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# Integration of Products and Services of Korean Firms and Innovation Policy Directions

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## Abstract

The integration of products and services is being expanded in both manufacturing and service companies such as in Apple's iPod & iTunes, Amazon's Kindle, and Hyundai Motor Company's Mozen. This phenomenon has recently accelerated due to multiple factors including market change, lessening of differences in quality of products or services, the paradigm of participation and sharing, and deindustrialization and evolution toward becoming a service economy. The objective of this paper is to investigate and analyze the status and characteristics of integration of products and services in Korean firms and to suggest policy directions promoting this integration. Towards this purpose, income statements from the Korea Listed Companies Association (KLCA) database of companies listed on the Korea Stock Exchange are analyzed regarding the servitization of manufacturing firms as well as the productization of service firms. In addition, this research investigates the Korean Innovation Survey 2011 database for the service sector and 2010 database for the manufacturing sector in order to evaluate R&D activity in each. In the manufacturing sector, the average ratio of service sales (servitization) was low at 0.208, with bias in the level and distribution of ratios associated with the manufacturing sector. 18 out of a total of 23 sectors (78%) have low servitization, showing there's a long way to go for servitization in the Korean manufacturing sector. In the service sector, the average ratio of product sales (productization) was 9.53%, which is relatively high compared to that of the manufacturing sector. However, the distribution of ratios is also biased, as with the manufacturing sector. Based on this analysis, policy directions are proposed in terms of 1) R&D, 2) concept boost, 3) R&D result spread, 4) statistics, 5) infrastructure and 6) green growth.

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## Keywords

Integration of products and services, servitization, productization

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## 1. INTRODUCTION

### 1.1. Research Background

The recent phenomenon of the integration of products and services is being expanded in both manufacturing and service companies. Based on successful cases such as Apple's iPod & iTunes and Amazon.com's Kindle, the integration of products and services is attracting attention from global and domestic firms and researchers. Apple Inc. integrated their mp3 player product iPod with their online digital media store service iTunes, creating a new integrated business model. After opening in 2003, the iTunes Store has gone on to become the most popular music store in the world since 2010. Apple's dominant global market share in mp3 players depends not only on the iPod's product competitiveness but also on this new business model. The provided services in iTunes were expanded to applications, books, and games, and the supplied products also have been extended to the iPhone and iPad lines.

While Apple Inc. integrates the service from the product point, Amazon.com, Inc., the world's largest electric commerce retailer, integrates the product from the service point. Amazon's self-manufactured Kindle enables customers to read books, newspapers, magazines, and multimedia sold through Amazon.com. The hardware product itself was developed by Lab126, an Amazon.com subsidiary. The price of the Amazon Kindle Fire edition is competitive (the 7-inch Amazon Kindle Fire costing \$199) and less expensive than its rival products such as the Apple iPad. Amazon's strategy is to take its profits from the content service model rather than the manufactured product itself. Keeping these two examples in mind, integration of products and services can generally be classified into either product servitization in manufacturing firms (Apple's case) or service productization in service firms (Amazon.com's case) as shown in Figure 1.

FIGURE 1. Servitization and Productization in Integration of Products and Services



The integration of products and services is also found in the automotive industry. A motor vehicle is a classic manufacturing product with direct and indirect employment of the domestic automotive industry numbering 1.75 million, occupying 7.3% of Korea's 23.83 million laborers. In its most traditional sense, a motor vehicle is a means of physical transportation, a way to get from A to B. However, the biggest Korean automaker, Hyundai Motor Company, LTD, has begun to pursue the image of a service-oriented firm as well as that of a manufacturing-oriented hardware firm. In the past, the automaker maintained only a restricted relationship with its consumers such as with its post-sale warranty service, failing to create additional valuable business opportunities. To overcome this restriction and to expand its customer relationship, the Hyundai Motor Company devel-

oped Mozen, integrating the Hyundai motor vehicle (product) with related car services. Hyundai motor vehicles offering the Mozen service include middle and luxury sedans and SUV's (Sonata, Grandeur, Genesis, Equus, Veracruz). Mozen can be classified into 5 service categories – Safety, Driving, Car Care, Life and Secretary (see Table 1). Mozen Safety is comprised of an SOS system, theft prevention, airbag alarm, and robbery alert services. Mozen Driving has fast route guidance, real time traffic information, and hazard alert services. Mozen Car Care provides users with remote diagnosis and expendable materials management. Mozen Life provides customers with a travel destination service, restaurant recommendations, and practical living information. Mozen Secretary is a secretarial and voice recognition service. Through Mozen, the Hyundai Motor Company aims to build a more solid relationship with its customers and expand its current market share. The Hyundai Motor Company plans to launch the Mozen service in the global market after testing it in Korea.

TABLE 1. Hyundai Motor Company Mozen Service

Product (Device)	Service Category	Services
Motor Vehicle (Sonata, Grandeur, Genesis, Equus, Veracruz)	Safety	SOS, theft prevention, airbag alarm, robbery alert
	Driving	Fast route guidance, real time traffic information, hazard alert
	Car Care	Remote diagnosis, expendable materials management
	Life	Travel destination, restaurant recommendations, practical living information
	Secretary	Secretary service, voice recognition

The integration of products and services has recently accelerated due to multiple factors. Firstly, the market has been changing from being a technology-oriented seller's market to a customer-oriented buyer's market. Traditionally, product and service providers only offered products or services that were familiar to the provider's perspective. Nowadays, although the product or service providers may not be familiar with what the customer wants, they must offer a total and integrated experience in all stages of their product's life cycle in order to win customer satisfaction. Secondly, due to technological development, differences in quality in products and services have been disappearing, and the integration of products and services is quickly becoming a way of distinguishing a product or service from its competitors. Thirdly, the paradigm of participation and sharing such as web 2.0 and open innovation is spreading as the result of advances in IT technology. In the field of product and service development, the virtual model of evaluation and improvement based on the open innovation model and social networks is utilized widely. The fourth factor is deindustrialization and the evolution from a mass manufacturing economy towards a service economy. An important feature in the transition to a service-oriented economy is that the relative importance of economy of scale, products ownership, and tangible assets gradually slows down and the significance of the economy of speed, product utilization, and intangible assets grows. The fifth factor is the integration of products and services, enhancing sustainability in terms of manufacturing, consumption, and environment. For example, car-sharing services and bicycle-rental services improve the satisfaction of individual users by their reduction of environmental impact. The rental and lease model of cars, electric home appliances, carpets, and industrial equipment combined with financial incentives simultaneously enhances economic and environmental values by turning the concept of ownership to utilization and reducing waste in resources.

