A Study on Quantitative Analysis for New Product Development Strategy

Junseok Lee[1], Hyun woo Kim[1], Jongchan Kim[1], Joonhyuck Lee[1], Sangsung Park[2], Dongsik Jang[1]

[1]Department of Industrial Management Engineering, Korea University

[2]Graduate School of Management of Technology, Korea University

***Abstract*:** *As technology has been advanced these days, many companies try technology innovation for differentiation and competitive advantages over rival companies. Especially, new product development is integral to the survival of business. However, it has been largely dependent on qualitative methods, such as QFD method, for developing new products. This paper researches on the quantitative methods based on intellectual property to establish new product development strategy.*

Keywords: *new product development, quantitative method, intellectual property*

1. Introduction

A lot of companies are continuously making efforts for advanced technology and products because of customers' various types of demands. In order to develop such products, it is necessary to input a lot of investments and time. As market size reaches a certain standard and technology standards are established, the technology difference between late-movers gets narrowed as well as consumer demand increases. Therefore, legal guarantee, such as patent rights, are necessary to secure new market and keep technology gap from late-movers.

Currently, intellectual property rights (IPRs) is one of the intangible assets, and there are industrial property right, copyright, and newly emerging IPRs [1]. Newly emerging IPRs, particularly, are expanded to the areas that were not recognized before, such as business secret, computer program, database, etc., to extend the protection of law. Industrial property rights are composed of patent, utility model, design right, and trademark. Among these, patent is a right that is given to an invention with technical ideas utilizing a law of nature and high level of invention [1]. Since companies are exercising patent rights over competitors these days, the importance of patent is getting emphasized and many companies are applying patents for the protection of their technology [1].

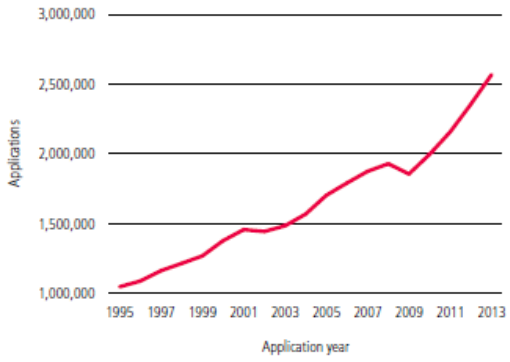

Fig. 1: Patent Application Trend[2]

There were several qualitative methods, such as quality function deployment (QFD), for developing new products. QFD, one of the common methods, predicts for what consumer needs are and how to satisfy the needs so as to progress development. However, there are some limitations that it is difficult to define every new type of

consumers [1]. Kim and Kwon (2002) mentioned that developing new profitable products was very depressed, and related theoretical research was insufficient [3].

In order to satisfy various consumer needs and secure competitive advantages, continuous new product development is an integral part of business management. This paper conducts a research on quantitative analysis for R&D trends and strategy for new product development.

2. Background

Many companies set an objective for market expansion through new product development. However, there are more than 95% of new product projects that are failed to get economic compensation [4]. Companies examines for higher success rates from various angles in order to achieve three goals, which are maximizing customer satisfaction, minimizing development period, and managing development cost [4].

This paper studies on a methodology for minimizing new product development period by patent analysis.

2.1. Patent

Patent is one of intellectual property, and is a legal system to encourage invention activity. As the importance of patent has been emphasized, many companies make efforts to secure patents. In addition, it has become a criterion of evaluating companies as an intangible asset.

Patent is technology document, which contains detailed description of technology for protecting the invention. It is composed of purpose, technical solution, range of protection, and so on. Based on the patent specification, the inventor gets not only legal protection of the technology but also credits for having an intangible asset.

2.2. O/S Matrix

As mentioned above, patent document involves specific structure. Every invention has the purpose and solution for specific problem, and it is indicated in the document. Therefore, it can be expressed in matrix form, as shown in Fig 2, which enables to classify vacant or actively developing technology easily by the purpose and solution [5].

