

Product Migration Strategies to Product-Service Systems Based on Korean Industrial Cases

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Abstract — Product-service system (PSS) is a system of products, service, supporting networks and infrastructure that is designed to be competitive. The concept of PSS is rather new and currently many companies and governmental institute are eager to implement the PSSs as a new business model. In this paper, we propose a three-dimensional model to classify PSS based on three axes. The three axes consist of selling product type, product usage type, and sustainability. The selling product type is classified as physical product, physical product and added services, and product-service system. The product usages type is classified as product-oriented, use-oriented, and result-oriented usage. The sustainability is classified as economy, society and environment. The 3D model is applied to the surveyed Korean industrial practices to identify some typical migration paths from physical product to PSS. Three typical migration paths are identified and the paths are used to suggest Sustainable PSS(SPSS) development strategies. Three identified paths are value-extended SPSS, positioning-extended SPSS, and field-extended SPSS.

Keywords — Industrial practices, product service integration, Product-Service System, PSS development strategy.

I. INTRODUCTION

The number of companies of Republic of Korea which exports the most in the world is declining as illustrated in Fig. 1 [3]. As a result, average net profit rate to sales of Korean manufacturing industry is reduced from 6.2% in 2004 to 4.9% in 2007. This implies new business strategies are urgently needed for Korean manufacturing industry.

Such manufacturing industry problems were prevailing in USA or Europe much earlier than Korea. To come up with such problem, new business models are proposed recently [1, 6, 11,12]. Product-service system (PSS) is one of the new business models to solve such problems. PSS is an integrated system of products and services. PSSs support competitively designed networks and infrastructure. PSSs also satisfy customers' needs while have a lower environmental impact than traditional business models. Currently many companies and governmental institute are beginning to develop the PSS as a new business model.

In this paper, we are focusing on industrial practices as new business models for the companies. PSSs are rather popular in electronic industry. The examples of the PSS in electronic industry are iPod, iPhone, e-Book, etc. We first thoroughly investigate the current practices of PSS in Korean electronic industry. The examples are surveyed

and projected directions are given. Then, non-electronic PSSs are surveyed; especially mechanical PSSs are intensively discussed. Using the survey results, we propose several major development strategies of PSSs.

In this paper, we briefly review the previous works related to the PSS classification. Then, we give a three-dimensional model to identify typical migration paths from physical product to PSS. Based on the paths, three typical SPSS (Sustainable PSS) development strategies are suggested. Finally, we conclude our work and discuss the future research directions.



Fig.1. The Trend of the Number of Top Global Exporting Korean Company

II. RELATED WORKS

Early researches on PSSs are focused on how to implement concept of services on the existing products. To add services to the existing products, we need to classify how to add services and develop business models. The focus of this paper is to identify development strategies of PSSs. To identify the strategies, we focus on the classification of PSSs. Two major existing classifications of PSSs are given in the next sections.

A. PSS Classification by Cook and Tukker

Cook classifies PSSs into three categories and Tukker reclassifies them into eight sub-categories as given in Fig. 2[2, 9, 10]. In product-oriented services, the business model is still dominantly geared towards sales of products, but some extra services are added. In use-oriented services, the traditional product still plays a central role, but the business model is no longer feared towards selling products. In result-oriented services, the client and provider in principle agree on a result, and there is no predetermined product involved.

Value mainly in product content	Product-service system			Value mainly in service content
	Product content (tangible)		Service content (intangible)	
Pure product	A: product-oriented	B: use-oriented	C: result-oriented	Pure service
	1. Product-related service 2. Product-related advice/consultancy	3. Product lease 4. Product renting/sharing 5. Product pooling 6. Pay-per-service unit	7. Activity management 8. Functional result	

Fig.2. The PSS Classification by Cook and Tukker

Because this classification is based on how to use the physical product, it is not sufficient to classify all PSSs. Especially the PSSs developed from services are hardly included in this classification. However this classification is very useful in identifying the usage type of products. Therefore we use this classification as one dimension to explain various and evolving PSSs in Section 3.

