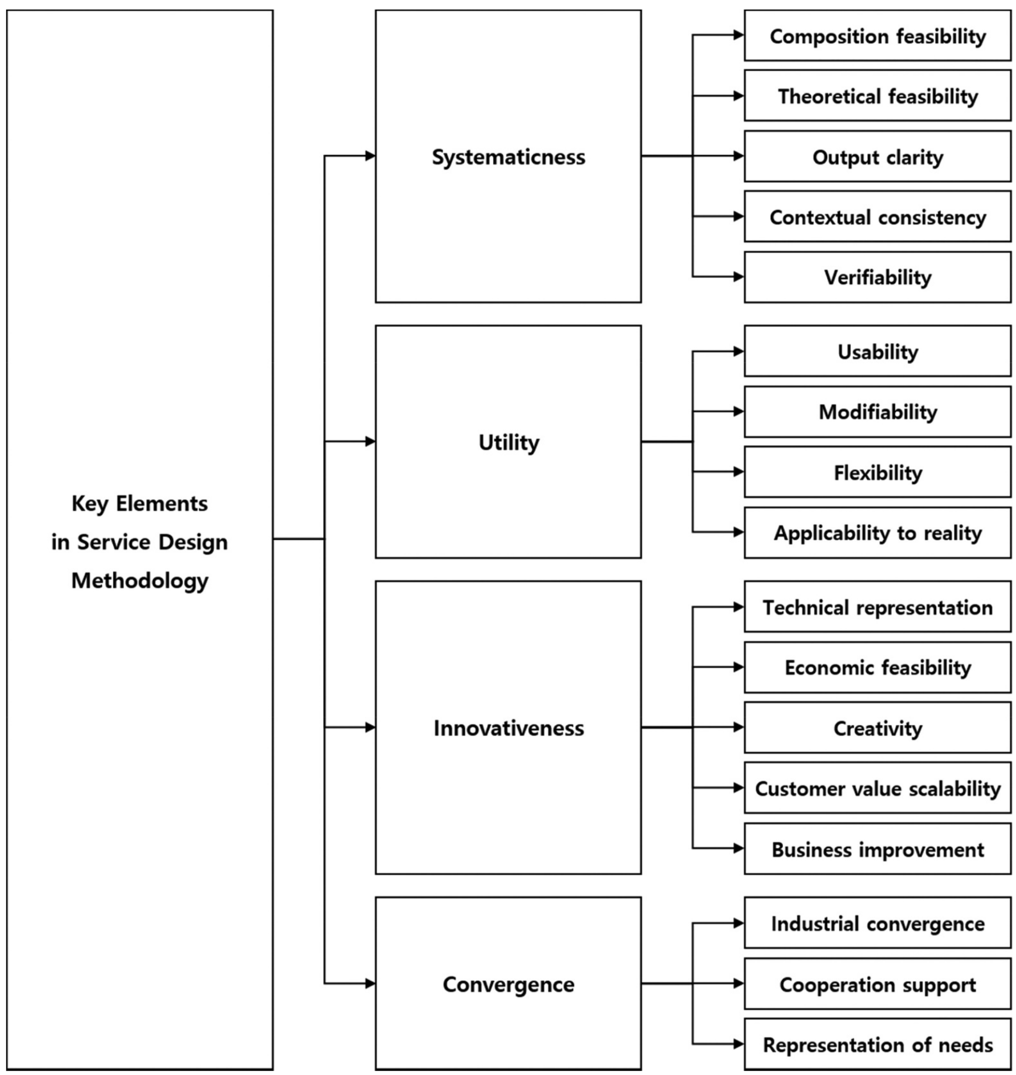
Table 5. Categorization of key elements in service design methodology