Therefore, the integration of products and services has changed the framework of the companies' business strategy and competition, becoming a key factor to a firm's survival and success. With this integration, firms can add a unique selling point to their existing standards and stereotypical products or services and propose new value propositions for customers. Manufacturing firms can strengthen their relationship toward customers and build barriers against new competitors through servitization. Through productization, service firms can keep their market share and expand their current service portfolio through a product medium for service delivery. Furthermore, the integration of products and services can enhance the reputation of firms by green marketing and helps them meet their social responsibility towards the environment.

## **1.2. Research Question and Objective**

Although the integration of products and services is becoming more and more significant, analysis on Korean firms is still insufficient. It is unclear what percentage of firms in the manufacturing and service sectors is associated with the integration of products and services. Moreover, the sectors are so diverse that it is difficult to categorize them in terms of integration.

The objective of this paper is to investigate and analyze the status and characteristics of integration of products and services of Korean companies and suggest policy towards promoting the integration of products and services. For this purpose, this research investigates the percentage of firms in the manufacturing and service sectors associated with the integration of products and services. In particular, group patterns among various manufacturing and service sectors are extracted, illuminating the overall characteristics of servitization and productization in Korean industry. Policy directions are suggested according to analyses of these group patterns.

The paper is organized as follows: Section 2 presents a survey of current literature, and Section 3 explains the research methodology and database. Section 4 analyzes the integration of products and services in Korean manufacturing firms while Section 5 examines integration in Korean service firms. Section 6 outlines some innovation policy implications along with concluding remarks.

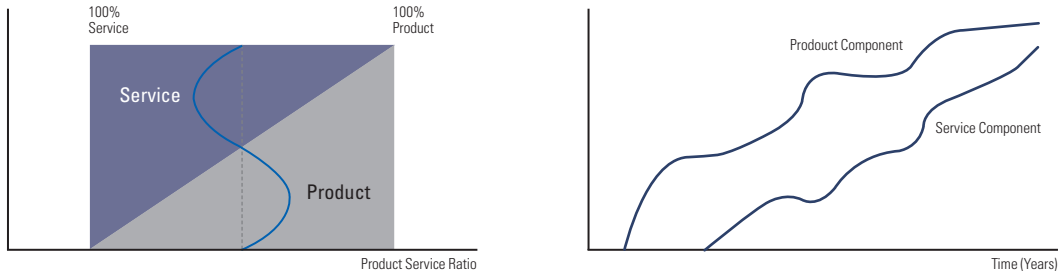
## **2. LITERATURE SURVEY**

Research on how the manufacturing firms can have competitive strategies based on service has been suggested in various related literatures. The concept of servitization was first presented by Vandermerwe et al. in 1988 (Vandermerwe et al., 1988). They argue that firms are increasingly offering bundles of customer-focused combinations of goods, services, support, self-service, and knowledge, and services are beginning to dominate.

The product-service system (PSS) is described as a marketable set of products and services capable of jointly fulfilling a user's need. The product-service ratio can vary either in terms of function fulfillment or economic value. Product-service ratios vary from case to case, but they can also vary

over time due to technological development, economic optimization and the changing needs of consumers (Goedkoop et al., 1999). The product-service ratio diagram and the variation of the product-service component are illustrated in Figure 2.

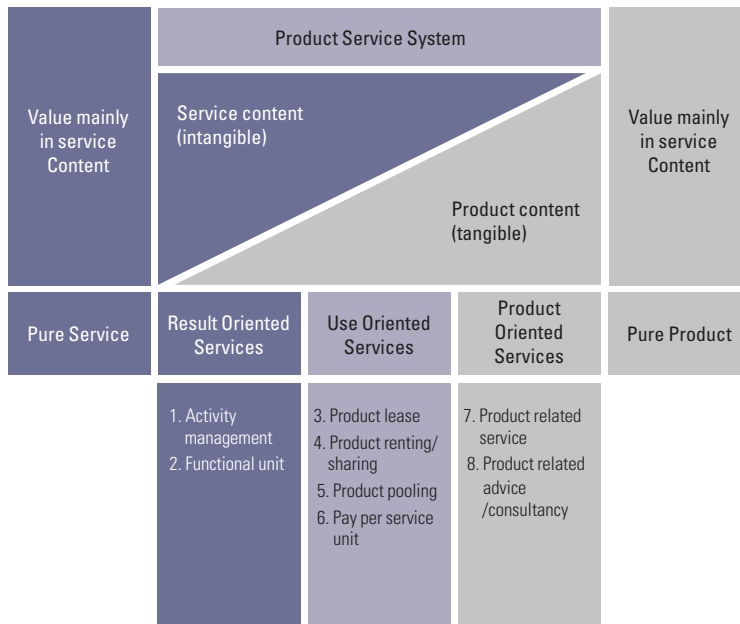
FIGURE 2. Product Service Ratio and Product Service Component



Source : Goedkoop et al. (1999), re-edited

The notion of the product-service ratio and component expands into different types of products and services. Cook has identified three types of product-service systems (PSS) (Cook, 2004; Tukker et al., 2005). The first is the product-oriented product-service system, a product-service integration where ownership of the tangible product is transferred to the consumer while product-related services (such as maintenance and supplies contracts and recovery of waste materials) and product-related advice or consultancy (such as advisory for consumers in product use or logistics optimization of plants where the product is put) are provided. The second is the use-oriented product-service system, a product-service integration where ownership of the tangible product is retained by the service provider, who sells the functions of the product via modified distribution and payment systems such as product leases, product renting or sharing, product pooling, and pay-per-service units (pay for the use of a copier, a fixed fee per washing cycle, taxi fare, etc.). The third is the result-oriented product-service system, a product-service integration where products are replaced by services like activity management (such as outsourced support services) and functional units (such as chemical management services and provision of a pleasant environment in lieu of installing an air conditioner or obtaining heating fuel supply). The three types of product service systems are outlined in Figure 3.