B. Service-Opportunity Matrix

Sawhney, Balasubramanian and Krishnan proposed the service-opportunity matrix (SOM) by merging the focus of growth with the type of growth as given in Fig. 3 [8]. The four elements are included in the matrix. The element of temporal expansion means growth from services that add new activities to a primary activity chain. The element of spatial expansion means growth from services that add new activities to an adjacent chain. The element of temporal reconfiguration means growth from services that change the structure and control of activities within a primary chain. And the element of spatial reconfiguration means growth from services that change the structure and control of activities within an adjacent chain.

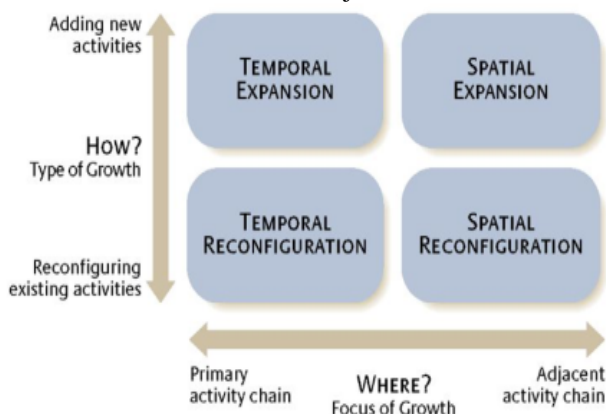


Fig.3. The Service-Opportunity Matrix

Even though this classification is rather complete by itself, it cannot be included in other model as a part. It is focused on expansion direction. Therefore we do not use this classification in our new model.

III. THREE-DIMENSIONAL MODEL

The classifications given in the previous section are two-dimensional and not enough to explain existing PSS business models. Therefore, we propose a three-dimensional (3D) PSS classification model as given in Fig. 4 to explaining more existing PSS business models. Even more, new 3D model can be useful in developing new business models.

The 3D model includes three independent axes of selling product type, product usage type, and sustainability. The sustainability is very important concept in the early PSS development because PSS was invented to solve environment issues of products. Existing classifications are mainly focused on the selling product and product usage types and in some sense overly simplified to explain more complicated PSSs.

In the proposed 3D model three axes are selling product type, product usage type, and sustainability. Each axis is categorized into three stages and total 27 cells are used in classifying PSSs. The three axes are intuitively independent even though theoretically hard to prove.

In selling product type axis, the three categories are physical products, product and added services, and PSSs as given in Fig. 5. In the stage of physical products, only physical products are selling in the market. Once physical product selling systems are established, services such as repair, maintenance, etc. are simply added as supporting business model to the products. That is the second product + added services stage. Then, PSSs are offered in the market as an integrated solution, which is the third PSS stage.

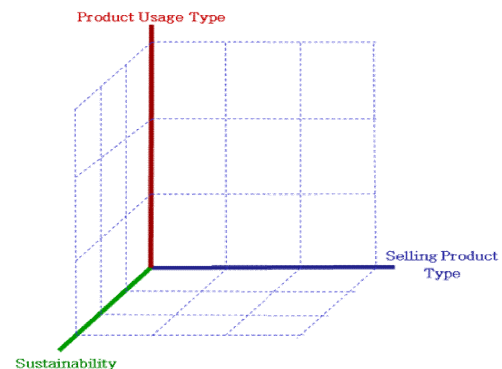


Fig.4. 3D Model



Fig.5. Selling Product Type Axis

In product usage type axis, we adopt the classification by Cook and Tukker given in Fig. 2 as shown in Fig. 6. As explained in Section 2, product usage is shifting from product-oriented to use-oriented, then result-oriented. The shifts are mainly caused by ownership change and how to define the solutions providing to the customers. The shift gives customers more freedom in utilizing the products. As a result, products and services can be used more efficiently.

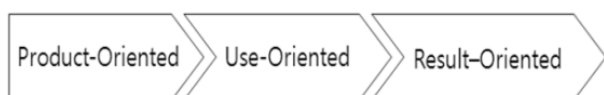


Fig.6. Product Usage Type Axis

In sustainability dimension, we adopt the concept of strong sustainability by Ott [4, 5, 7]. Ott proposed the concept based on triple-bottom lines (TBL), which are economical, social, and environmental sustainability as given in Fig 7. This dimension is very important because the total value of the product throughout the life-cycle has to be increased. To increase the life-cycle value of the product, product should have sustainability in terms of economical, social, and environmental sense.