Category	Factor	Contents
Upper	Systematicness	Degree to which the processes and components of the service design methodology are structured
Lower	Composition feasibility	Degree of feasibility of the composition and procedures of the service design methodology
	Theoretical feasibility	Degree of feasibility of the composition of the service design methodology from a theoretical standpoint
	Output clarity	Degree of clarity of the final output by each stage of the service design methodology
	Contextual consistency	Degree of consistency of the context comprising the service design methodology
	Verifiability	Degree to which the service design methodology can be derived in a verifiable form
Upper	Utility	Degree of usage facility of the service design methodology as a consulting tool
Lower	Ease of use	Degree of ease to use the service design methodology
	Modifiability	Degree to which continuous modification is possible in the course of service design methodology usage
	Flexibility	Degree of usage flexibility of the service design methodology according to application circumstances
	Applicability to reality	Degree of realistic use of the service design methodology at practical levels
Upper	Innovativeness	Degree of innovativeness of the service design methodology
Lower	Technical representation	Degree to which the service design methodology takes ICT into account in the service design process
	Economic feasibility	Degree to which the service design methodology reduces costs (temporal and economic) of designing a business model
	Creativity	Degree to which the use of service design methodology tools promotes idea creation
	Customer value scalability	Degree to which the service design methodology can expand values presented to customers
	Business improvement	Degree to which the service design methodology improves existing service models
Upper	Convergence	Degree to which the service design methodology facilitates collaboration across different disciplines

(*Continued*)

Category	Factor	Contents
Lower	Industrial convergence	Degree to which the service design methodology is applicable for inter-industrial convergence
	Cooperative support	Degree to which the service design methodology facilitates inter-industrial collaboration
	Representation of needs	Degree to which interested parties (industries, customers, partners) are represented in the application of the service design methodology

Figure 1. Hierarchy.



First, among the lower factors of utility (0.363), applicability to reality (0.155) ranked first and ease of use (0.122) second, which are the most basic factors considered when using a service design methodology at practical levels. A service design methodology developed by a government project or consulting firm, must be applicable at practical levels as a consulting tool. Therefore, the ease of use of methodology at practical levels as well as its use as a consulting framework to support servitization must be considered during development. Hence, methodologies must be applicable for conducting practical consulting.

Regarding ease of use, the user of the methodology and tool may not fully grasp the concepts and processes for manufacturing servitization design in the formulation of the business model to which service design is applied. Therefore, it is necessary to present specific contents for detailed items to facilitate the understanding of consultants or businesses. As such, the process structure of the methodology must clearly express and provide information consistently to allow anyone to use the methodology and tools intuitively.

The representation of needs (0.105) of convergence (0.196) ranked third. Academic fields and technology that can analyze and understand customer requirements are attracting attention owing to industrial paradigm changes. Understanding customers relative to supplier competitiveness, such as technology, is important. Therefore, customer experience insights must influence design innovation for all elements from the planning stage of the product. In this respect, it is essential to review service design methodologies or tools to identify customer needs. Ultimately, representing customer needs optimizes customized products and services for customers, thereby driving continued value-exchanging interactions.

Composition feasibility (0.103) of systematicness (0.237) ranked fourth. Previous studies on service design for manufacturing servitization reveal that services for design-oriented thinking are ongoing. As such, various government projects and consulting companies are developing service design methodologies for product or service innovation. However, there are no reference criteria for designing compositions or procedures while developing manufacturing and service design methodologies. Hence, existing methodological evaluation systems are adopted, or new ones are developed without verification. In addition to these limitations, there is a lack of standards for determining whether the methodology is applicable in terms of composition and procedures of previously developed service design methodologies. Therefore, it is important to ensure the feasibility of the methodology composition and procedures for service design.

Customer value scalability (0.073) of innovation (0.204) ranked fifth. There is an increasing awareness that innovation through service requires understanding customers. Therefore, design-oriented thinking from the customer's perspective identifies customer requirements, which conveys and provides value for the service experiences. Expanding customer value is a major factor that augments value, which customers enjoy through integrated services within a converged ecosystem.

Industrial convergence (0.053) of convergence (0.196) ranked sixth. As the requirements of interested parties become more diverse and detailed, it is essential to examine the creation of new ideas based on a holistic understanding of industries, technologies, products, and customers, which deliver values heretofore are not offered. This creation requires an ecological approach to share ideas based on expertise in various industries and fields. Therefore, it is important to implement servitization through processes and methodologies, using multidisciplinary approaches from a converged perspective.