FIGURE 3. Product Service Types



Source : Cook (2004), re-edited

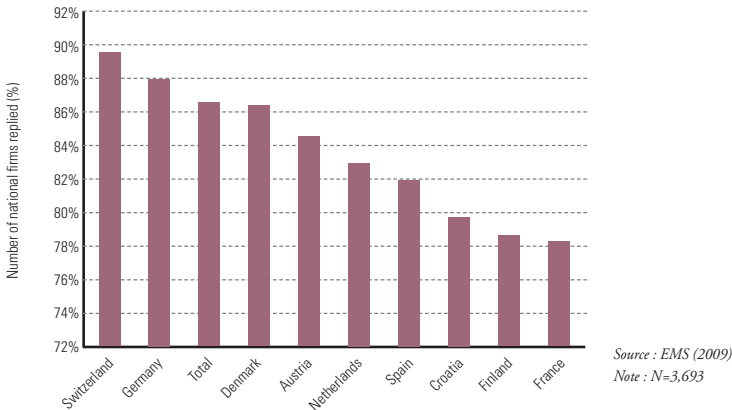
In addition to types of product-service integration, the financial consequences of the servitization of manufacturing are explored (Neely, 2009). The research shows that the manufacturing firms that have servitized have larger sales revenues than traditional manufacturing firms and generate lower profits as a percentage of sales while servitization appears to pay off in small firms, implying hidden risks associated with servitization.

In Europe, the European Manufacturing Survey (EMS)<sup>1</sup> investigated the servitization of manufacturing firms in 10 countries. Its survey considers eight types of product-related services which are closely associated with manufacturing such as design/consulting/project planning, technical documentation, software development, leasing/renting/finance, installation, start-up procedures, training, maintenance/repair, and build-operate-owner services (Dachs et al., 2012). The survey asks “Which of the following product-related services do you offer to your customers?” and the result of the proportion of firms offering at least one out of the eight types of services number around 78% to 90% across countries as shown in Figure 4 (Fraunhofer-ISI, 2011).

<sup>1</sup> The EMS is organized by a consortium of research institutes and universities coordinated by the Fraunhofer Institute for Systems and Innovation Research (ISI) and takes place every three years. The EMS investigates product, process, service and organizational innovation in the European manufacturing sectors. In contrast to the CIS, the EMS is more focused on technology diffusion and organizational innovation than on product innovation (Fraunhofer-ISI, 2011; Dachs et al., 2012).

FIGURE 4. Firms with Service Offers in European Manufacturing

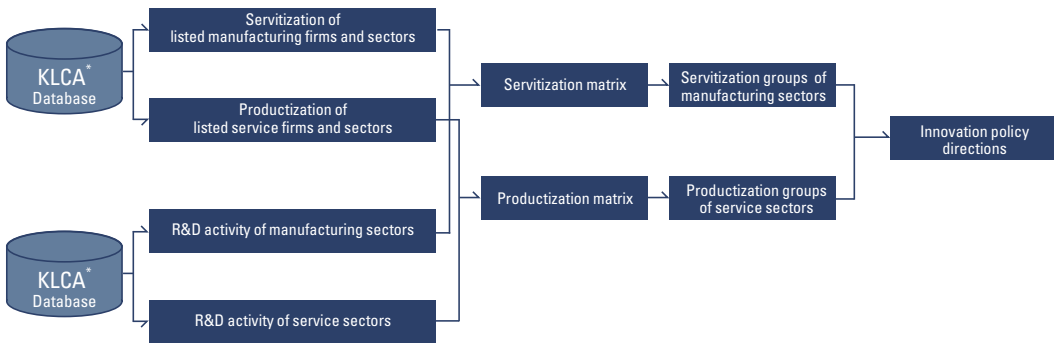
(Unit : %)



### 3. RESEARCH METHODOLOGY AND DATABASES

While the trend in integration of products and services has widely diverged recently, it is important to investigate this trend in terms of specific figures and data. This research utilizes data from two databases, the Korea Listed Companies Association (KLCA) database and the Korea Innovation Survey database. The two matrices of servitization and production are extracted by combining information on the servitization/productization of manufacturing/service sectors with data on R&D activity in servitization/productization. The overall research methodology is shown in Figure 5.

FIGURE 5. Research Methodology and Databases



\* KLCA : Korea Listed Companies Association

\*\* KIS : Korea Innovation Survey, 2011(service sector), 2010(manufacturing sector)

The total number of enterprises in Korea amounts to 3,128,582 ('10). However, the number of small and medium businesses (3,125,457) occupies most of this number (99.9%) while the number of large firms is only 3,125 (0.1%) (SMBA, 2012). In spite of the importance of small and medium enterprises, it is difficult to access their relevant data and financial statements. Hence, based on data

accessibility, only the listed large firms are considered for further analysis. Since the number of listed companies is small compared with that of small and medium enterprises, the analysis can effectively explain the status of integration of products and services in large companies.

For this purpose, the income statements of listed companies on the Korea Stock Exchange are analyzed regarding the servitization of manufacturing firms as well as the productization of service firms. Based on the Korea Listed Companies Association (KLCA) database which has all the income statements of the listed companies, the integration status of 438 listed-manufacturing companies and 144 listed-service companies (excluding electric/gas supply, construction, and financing) are investigated. The number of manufacturing sectors with the KSIC (Korea Standard Industry Code) is 23 and the number of KSIC service sectors is 21 as shown in Table 2.