Fig.7. TBL for Strong Sustainability

The major goal of the company is economical achievement, economy is the first stage in this axis. Then issues of corporate social responsibility arise. Therefore the society is the second stage. Finally environment issues are to be fulfilled for strong sustainability. The environment is the third stage.

The proposed 3D model is superior to 2D model in identifying the PSS development strategies. 2D model can just give three (SOM model) or ten (2D model by Cook and Tukker) migration paths from physical product to PSS. However 3D model can give maximum of 409 paths (proof is omitted because of paper space limit).

Since each axis of 3D model has three stages, total number of cells is 27. In this paper, we explain only the layer related to the first stage of the sustainability as shown in Table 1 because of the space limit. The first stage is economy as given in Fig. 7. We can project other two stages related to society and environment based on the explanation of the first stage.

Table. 1 The First Stage of Sustainability in 3D Model

Result -Oriented	G	H	I
Use-Oriented	D	E	F
Product-Oriented	A	B	C
	Physical Products	Product + Services	Product Service Systems

Nine cells, from A to I, are included in the first sustainability stage. Brief explanation of each cell is as follows:

- Physical products are simply selling in the market. High quality and performance of the products are main concern for the company.
- Supporting services are provided such as repair, maintenance, etc.

- Added services are integrated into the products tightly. Products and services are integrated to mutually support each other.
- Customers use the physical products by sharing without ownerships.
- Customers use the physical products and some supporting services by sharing without ownerships.
- Customers use the fully integrated PSS solutions by sharing without ownerships.
- Without specifying specific products, customers get agreed results provided by providers.
- Without specifying specific products or services, customers get agreed results provided by providers.
- Without specifying specific PSS solutions, customers get agreed results provided by providers.

IV. DEVELOPMENT STRATEGIES

Using the 3D model, we analyze the Korean companies how they migrate business models in 3D model. By grouping prominent patterns in the migration paths, we identify three major SPSS (Sustainable PSS) development strategies, value-extended SPSS, positioning-extended SPSS, and field-extended SPSS. There can be a lot more strategies and we are still identifying more strategies.

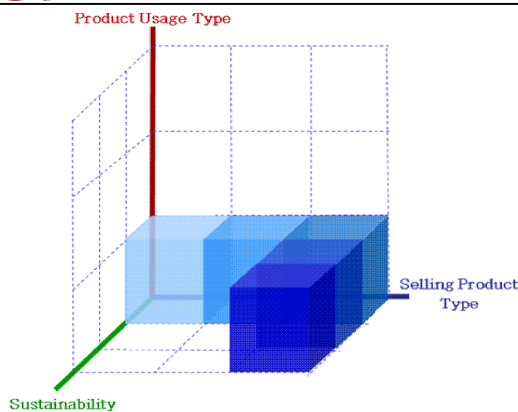
A. Value-Extended SPSS

The value-extended SPSS is classified as product-centered value extending PSS. A typical example is given as case of KD Power Inc. as shown in Fig. 8(a) [13]. The thickness of the shadow shows the migration paths. The thicker the shadow is, the later the business model is. The cases of Hyundai Shipbuilding, LS Industrial Electronics Inc. are also included in this type. The common characteristics of the products of these companies are B2B capital goods. The main strategy of PSS in this category is to extend the life-cycle of the product and increase the sustainability.

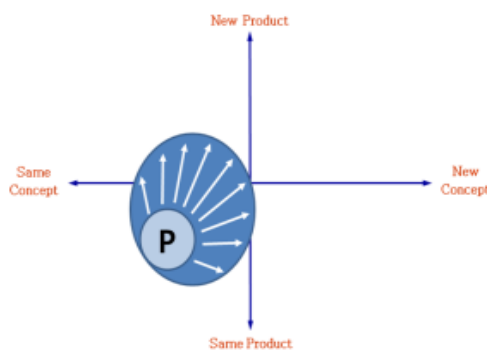
KD Power in the typical example is producing electrical machines. In the early stage, development and productions is focused on high quality and performance. Then the products are extended to IT-supported multi-functional systems with remote control capability. This brings 24-hour operation and environmental issues are considered in PSS development.