The flexibility (0.052) of utility (0.363) ranked seventh. For users pursuing design thinking-oriented manufacturing servitization, there is a limit to using numerous service design tools for new business models. In addition, the flexibility in the selection and use of service design tools enhances efficiency in realizing and expressing ideas in detail, as implementation varies depending on the industry and targets of use and development. Therefore, the possibility of selecting a tool depending on the application circumstances is important. A flexible service design methodology may be conducive as a systematic tool for practical use.

Output clarity (0.046) of systematicity (0.237) ranked eighth. According to the Lee (Lee, 2019), service design was defined by the Korea Service Design Council as "improving service experience by capturing potential requirements among interested parties through customer-centered insights and realizing them through creative, multidisciplinary, and cooperative design methods." Particularly notable is the necessity to visualize ideas derived from service design methods; that is, such ideas must be expressed as tangible and concrete outcomes. In addition, the output must be clearly presented to verify that the ideas derived from the service design methodology are feasible. Therefore, the results produced in each stage of the service design methodology must be clearly expressed.

Cooperative support (0.038) of convergence (0.196) ranked ninth. In various countries, there are rising interests in developing business models supporting the establishment of a manufacturing and service convergence ecosystem. Accordingly, there exists a need for a plan to implement servitization, using unique ideas based on strategic understanding of the industry and internal corporate resources. Therefore, creating opportunities to cooperate with experts in various fields and to share expertise, in addition to the consideration of technical aspects, is important in designing a methodology or using tools.

Table 6. Integrated results

Upper factors (A)	C.R.	Lower factors (B)		Rank (C = A*B)	
				Overall importance (C)	Rank
Systematicness (0.237)	0.002	Composition feasibility	0.434	0.103	4
		Theoretical feasibility	0.143	0.034	13
		Output clarity	0.194	0.046	8
		Contextual consistency	0.125	0.030	15
		Verifiability	0.104	0.025	17
Utility (0.363)	0.007	Ease of use	0.336	0.122	2
		Modifiability	0.096	0.035	12
		Flexibility	0.142	0.052	7
		Applicability to reality	0.426	0.155	1
Innovativeness (0.204)	0.004	Technical representation	0.131	0.027	16
		Economic feasibility	0.153	0.031	14
		Creativity	0.176	0.036	11
		Customer value scalability	0.359	0.073	5
		Business improvement	0.182	0.037	10
Convergence (0.196)	0.000	Industrial convergence	0.269	0.053	6
		Cooperative support	0.194	0.038	9
		Representation of needs	0.537	0.105	3

Finally, business improvement (0.037) of innovativeness (0.204) ranked tenth. With the increasing demand for industrial advancement through services, different alternatives and approaches are required. As such, manufacturing servitization enables design methods to be applied throughout the manufacturing and service delivery process; customer satisfaction is enhanced with improved productivity, and revenue is generated by new business models that promote innovation. Therefore, by promoting innovation, a company may achieve qualitative growth and quantitative results, including revenue generation through enhanced productivity or increased added value.

5. Conclusion

The increasing reliance on services in the manufacturing industry and the changing industrial environment have increased the need to depart from intense competition and innovate products and services. As such, governments in various countries are increasingly interested in converged ecosystems for manufacturing servitization. Following this trend, a service design methodology must be developed to establish an inter-industrial collaboration system. Various studies have been conducted to develop and provide directions for service design methodologies but have been limited to presenting methodologies for product or service innovation, using service design as a single aspect among various industrial areas.

This study identified the lack of clear criteria for designing or selecting conventional service design methodologies and conducted research to derive key factors for designing or selecting such methodologies. Prior to the AHP analysis, previous studies on service design were analyzed, and FGIs were conducted with 13 management and consulting experts to derive a hierarchical model comprising 4 upper and 17 lower factors. Then, surveys were conducted with these experts, and the priority of each factor was calculated using the AHP. After sequencing, the study analyzed ten top priority factors.