TABLE 2. Manufacturing & Service Sectors and Number of Listed Firms

KSIC	Manufacturing Sector	Number of Firms	KSIC	Service Sector	Number of Firms
10	Manufacture of food products	29	45	Motor vehicle and parts sales	1
11	Manufacture of beverages	5	46	Wholesale and goods brokerage	37
12	Cigarette manufacturing	1	47	Retail trade with the exception of cars	11
13	Manufacture of textile products (excluding apparel)	14	49	Ground transportation and pipeline transport	9
14	Apparel, clothing accessories and fur products manufacturing	17	50	Water transport	8
15	Manufacture of leather, bags and shoes	4	51	Air transport	2
16	Manufacture of wood and wood products (excluding furniture)	3	52	Warehouse and transportation related services	3
17	Manufacture of pulp, paper and paper products	21	58	Publishing	2
19	Manufacture of coke, briquette and petroleum products	5	59	Video and audio documentary production and distribution industry	4
20	Manufacture of chemicals and chemical products (excluding pharmaceuticals)	65	60	Broadcast industry	1
21	Medical material and pharmaceutical manufacturing		61	Post and telecommunications petroleum products	3
22	Manufacture of rubber products and plastic products	18	62	Computer programming, system integration and management	65
23	Non-metallic mineral product manufacturing	23	63	Information service industry	7
24	Primary metal manufacturing	44	68	Real estate	1
25	Manufacture of metal processing (excluding machinery and furniture)	9	71	Professional services plastic products	35
26	Electronics, computers, video, sound and communication equipment manufacturing	42	72	Building technologies, engineering and other scientific and technical services	4
27	Manufacture of medical, precision, optical instruments and clocks	5	73	Other professional, scientific and technical services	1
28	Manufacture of electrical equipment	16	75	Business support services	4
29	Manufacture of other machinery and equipment	30	85	Education services	2
30	Car and trailer manufacturing	38	91	Sports and entertainment related services	5
31	Other transportation equipment manufacturing	7	96	Other personal services	1
32	Furniture manufacturing	4			
33	Manufacture of other products	1			
	Total	438			144



In the listed manufacturing companies, the 'service sales' of the financial statements is extracted to compare with the company's 'total sales'. The 'total sales' amount of the listed manufacturing company consists of 'goods sales', 'product sales', 'service sales', 'construction earnings', 'other export', and 'other sales'. With the ratio of 'service sales' to 'total sales', it is possible to measure the percentage of sales of the listed-manufacturing company that depends on service (servitization). Similarly, in the listed service companies, the 'product sales' of the financial statements is extracted to compare with 'total sales'. 'Product sales' means sales obtained from selling products directly made through the manufacturing process. In contrast with 'product sales', 'goods sales' mean sales acquired from selling purchased goods outside the company's manufacturing process (or outside its main manufacturing process). 'Total sales' of the listed service company consists of 'goods sales', 'product sales', 'service sales', 'construction earnings', 'communication', 'broadcast (production) earnings', 'lease (rental) earnings', 'royalty income', and 'other sales'. With the ratio of 'product sales' to 'total sales', it is possible to measure what percentage of sales of the listed service company depends on service (productization).

In addition to the Korea Listed Companies Association (KLCA) database, this research investigates the Korean Innovation Survey 2011 database for service sectors (3925 service firms) and the 2010 database for manufacturing sectors (4044 manufacturing firms) in order to evaluate R&D activity in manufacturing and service.

The R&D activity-servitization/productization matrices are created and typology extracted with group classifications by combining the servitization/productization ratio from the Korea Listed Companies Association (KLCA) database with information on R&D activity from the Korea Innovation Survey database.

#### **4. INTEGRATION OF PRODUCTS AND SERVICES IN MANUFACTURING FIRMS**

The total sales of the 438 listed manufacturing companies amounts to 574.6 trillion KRW. Most of total sales consist of 'goods, product sales', 'goods sales', and 'product sales', which amount to 512.7 trillion KRW or 89.2% of 'total sales'. However, the 'service sales' amount is only 1.2 trillion KRW or 0.221% of 'total sales'. 'construction earnings', 'other export', and 'other sales' amount to 21.2 trillion KRW (3.69%), 22.9 trillion KRW (4.00%), and 20.8 trillion KRW (3.63%) as shown in Table 3.

Based on this investigation, the Korean listed manufacturing companies show a low percentage of 'service sales' in the 'total sales' amount. The 'service sales' amount is far below the 'goods, product sales', 'goods sales', and 'product sales' amount.

For further analysis, the listed manufacturing companies are divided into 23 manufacturing sectors. The manufacturing sectors which have more than 1% of service sales to total sales are non-metallic mineral product manufacturing (1.782%) and the manufacturers of coke, briquette and petroleum

TABLE 3. Sales Composition and Ratio of Korean Listed Manufacturing Companies

(Unit : Million KRW, %)

Category	Amount(Million KRW)	Ratio(%)
Total Sales	574,621,296	100
Goods, Product Sales   Goods Sales   Product Sales	512,751,568	89.2
Service Sales	1,269,986	0.221
Construction Earnings	21,207,091	3.69
Other Export	22,990,037	4.00
Other Sales	20,862,782	3.63