The PSS development changes of value-extended SPSS are illustrated in Fig. 8(b). The characteristics of the value-extended SPSS are as follows:

- The value of the products is expanded as a major strategy.
- The main customer needs are product quality and performance.
- Sustainability: Improvement in after services and distribution networks.



(a) Case of KD Power

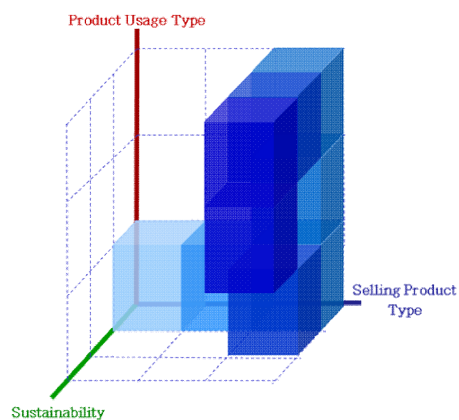


(b) Value-Extended SPSS

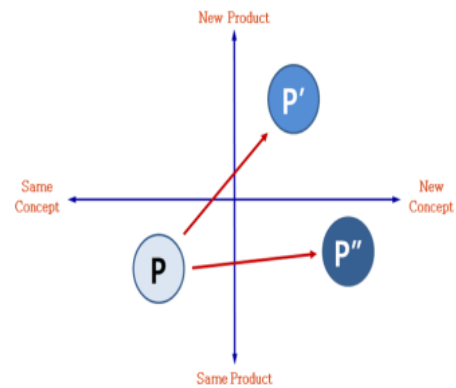
Fig.8. Case of KD Power and Value-Extended SPSS

B. Positioning-Extended SPSS

The positioning-extended SPSS is occurring in the companies producing both consumer goods and capital goods. The need for find new position in the market is very urgent for this type of companies. A typical example is given as case of Hyundai Motors Co. in Fig. 9(a) [14]. The cases of Hyosung Inc., Woongjin Coway Inc. are also included in this type. The main strategy of PSS in this category is to add new services on the products to find new position in the markets.



(a) Case of Hyundai Motors



(b) Position-Extended SPSS

Fig.9. Case of Hyundai Motors and Position-Extended SPSS

Hyundai Motors Co. in the typical example is producing commercial vehicles. In the early stage, development and productions of the company is focused on high quality and performance. Then the supporting services such as after service, BLU service, lease/rental service, etc. to compete with other foreign motor companies. The worldwide trend for assigning responsibility of recycling to manufactures is arising. This forces Hyundai to develop environment friendly vehicles.

The PSS development changes of position-extended SPSS are illustrated in Fig. 8(b). The characteristics of the position-extended SPSS are as follows:

- More advanced products and services are supplied in the network to expand the business models.
- More integrated PSSs are repositioned to expand market.
- The main customer needs shifts from physical products and services.
- Sustainability: Expansion of PSS fulfills social and environmental needs.

C. Field-Extended SPSS

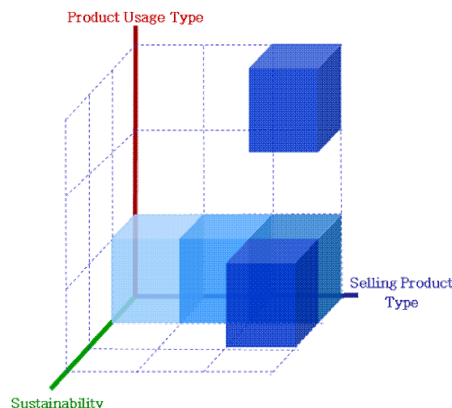
The Field-extended SPSS is occurring in the companies providing services and physical products are rather supporting roles in the PSS. The services are mostly related to consumer products. A typical example is given as case of Mint Pad in Fig. 10(a) [15]. The main strategy of PSS in this category is to provide integrated service solutions for sustainable business model.

Mint Pad in the typical example is PSS for integrated medical services. In this case, service models are developed first, the product to support the services is developed. Then the social sharing structure of such systems is implemented. In the end, social impact of the PSS become huge and sustainability of the PSS increase tremendously.