This research process provides several results. Utility is the priority in designing and selecting service design methodologies. Therefore, service design methodologies must present ease, flexibility, and realistic applicability of use. From an industrial perspective, a methodology that establishes a mutual cooperation framework must be developed, and it should promote collaboration among various interested parties involved in the service. A multidisciplinary view will augment customer experience. Ultimately, a collaborative system through inter-industrial convergence based on design-oriented thinking must be established, and a macroscopic service design methodology in terms of an ecosystem enabling value-sharing among interested parties, must be developed and implemented.

6. Implications

6.1. Academic implications

This paper has two main academic implications. First, the core elements of the service design methodology for manufacturing servitization were derived. In the existing service design methodology, there was no evaluation tool or system, and there were no set specific criteria for developing the methodology, so there are limitations relating to selecting items from evaluation cases in other fields. Therefore, in this study, the core elements of the service design methodology of four high-level factors and 17 low level factors were derived using expert FGIs based on prior research so that they could be used for practical innovation and development of the convergence industry business model.

Second, the important rankings of the core elements of the service design methodology derived in this study were calculated, and can be used in future studies. It can be confusing when there are many evaluation elements that can be used for designing or selecting a service design methodology, so it may be helpful to indicate the relative importance of each core element. Therefore, this study attempted to increase the usability of the core elements of the service design methodology by calculating the importance of each core element finally reflected using the AHP methodology.

6.2. Managerial implications

This study presents the following implications. First, the criteria to support the development and use of service design methodology were presented. Despite the need for development of a service design methodology that establishes an inter-industrial cooperation system departing from industrial age competition, there has been a lack of standardized steps and methodology with a feedback system. Additional limitations include microscopic views, applicable only in particular areas. Hence, this study identified the key factors of service design methodology based on previous research, refined the factors by gathering opinions from experts, and identified the priorities of each factor. This study is significant as it provides an academic and practical basis for criteria to design methodologies and select tools for servitization. This can be practically used as a standard when developing a service design methodology from a macroscopic perspective, and selectively borrowing.

Second, in order to implement the service design methodology for manufacturing-service innovation, the core elements were derived by considering the overall service implementation system. Since most of the existing methodologies focus only on the service derivation stage through business model innovation, a methodology that considers the overall service implementation process was required. Therefore, in consideration of the practical application of the service design methodology, the core factors were derived so that the feedback system reflecting the customer experience can be reviewed. By utilizing the key factors considering actual service implementation, the effectiveness of the service design methodology can be improved.

Third, the core elements of the service design methodology were derived from an integrated perspective for the entire industry, and were not limited to specific fields. In accordance with the trend of gradually pursuing a service design methodology for industrial convergence, a methodology for a convergence industrial business model is required. Therefore, through prior research and expert FGIs, key elements that can be considered from the perspective of business ecosystem were derived. These can be flexibly applied according to the industrial field. In addition, by using the innovative business model corresponding to the new paradigm as a means to review, it will be able to contribute to the creation of a convergence ecosystem.

6.3. Limitations and future directions

This study also has a few limitations. First, this study conducted an AHP analysis of experts to investigate key factors in service design methodology, but further analysis with users of this methodology will help verify whether the derived factors are conducive to the use of methodologies or selecting and adopting tools.

Second, only 13 experts participated in the survey, which may not represent the opinions of industries or companies using this methodology. Nevertheless, this study is significant in that it collects and analyzes opinions from various field experts in academia and industries.

This study derives the core factors of the service design methodology to support those unable to innovate and improve business models due to the lack of a service design methodology for manufacturing-service convergence. However, the ways to use the core factors derived from this research result to apply it to develop an innovative business model, or to innovate and improve the existing business model, and to verify the subsequent management effect is an area for future research. Therefore, as the scope of this study is tailored to the integrated perspective for industrial convergence, a study to verify future application effects is needed.