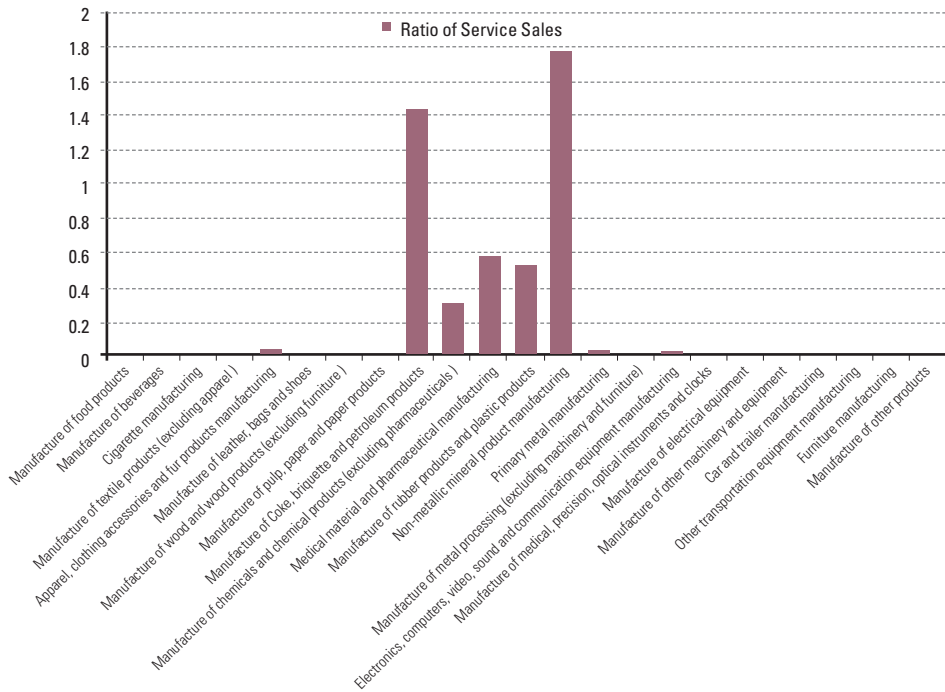
products (1.438%). Medical material and pharmaceutical manufacturing is 0.577%, manufacturers of rubber products and plastic products are 0.530%, and manufacturers of chemicals and chemical products (excluding pharmaceuticals) are 0.308%. The manufacturing sectors including manufacturers of beverages, cigarettes, textile products (excluding apparel), leather/bags/shoes, wood/wood products (excluding furniture), and pulp/paper/paper products, etc. have 0% service sales. The average of ‘service sales’ is 55.2 billion KRW with an average ratio of 0.208%. ‘Service sales’, ‘ratio of service sales’, and ‘total sales’ of each manufacturing sector are shown in Table 4 and Figure 6.

TABLE 4. Service Sales and Ratio of Service Sales in Manufacturing Sectors

(Unit : Million KRW, %)

Manufacturing Sector	Service Sales (Million KRW)	Ratio of Service Sales (%)	Total Sales (Million KRW)	Ratio of R&D Activity(%)
Manufacture of food products	2,105	0.010	20,408,314	56.9
Manufacture of beverages	0	0.000	3,094,325	57.7
Cigarette manufacturing	0	0.000	2,776,403	0
Manufacture of textile products (excluding apparel)	0	0.000	2,545,583	35.6
Apparel, clothing accessories and fur products manufacturing	1,679	0.038	4,440,392	26.4
Manufacture of leather, bags and shoes	0	0.000	391,869	38.5
Manufacture of wood and wood products (excluding furniture)	0	0.000	569,280	25.1
Manufacture of pulp, paper and paper products	0	0.000	6,101,485	35.3
Manufacture of coke, briquette and petroleum products	775,481	1.438	53,944,965	37.2
Manufacture of chemicals and chemical products (excluding pharmaceuticals)	224,155	0.308	72,825,697	78.7
Medical material and pharmaceutical manufacturing	48,130	0.577	8,345,517	86.2
Manufacture of rubber products and plastic products	48,836	0.530	9,213,332	54.3
Non-metallic mineral product manufacturing	107,655	1.782	6,042,344	45
Primary metal manufacturing	20,917	0.033	64,244,023	43
Manufacture of metal processing (excluding machinery and furniture)	0	0.000	1,371,925	45.3
Electronics, computers, video, sound and communication equipment manufacturing	36,907	0.023	162,601,568	75.2
Manufacture of medical, precision, optical instruments and clocks	262	0.009	2,836,918	72.7
Manufacture of electrical equipment	754	0.010	7,735,293	75.7
Manufacture of other machinery and equipment	3,100	0.018	16,804,767	63.2
Car and trailer manufacturing	0	0.000	69,357,285	51.3
Other transportation equipment manufacturing	0.8	0.000	57,909,606	33.5
Furniture manufacturing	0	0.000	977,382	42.3
Manufacture of other products	0	0.000	83,023	52.6
<b>Average</b>	<b>55,216</b>	<b>0.208</b>	<b>24,983,534</b>	<b>50.4</b>

FIGURE 6. Service Sales Ratio of Manufacturing Sectors



An R&D activity and servitization matrix can be created by combining the ratio of R&D activity with the service sales ratio (servitization) as shown in Figure 7. This matrix can be classified into 4 group quadrants (see Table 5). While none of the sectors fall into quadrant I (high servitization and high R&D activity), quadrant II with low servitization and high R&D activity can be further categorized into 2 sub-groups, II-a with relatively high servitization and high R&D activity and II-b with low servitization and high R&D activity. Sub-group II-a includes medical material and pharmaceutical manufacturing, manufacturers of chemicals and chemical products (excluding pharmaceuticals), and manufacturers of rubber products and plastic products. Sub-group II-b has manufacturers of electrical equipment and electronics, computers, video, sound and communication equipment manufacturing, etc. Group III with low servitization and low R&D activity has 10 sectors including manufacturers of metal processing (excluding machinery and furniture), primary metal manufacturing, etc. Group IV with high servitization and low R&D activity contains non-metallic mineral product manufacturing as well as manufacturers of coke, briquette and petroleum products.