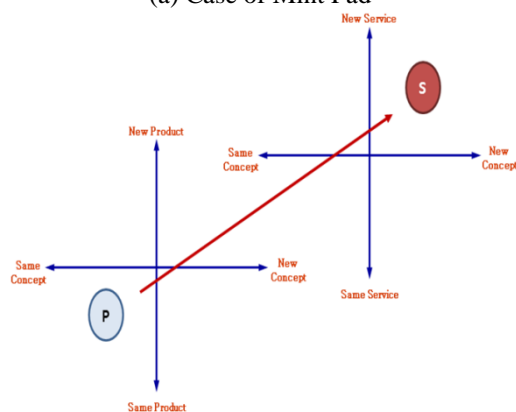
The PSS development changes of field-extended SPSS are illustrated in Fig. 8(b). The characteristics of the field-extended SPSS are as follows:

- The value of the products is expanded as a major strategy.
- The main customer needs are product quality and performance.

- Sustainability: Improvement in after service and distribution network.



(a) Case of Mint Pad



(b) Field-Extended SPSS

Fig.10. Case of Mint Pad and Field-Extended

D. Strategies Conclusion

In this paper, we suggested major three SPSS out of possible more than four hundred cases. More investigation is needed to come up with more prominent migration paths which can be applied to various industries and companies.

V. CONCLUSION

In this paper, we investigate industrial practices of new business models in Korean industry. Especially what kind of PSSs is implemented in the market. We first thoroughly investigate the current practices of PSS in Korean electronic industry. The examples are surveyed and projected directions are given. Then, non-electronic PSSs are surveyed; especially mechanical PSSs are intensively discussed. Using the survey results, we propose several major development strategies of PSSs.

To project the future directions of PSSs, 3D model to classify PSSs are proposed. Based on the 3D model, we identify three major SPSS and they can be used as PSS development strategies. The more strategies are now investigating and more strategies will be suggested in the future research.

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REFERENCES

- [1] A. Azarenko, et al, "Technical product-service systems: some implications for the machine tool industry," *Journal of Manufacturing Technology Management*, vol. 20, 2009, pp. 700-722.
- [2] M.B. Cook, T.A. Bhamra, and M. Lemon, "The transfer and application of Product Service Systems: from academia to UK manufacturing firms," *Journal of Cleaner Production*, vol. 14, 2006, pp. 1455-1465.
- [3] Hyundai Research Institute Report, *Global Economic Crisis and Korea Economic*, Hyundai Research Institute, pp. 371, 2009. (in Korean)
- [4] R.W. Kates, T.M. Parris, and A.A. Leiserowitz, "What is Sustainable development? Goal, Indicators, Values and Practice," *Environment: Science and Policy and Sustainable Development*, vol. 47, 2005, pp. 8-21.
- [5] E. Manzini and C. Vezzoli, "A strategic design approach to develop sustainable product service systems: examples taken from the 'environmentally friendly innovation' Italian prize," *Journal of Cleaner Production*, vol. 11, 2003, pp. 851-857.
- [6] N. Morelli, "Developing new product service systems (PSS): methodologies and operational tools," *Journal of Cleaner Production*, vol. 14, 2006, pp. 1495-1501.
- [7] K. Ott, *Greifswald's Environmental Ethics, Chapter 8 – The case for strong sustainability*, Greifswald: Steinbecker Verlag Ulrich Rose, 2003.
- [8] M. Sawhney, S. Balasubramanian, and V. Krishnan, "Creating growth with services," *MIT Sloan Management Review*, Winter 2004, pp. 34-43.
- [9] A. Tukker, "Eight types of Product-Service System: Eight ways to sustainability? Experiences from SusProNet," *Business Strategy and the Environment*, vol. 13, 2004, pp. 246-260.
- [10] A. Tukker and U. Tischner, *New Business for Old Europe: Product-service development, competitiveness, and sustainability*, Greenleaf Publishing, 2006.
- [11] A. Williams, "Product-service systems in the automotive industry: the case of micro-factory retailing," *Journal of Cleaner Production*, vol. 14, 2006, pp. 172-184.
- [12] A. Williams, "Product service systems in the automobile industry: contribution to system innovation," *Journal of Cleaner Production*, vol. 15, 2007, pp. 1093-1103.
- [13] www.kdpower.co.kr
- [14] www.hyundai.com
- [15] www.mintpass.co.kr

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