In addition, in the rapidly changing industrial environment, the process and tools of the service design methodology must be repeatedly developed and modified. Accordingly, in order to flexibly apply and support the innovative methodology that will emerge in the future in addition to the previously developed methodology, a follow-up study is needed to modify and supplement the key factors derived through continuous practical verification.

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Author details
Hyeog-in Kwon[1]
Bo-Hyun Baek[2]
Yong-Su Jeon[3]
Ye-Lin Kim[2]
E-mail: Yelinkim728@gmail.com
ORCID ID: http://orcid.org/0000-0002-4433-9108
Hwa-Bin Jung[2]
[1] School of Business Administration, Chung-Ang University, Seoul, 06974, Korea.
[2] Department of Arts and Cultural Management, Graduate School, Chung-Ang University, Seoul, 06974, Korea.
[3] Department of Arts and Cultural Management, Graduate School, Chung-Ang University, Seoul, 06974, Korea.

Declaration of Interest Statement
The authors declare no conflict of interest.

Author Contributions
Conceptualization, Hyeog-in Kwon, Bo-hyun Baek, Yong-su Jeon, Ye-lin Kim, and Hwa-bin Jung.; methodology, Bo-hyun Baek and Ye-lin Kim.; formal analysis, Ye-lin Kim and Hwa-bin Jung.; investigation, Bo-hyun Baek and Yong-su Jeon.; resources, Hyeog-in Kwon, Yong-su Jeon, and Hwa-bin Jung.; data curation, Ye-lin Kim.; writing—original draft preparation, Ye-lin Kim.; writing—review and editing, Bo-hyun Baek.; supervision, Hyeog-in Kwon. All authors have read and agreed to the published version of the manuscript.

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References
Adrodegari, F., & Saccani, N. Business models for the service transformation of industrial firms. *The Service Industries Journal* 2017, *37*(1), 57–83. https://doi.org/10.1080/02642069.2017.1289514

Brax, S. A., & Visintin, F. Meta-model of servitization: The integrative profiling approach. *Ind Market Manag* 2017, *60*, 17–32. https://doi.org/10.1016/j.indmarman.2016.04.014

Brown, T., & Wyatt, J. Design thinking for social innovation. *Dev Outreach* 2010, *12*(1), 29–43. https://doi.org/10.1596/1020-797X_12_1_29

Choi, E. M. A study on the 4E model as a consulting framework for supporting manufacturing services. Doctoral thesis in Korea, Major in Design, Graduate School of Techno Design, Kookmin University, 2018.

Costa, N., Patra, N., & Morelli, L., N. Revisiting PSS and service design in the light of SD-logic. In *Service Design geographies. Proceedings of the ServDes2016 Conference*; Linköping University Electronic Press, 2016; No. 125, pp. 119–131.

Dyer, J. H., Singh, H., & Hesterly, W. S. The relational view revisited: A dynamic perspective on value creation and value capture. *Strategic Management Journal* 2018, *39*(12), 3140–3162. https://doi.org/10.1002/smj.2785

Goedkoop, M. (1999). Product service systems. Ecological and economic basis.

Hansen, A. V. Value co-creation in service marketing: A critical (re) view. *Int J Innov Stud* 2019, *3*(4), 73–83. https://doi.org/10.1016/j.ijis.2019.12.001

Jung, Y. S., Lee, S. H., Yoon, J. H., & Sung, S. H. Develop and evaluate entrepreneurial business process models. *J Korean Ind Manag Assoc, 1*, 367–372. http://scholar.dkyobobook.co.kr/searchDetail.laf?barcode=4010026112821

Kang, M. S., Cho, H. S., & Ko, D. Y. Survey of policy direction for reinforcing innovation capabilities of Korean service companies. *Korea Evaluation Institute of Industrial Technology (KEIT)*. 2018. https://www.nkis.re.kr:4445/subject_view1.do?otpId=OTP_0000000000002386&otpSeq=0&popup=P

Kelley, D. Design thinking. IDEO.2010. https://www.ideou.com/pages/design-thinking