FIGURE 7. R&amp;D Activity and Servitization (Service Sales) Matrix

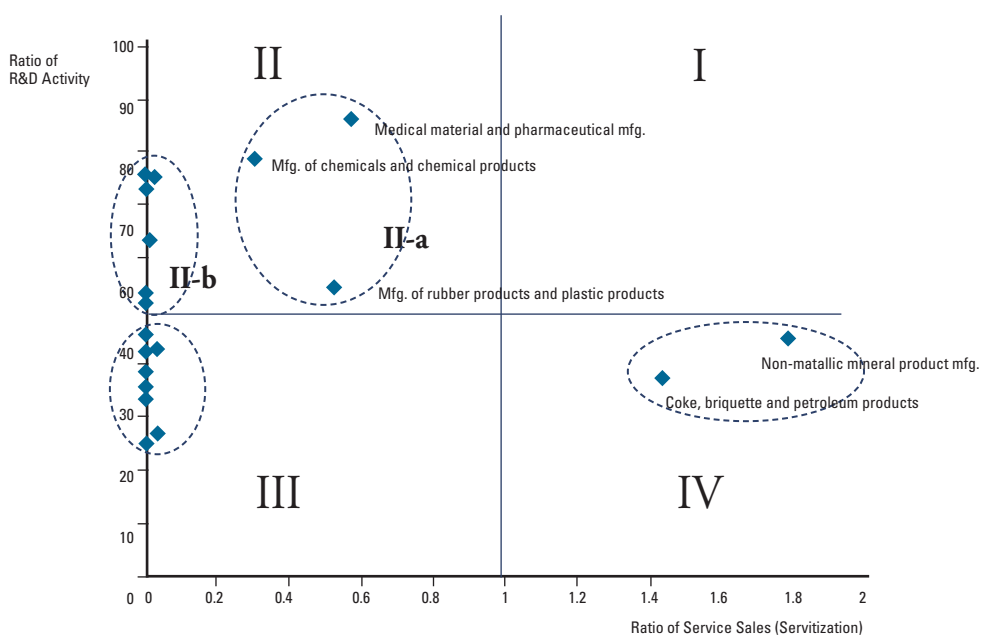


TABLE 5. R&amp;D Activity and Servitization Matrix's Group Quadrants and Characteristics

Group	Sub-group	Characteristics	Manufacturing Sectors	Number of Sectors
I		High servitization High R&D activity	None	0
II	II-a	Relatively high servitization High R&D activity	Medical material and pharmaceutical manufacturing Manufacture of chemicals and chemical products (excluding pharmaceuticals) Manufacture of rubber products and plastic products	3
	II-b	Low servitization High R&D activity	Manufacture of electrical equipment Electronics, computers, video, sound and communication equipment manufacturing Manufacture of medical, precision, optical instruments and clocks Manufacture of other machinery and equipment Manufacture of beverages Manufacture of food products Manufacture of other products Car and trailer manufacturing	8
III		Low servitization Low R&D activity	Manufacture of metal processing (excluding machinery and furniture) Primary metal manufacturing Furniture manufacturing Manufacture of leather, bags and shoes Manufacture of textile products (excluding apparel) Manufacture of pulp, paper and paper products Other transportation equipment manufacturing	10

Group	Sub-group	Characteristics	Manufacturing Sectors	Number of Sectors
III	Low servitization	Low R&D activity	Apparel, clothing accessories and fur products manufacturing	2
		High servitization	Cigarette manufacturing	
	Low R&D activity	Manufacture of wood and wood products (excluding furniture)		
IV	High servitization	Low R&D activity	Non-metallic mineral product manufacturing	2
	Low R&D activity		Manufacture of Coke, briquette and petroleum products	

## 5. INTEGRATION OF PRODUCTS AND SERVICES OF SERVICE FIRMS

Total sales of the 144 listed service companies (excluding electric gas supply, construction, financing) amount to 184 trillion KRW. Total sales consists of ‘goods sales’ and ‘goods, product sales’ (82 trillion KRW, 44.7%), ‘service sales’ (38 trillion KRW, 21.03%), ‘communication, broadcast (production) earnings’ (29 trillion KRW, 15.85%), etc. ‘Product sales’ of listed service companies amounts to 4 trillion KRW (2.18%). The sales structures of listed service companies are relatively more diversified than listed manufacturing companies. In listed service companies, ‘lease (rental) earnings’ and ‘royalty income’ occupy 0.65% (1.1 trillion KRW) and 0.31% (0.5 trillion KRW) respectively as shown in Table 6.

TABLE 6. Sales Composition and Ratio of Korean Listed Service Companies

(Unit : Million KRW, %)

Category	Amount(Million KRW)	Ratio(%)
Total Sales	184,742,382	100
Goods Sales, Goods, Product Sales	82,561,880	44.7
Product Sales	4,027,218	2.18
Service Sales	38,855,770	21.03
Construction Earnings	6,771,881	3.67
Communication, broadcast (production) Earnings	29,274,992	15.85
Lease (rental) Earnings	1,197,928	0.65
Royalty Income	569,644	0.31
Other Sales	22,555,170	12.21

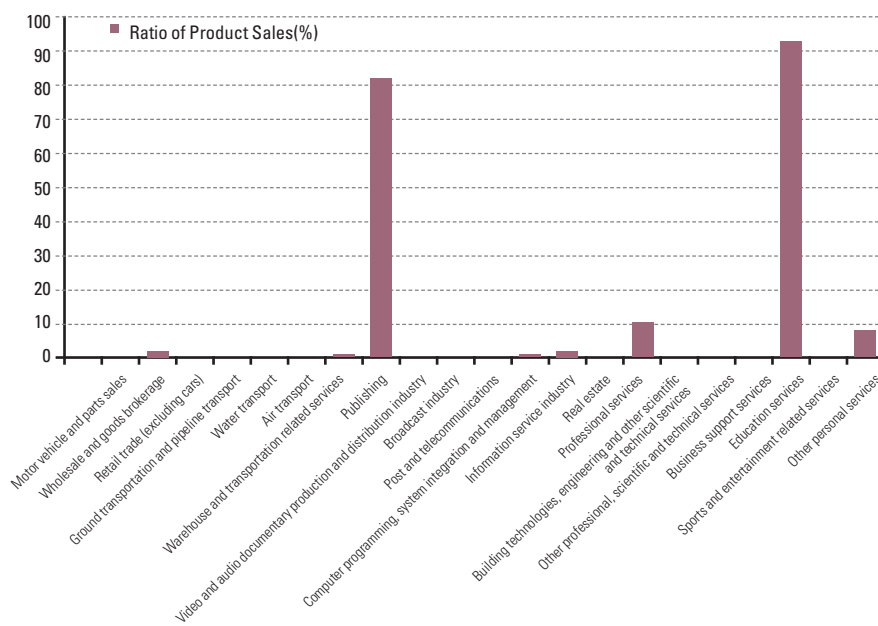
The listed service companies were separated into 21 service sectors. Education service and publishing in particular have most of their sales originate from ‘product sales’, taking up 92.93% (1.5 trillion KRW) and 82.12% (0.12 trillion KRW) respectively. Professional services and other personal services also have a relatively high proportion of ‘product sales’ with 10.3% (0.68 trillion KRW) and 8.26% (0.11 trillion KRW). The information service industry (2.04%, 46 billion KRW) and wholesale and goods brokerage (1.98%, 1.3 trillion KRW) have around 2%, while warehouse and transportation related services (0.99%, 37 billion KRW) and computer programming, system integration and management (0.94%, 13 billion KRW) show around 1%. Other 11 service sectors including motor vehicle/parts sales and ground transportation/pipeline transport/air transport have 0% ‘product sales’. Average ‘product sales’ is at 191.7 billion KRW with an average ratio of 9.53%. ‘Product sales’, ‘ratio of product sales’, and ‘total sales’ of each service sector are shown in the Table 7 and Figure 8.