Kim, W. C., & Mauborgne, R. Value innovation: A leap into the blue ocean. *J Bus Strat, 26*(4), 22-28. https://pdfs.semanticscholar.org/06c8/e22889dc80c703185531e726a863eae8d60b.pdf

Kim, W. C., & Mauborgne, R. Nondisruptive creation: Rethinking innovation and growth. *MIT Sloan Manag Rev* 2019, *60*(3), 46–55. https://mitsmr.com/2txDu6Y

Kim, Y., Lee, K. J., Lee, J. H., Lee, J., Kim, Y. M., Jin, H., & Yun, M. H. Study on developing customer groups in consolidated financial services using qualitative and quantitative analysis. *IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* 2018, 168–172. DOI:10.1109/IEEM.2018.8607770

Ko, D. Y., Kim, S. M., Lee, D. H., Kang, M. S., Kim, C. K., Park, J. S., & Park, M. S. Analysis of the impact of service convergence innovation capabilities on corporate performance and implications: Focusing on service convergence patents. *Korea Evaluation Institute of Industrial Technology (KEIT)*. 2019. https://www.nkis.re.kr:4445/subject_view1.do?otpId=OTP_0000000000004748&otpSeq=0&popup=P

Korea Institute of Design Promotion (KIDP). The status of service design education and the development of educational methods 2015a.

Korea Institute of Design Promotion (KIDP). Survey of overseas service design status 2015b.

Lederman, L. C. Assessing educational effectiveness: The focus group interview as a technique for data collection. *Comm Edu* 1990, *39*(2), 117–127. https://doi.org/10.1080/03634529009378794
Lee, M. Y., & Park, N. C. A study on the product-service design method of the user experience design perspective. *Arch Des Res* 2015, *26*(2), 165–191. DOI : 10.15187/adr.2013.05.26.2.165
Lee, S. H. A study on the major service design management factors affecting the organization's innovation performance. Domestic Doctorate Thesis Soongsil University Graduate School, 2019.
Lee, S. W., Maeng, J. W., Hong, Y. K., Park, H. J., & Kim, Y. S. Product-service system design processes and cases. *International Conference Papers of the Korean CDE Society*. 2010, 126–129. https://www.dbpia.co.kr/Journal/articleDetail?nodeId=NODE02359953
Lusch, R. F., & Nambisan, S. Service innovation: A service-dominant logic perspective. *MIS Quart* 2015, *39*(1), 155–176. https://doi.org/10.25300/MISQ/2015/39.1.07
Micheli, P., Wilner, S. J., Bhatti, S. H., Mura, M., & Beverland, M. B. Doing design thinking: Conceptual review, synthesis, and research agenda. *Journal of Product Innovation Management* 2019, *36*(2), 124–148. https://doi.org/10.1111/jpim.12466
Middlehurst, G., Yao, R., Jiang, L., Deng, J., Clements-Croome, D., & Adams, G. A preliminary study on post-occupancy evaluation of four office buildings in the uk based on the analytic hierarchy process. *Intelligent Buildings International* 2018, *10*(4), 234–246. https://doi.org/10.1080/17508975.2018.1495607
Morgan, R. An investigation of constraints upon fisheries diversification using the Analytic Hierarchy Process (AHP). *Marine Policy* 2017, *86*, 24–30 https://doi.org/10.1016/j.marpol.2017.05.037
Neely, A. Exploring the financial consequences of the servitization of manufacturing. *Oper Manag Res* 2008, *1*(2), 103–118. https://doi.org/10.1007/s12063-009-0015-5
Park, G. W., Kim, Y. S., Kim, S. H., & Park, K. T. Product-service integrated system design considering service contact technology: Focusing on universal design. *Korean J Bus Adm* 2015, *28*(8), 2165–2185. https://www.dbpia.co.kr/Journal/articleDetail?nodeId=NODE02172203
Park, S. H. A study on the evaluation of SFAT process model based on empirical design thinking for service industry innovation. *Dig Des Stud* 2013, *13*(2), 79–91. DOI :10.17280/jdd.2013.13.2.009
Satty, G. J. Trigonometry revisited: A combined approach. *Math Teach* 1976, *69*(7), 557–560. https://doi.org/10.5951/MT.69.7.0557
Shostack, G. L. How to design a service. *Eur J Market, 16*(1), 49-63.
Stevick, E. Evaluating and adapting language materials. In *Teaching English as a Second Language: A Book of Readings*, H. B. Allen & R. N. Campell, Eds.; McGraw-Hill: 1972; Volume 2, pp. 101–120.
Vargo, S. L., & Lusch, R. F. Service-dominant logic: Continuing the evolution. *J Acad Market Sci* 2008, *36*(1), 1–10. https://doi.org/10.1007/s11747-007-0069-6
Vargo, S. L., & Lusch, R. F. (2011). It's all B2B ... and beyond: Toward a systems perspective of the market. *Ind Market Manag* ***2011***, *40*(2), 181–187. https://doi.org/10.1016/j.indmarman.2010.06.026
Verma, R., Ng, I., Parry, G., Smith, L., Maull, R., & Briscoe, G. Transitioning from a goods-dominant to a service-dominant logic. *J Serv Manag, 23*(2), 416-439. https://doi.org/10.1108/09564231211248480
Viglia, G., Pera, R., & Bigné, E. The determinants of stakeholder engagement in digital platforms. *Journal of Business Research* 2018, *89*, 404–410. https://doi.org/10.1016/j.jbusres.2017.12.029
Wilden, R., Akaka, M. A., Karpen, I. O., & Hohberger, J. The evolution and prospects of service-dominant logic: An investigation of past, present, and future research. *Journal of Service Research* 2017, *20*(4), 345–361. https://doi.org/10.1177/1094670517715121
Yu, E., & Sangiorgi, D. Service design as an approach to implement the value cocreation perspective in new service development. *Journal of Service Research* 2018, *21*(1), 40–58. https://doi.org/10.1177/1094670517709356.

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Appendices

Table A1. Stage-by-stage refinement of factors and final key factors.

Literary research (stage 1)		**FGI (stage 2)**	**AHP (stage 3)**
Upper factors	Lower factors	Additional factors for expert interviews	Finalized factors
Systematicness	Sequence feasibility	(Deleted)	
	Composition feasibility		Composition feasibility
	Theoretical feasibility		Theoretical feasibility
	Output clarity		Output clarity
		Contextual consistency	Contextual consistency
		Verifiability	Verifiability
Utility	Accessibility	Usability	Ease of use
	Complementarity	Modifiability	Modifiability
	Flexibility		Flexibility
	Degree of reality	Applicability to reality	Applicability to reality
Innovativeness	Technical perspective	Technical representation	Technical representation
	Business perspective	Economic feasibility	Economic feasibility
	Instrumental perspective	Creativity	Creativity
		Customer value scalability	Customer value scalability
		Business improvement	Business improvement
Convergence	Industrial convergence		Industrial convergence
	Cooperative support		Cooperative support
	Representation of needs		Representation of needs

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Table A2. Results of expert-specific responses for upper factors

Respondent	Systematicness	Utility	Innovativeness	Convergence	C.R.	Result
A	0.230	0.665	0.031	0.074	0.185	A
B	0.636	0.246	0.071	0.046	0.121	A
C	0.213	0.087	0.667	0.033	0.109	A
D	0.052	0.264	0.115	0.569	0.044	A
E	0.114	0.053	0.264	0.569	0.044	A
F	0.534	0.325	0.105	0.036	0.126	A
G	0.052	0.114	0.264	0.569	0.044	A
H	0.053	0.568	0.115	0.265	0.043	A
I	0.360	0.106	0.414	0.120	0.012	A
J	0.044	0.635	0.243	0.078	0.14	A
K	0.041	0.619	0.068	0.272	0.194	A
L	0.582	0.252	0.048	0.119	0.155	A
M	0.459	0.361	0.123	0.056	0.03	A