TABLE 7. Product Sales and Ratio of Product Sales in Service Sectors

(Unit : Million KRW, %)

Service Sector	Product Sales (Million KRW)	Ratio of Product Sales (%)	Total Sales (Million KRW)	Ratio of R&D Activity(%)
Motor vehicle and parts sales	0	0.00	2,685,608	16.1
Wholesale and goods brokerage	1,335,266	1.98	67,315,126	7.0
Retail trade (excluding cars)	54,719	0.22	24,958,457	12.2
Ground transportation and pipeline transport	0	0.00	4,217,898	3.3
Water transport	57,273	0.41	13,902,714	10.4
Air transport	0	0.00	13,280,930	0.0
Warehouse and transportation related services	37,593	0.99	3,805,281	5.7
Publishing	124,054	82.12	151,071	20.1
Video and audio documentary production and distribution industry	0	0.00	483,252	4.8
Broadcast industry	0	0.00	555,502	17.4
Post and telecommunications	0	0.00	32,956,478	10.0
Computer programming, system integration and management	13,941	0.94	1,487,150	26.3
Information service industry	46,228	2.04	2,271,514	40.0
Real estate	0	0.00	42,968	4.0
Professional services	688,887	10.30	6,688,266	9.6
Building technologies, engineering and other scientific and technical services	0	0.00	4,074,205	13.2
Other professional, scientific and technical services	0	0.00	736,474	0.0
Business support services	0	0.00	261,634	4.9
Education services	1,552,609	92.93	1,670,699	21.4
Sports and entertainment related services	0	0.00	1,785,233	10.0
Other personal services	116,642	8.26	1,411,922	10.2
Average	191,772	9.53	8,797,256	11.7

FIGURE 8. Product Sales Ratio of Service Sectors



An R&D activity and productization matrix is created by combining the ratio of R&D activity and product sales ratio (productization) as shown in Figure 9. The matrix can be classified into 4 group quadrants (see Table 8). Education service and publishing fall into quadrant I with high productization and high R&D activity. Quadrant II with low productization and high R&D activity can be further categorized into 2 sub-groups, II-a with relatively high productization and high R&D activity and II-b with low productization and high R&D activity. Sub-group II-a includes the information service industry and computer programming/system integration/management. Sub-group II-b includes broadcast industry, motor vehicle/parts sales, etc. Quadrant III with low servitization and low R&D activity can also be classified into 2 sub-groups, III-a with relatively high productization and low R&D activity and III-b with low productization and low R&D activity. Sub-group III-a has wholesale and goods brokerage as well as warehouse and transportation related services. Sub-group III-b includes water transport, post and telecommunications, etc. Quadrant IV with high productization and low R&D activity contains professional and other personal services.

FIGURE 9. R&D Activity and Productization (Product Sales) Matrix

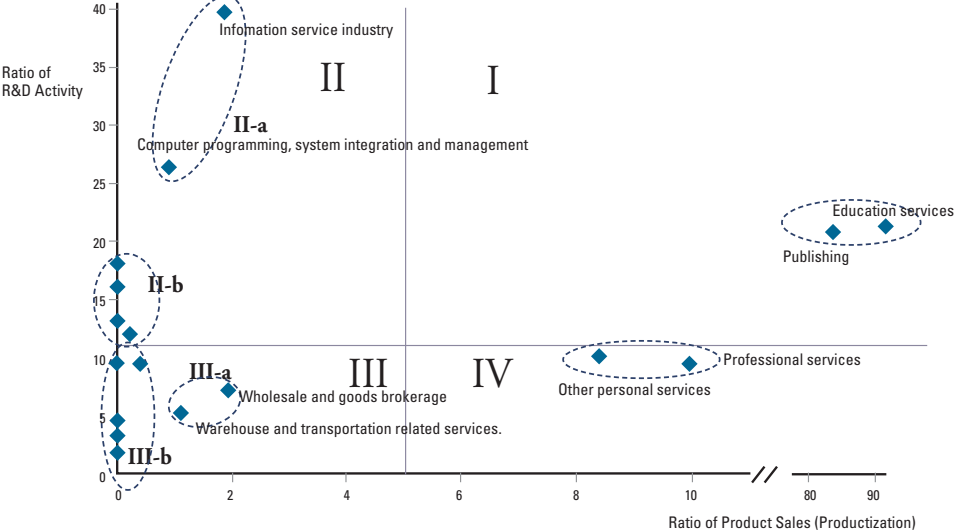


TABLE 8. R&D Activity and Productization Matrix's Group Quadrants and Characteristics

Group	Sub- group	Characteristics	Service Sectors	Number of Sectors
I		High productization	Education service	2
		High R&D activity	Publishing	
II	II-a	Relatively high productization	Information service industry	2
		High R&D activity	Computer programming, system integration and management	
	II-b	Low productization	Broadcast industry	4
		High R&D activity	Motor vehicle and parts sales Building technologies, engineering and other scientific and technical services Retail trade (excluding cars)	

Group	Sub- group	Characteristics	Service Sectors	Number of Sectors
III	III-a	Relatively high productization	Wholesale and goods brokerage	2
		Low R&D activity	Warehouse and transportation related services	
IV	III-b	Low productization Low R&D activity	Water transport	9
			Post and telecommunications	
			Sports and entertainment related services	
			Business support services	
			Video and audio documentary production and distribution industry	
			Real estate	
			Ground transportation and pipeline transport	
			Air transport	
			Other professional, scientific and technical services	
IV		High productization	Professional services	2
		Low R&D activity	Other personal services	