A: Accepted/R: Rejected

Table A3. Integrated results of upper factors

Category	Systematicness	Utility	Innovativeness	Convergence	Weight	Rank
Systematicness	1	0.773	0.948	1.244	0.237	2
Utility		1	1.848	2.117	0.363	1
Innovativeness			1	0.885	0.204	3
Convergence				1	0.196	4
C.R.	***0.010***					

Table A4. Results of expert-specific responses to lower factors

Category		A	B	C	D	E	F	G	H	I	J	K	L	M
Systematic ness	C.R.	0.195	0.098	0.113	0.073	0.074	0.150	0.167	0.099	0.132	0.101	0.087	0.182	0.072
	Compos ition feasibility	0.572	0.256	0.51	0.269	0.263	0.473	0.114	0.269	0.456	0.149	0.501	0.456	0.496
	Theoreti cal feasibility	0.022	0.52	0.274	0.075	0.036	0.271	0.025	0.05	0.18	0.523	0.023	0.252	0.132
	Output clarity	0.110	0.053	0.03	0.469	0.506	0.171	0.489	0.038	0.247	0.233	0.135	0.047	0.276
	Contex tual consis tency	0.253	0.029	0.122	0.145	0.134	0.060	0.041	0.138	0.028	0.065	0.276	0.160	0.063
	Verifiability	0.043	0.142	0.064	0.042	0.062	0.025	0.330	0.505	0.090	0.030	0.064	0.900	0.033
Utility	C.R.	0.185	0.100	0.150	0	0.048	0.090	0.175	0.045	0.027	0.037	0.044	0.188	0.157
	Ease of use	0.281	0.224	0.216	0.124	0.254	0.557	0.256	0.567	0.249	0.256	0.216	0.585	0.300
	Modifia bility	0.034	0.083	0.034	0.375	0.051	0.267	0.030	0.053	0.057	0.042	0.460	0.220	0.103
	Flexibility	0.083	0.043	0.085	0.375	0.106	0.131	0.083	0.265	0.091	0.096	0.108	0.117	0.041
	Applica bility to reality	0.602	0.650	0.664	0.125	0.589	0.045	0.631	0.115	0.602	0.607	0.215	0.079	0.556

(*Continued*)

Table A4. (*Continued*)

Category		A	B	C	D	E	F	G	H	I	J	K	L	M
Innovativeness	C.R.	0.192	0.154	0.137	0.070	0.069	0.141	0.168	0.054	0.144	0.082	0.061	0.108	0.072
	Technical representation	0.036	0.028	0.024	0.041	0.033	0.473	0.023	0.512	0.044	0.137	0.051	0.429	0.468
	Economic feasibility	0.112	0.413	0.047	0.075	0.060	0.300	0.037	0.268	0.055	0.060	0.030	0.292	0.270
	Creativity	0.027	0.132	0.114	0.469	0.270	0.151	0.109	0.031	0.087	0.504	0.121	0.058	0.145
	Customer value scalability	0.533	0.050	0.509	0.269	0.507	0.054	0.562	0.129	0.553	0.264	0.518	0.188	0.075
	Business improvement	0.292	0.376	0.305	0.145	0.130	0.023	0.269	0.060	0.260	0.035	0.280	0.033	0.042
Convergence	C.R.	0.192	0.021	0.032	0.000	0.034	0.190	0.154	0.033	0.012	0.130	0.055	0.119	0.083
	Industrial convergence	0.048	0.116	0.132	0.199	0.639	0.737	0.050	0.640	0.118	0.207	0.077	0.711	0.234
	Cooperative support	0.163	0.199	0.080	0.199	0.103	0.219	0.177	0.257	0.133	0.057	0.186	0.197	0.061
	Representation of needs	0.789	0.685	0.788	0.602	0.258	0.045	0.772	0.103	0.750	0.736	0.737	0.092	0.705
Rejection		***A***	***A***	***A***	***A***	***A***	***A***	***A***	***A***	***A***	***A***	***A***	***A***	***A***