## 6. IMPLICATIONS AND POLICY DIRECTIONS

### 6.1. Implications

In manufacturing, the average ratio of service sales (servitization) was a low 0.208, with bias in the distribution of ratios associated with the manufacturing sectors. While none of the sectors fell into Group I with high servitization and high R&D activity in our R&D activity and servitization matrix, Group II-a (medical material and pharmaceutical manufacturing, manufacturers of chemicals and chemical products excluding pharmaceuticals, manufacturers of rubber products and plastic products) with relatively high servitization and high R&D activity, and Group IV (non-metallic mineral product manufacturing, manufacturers of coke, briquette and petroleum products) with high servitization and low R&D activity lead in beginning to integrate products and services in the manufacturing sectors. Nevertheless, most manufacturing sectors—Group II-b (8 sectors) and Group III (10 sectors), or 18 out of a total of 23 sectors (78%)—have low servitization, showing how there still remains a long journey to servitization in Korean manufacturing sectors.

In the service sectors, the average ratio of product sales (productization) was 9.53%, relatively higher than that of the manufacturing sectors, but also with a bias in distribution ratios. The service sectors feature two Group I sectors (education services and publishing) with high productization and high R&D activity. Group II-a (information service industry and computer programming, system integration and management) with relatively high productization and high R&D activity, and Group III-a (wholesale and goods brokerage and warehouse and transportation related services) with relatively high productization and low R&D activity are also pushing the boundaries of productization. Similar to manufacturing sectors, Group II-b (4 sectors) with low productization and high R&D activity and Group III-b (9 sectors) with low productization and low R&D activity occupy 62% (13 out of total 21 sectors).



## 6.2. Policy Directions

Systematic innovation policies are required in order to promote innovation in the integration of products and services and enhance the competitiveness of manufacturing and service firms.

First is the need for a national R&D program designed for the integration of products and services. As described in the servitization and productization matrices' group quadrants and characteristics, different groups and types of integration of products and services depend on the nature of each specific sector. A national-level R&D program which reflects these groups and characteristics of sectors is required.

Second is the promotion and expansion of concepts for integration of products and services. As shown in Sections 4 and 5, general levels of servitization and productization are still low. To boost and expand the concept, it is essential to collect the best practices of integration of products and services for each sector worldwide and create a database which publicizes the cases and concepts.

Third is to share the results of this national R&D program via an Internet portal in order to have steady and effective diffusion of information.

Fourth is to reform the statistics of servitization and productization. While this research utilizes the income statements of listed companies, these statements have certain limitations in analyzing the servitization and productization of firms. For example, the car and trailer manufacturing sector (KSIC 30) includes the Hyundai Motor Company, but Hyundai's Mozen service is not reflected on the income statements and thus shows a 0% ratio of service sales. Although the servitization of manufacturing firms contributes to sales of product, servitization itself is not calculated as sales.

To resolve this obstacle in the methodical analysis of the servitization and productization of Korean firms, it is necessary to reform and reorganize the Korean Innovation Survey (KIS) to cover integration of products and services. Because the KIS is based on the OECD's Oslo Manual, the current KIS focuses on 4 types of innovations: product innovation, process innovation, organizational innovation, and marketing innovation. The KIS does not include questionnaires about the integration of products and services. Questionnaires regarding servitization for manufacturing firms and the those regarding productization for service firms need to be included. In case this is not feasible, a separate innovation survey should be considered along the lines of the European Manufacturing Survey (EMS), which investigates the servitization of manufacturing firms in 10 European countries.

Fifth is to build infrastructure to test and evaluate the integration of products and services. When a new type of servitization or productization model is developed, it is necessary to test the new model in real or virtual environments. A service zone or service test bed infrastructure can test and experiment with developed prototypes.

The last is to associate the concept of integration of products and services with the current green growth innovation strategy. Integration of products and services can provide not only economic value for firms and experience value for customers but also ecological value in terms of energy

saving, dematerialization, reducing ecological burden, and recycling. However, the current green growth innovation strategy mainly focuses on technology and hardware development, and is yet insufficient to associate the integration of products and services with a new servitization and productization model. The suggested policy directions are summarized in Table 9.

TABLE 9. Policy Categories and Policy Directions Summary

Policy Categories	Policy Directions
R&D	Launch a national R&D program designed for the integration of products and services
Concept boost	Collect the best practices of integration of products and services for each sector worldwide to create a database and to endorse and publicize cases and concepts
R&D result spread	Share the results of national R&D program designed for the integration of products and services via internet portal.
Statistics	Reform the statistics of servitization and productization
Infrastructure	Build infrastructure to test and evaluate the integration of products and services
Green growth	Associate the concept of integration of products and services with the current green growth innovation strategy

The suggested policy directions need to be adapted and customized for implementation by the derived groups from the servitization/productization matrices as shown in Table 10. Group I with high servitization/productization and high R&D activity shall primarily require the ‘green growth’ policy while R&D policy is essential for Group IV with high servitization/productization and low R&D activity. Group II with low servitization/productization and high R&D activity requires the ‘R&D result spread’ policy along with an R&D policy. The preemptive ‘concept boost’ policy is indispensable for Group III with low servitization/productization and low R&D activity.

TABLE 10. Customized Policies for Sector Groups

Group	Sub- group	Characteristics	Num. of Mfg. Sectors	Num. of Service Sectors	Customized Policies
I		High servitization/productization High R&D activity	0	2	Green growth
II	II-a	Relatively high servitization/productization High R&D activity	3	2	R&D result spread R&D
	II-b	Low servitization/productization High R&D activity	8	4	
III	III-a	Relatively high servitization/productization Low R&D activity	0	2	Concept Boost
	III-b	Low servitization/productization Low R&D activity	10	9	
IV		High servitization/productization Low R&D activity	2	2	R&D

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