	Object_1	**Object_2**	⋯	**Object_n**
Solution_1	*Patent_1* *Patent_2*		⋯	*Patent_n-3* *Patent_n-1*
Solution_2		*Patent_4*	⋯	
⋮	⋮	⋮	⋮	⋮
Solution_n	*Patent_5* *Patent_8*	*Patent_7*	⋯	*Patent_3* *Patent_6* *Patent_n-2*

Fig. 2: Example: O/S Matrix

3. Methodology

In this paper, a new product development methodology based on intellectual property is proposed. First, patent documents are collected for analysis. Then the final dataset is prepared after removing noise and overlapping patents. As mentioned in section 2.2, patent document shows the purpose and solution of an invention. So it is necessary to extract core patent and vacant technology groups by classifying by similar purposes, reclassifying by solutions, and finally constructing matrix of purpose in row and solution in column. In addition, clustering, which is one of the data mining techniques, is applied to the matrix for extracting core and vacant technology from the patent clusters. Lastly, those two results are combined to obtain final clusters of core and vacant technology. Based on the result, insufficient and promising technology areas are extracted to be used in new product development strategy

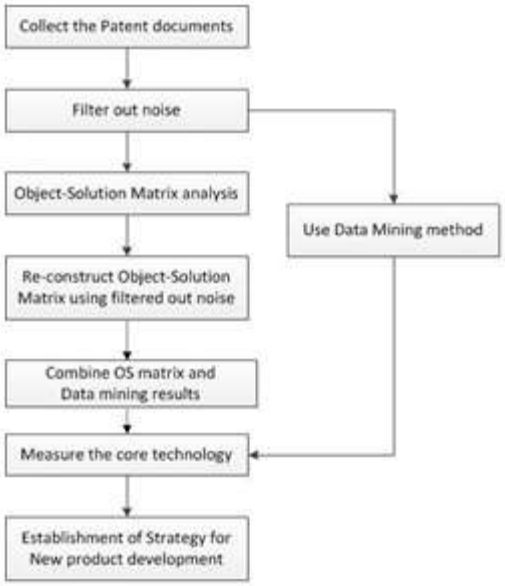

Fig. 3: Flow chart

4. Experimental Result

Patent documents related to automatic transmission of construction machinery were to chosen be analyzed. Six representative companies, or applicants, related to the technology were set as a search condition. 1,878 patent documents were collected, then it was reduced to 1,009 patents after removing overlapping and noise data. [6]

At the date of this writing, patents applied from May 2013 is not disclosed yet. Except pre-disclosed patents, it is possible that those patents are not published yet. Therefore, patents applied through 2012 were used for the analysis. Patent application trend showed that the technology was first introduced on 1980s, and the number of application was largely increased after mid-1990s.

The collected patent data was classified by IPC codes first, then it was reclassified by purposes for matrix analysis as shown in Fig 4.

IPC CODE		A01A-00/0	A01B-00/0	…	A10A-00/1
		Object 1	Object 2	…	Object *n*
A01A-00/0	Solutiuon 1	Patent Doc.1 Patent Doc.5	Patent Doc.2 Patent Doc.7 Patent Doc.8	…	Patent Doc. *n-2* Patent Doc. *n-1*
D01B-00/0	Solutiuon 2		Patent Doc.20	…	
⋮	⋮	⋮	⋮	⋮	⋮
C10A-00/1	Solution *n*	Patent Doc.7 Patent Doc.15		…	Patent Doc. *n*

Fig. 4: Example for Matrix Analysis

In accordance with the above method, OS matrix are shown in Fig 4, which overlapping patents applied in different countries, noise, PCT are excluded. The blank cells of the matrix were excluded in the analysis because those are the parts that purpose and solution are not matched.

Fig. 5 shows that there is an area for solving problems of "miniaturizing and lightening transmission" as hardware part. For the control part, the research is mainly focused on "a method for engine control". In order to extract core and vacant technology areas, a matrix was constructed with the cells of many patent applications and less applications. Fig. 6 shows the re-classified matrix.

Solution \ Object	transmission of power optimized	engine speed control	weight reduction of transmission
control method using micro computer unit	C-JP 1996-073481 H-JP 5247025		
operation paramater modification method	K-JP 2010-064861 K-JP 2010-0264860	C-JP 1996-136408	
transmission control method by engine output condition		C-JP 1996-136407 C-JP 2000-107962 C-JP 2000-104302 C-JP 2013-541990 C-JP 2010-535993 K-JP 3664460 K-JP 2000-075204 C-JP 1996-126955 H-JP 5242786 K-JP 1999-148744	
supply powerflow method using hydraulic transmission and mechanical transmission	C-JP 1997-302676		K-JP 1996-150257
transmission warming up method using magnetic solenoid after measuring temperature and viscosity	C-JP 1998-015252		
control logic design for transmission protection		C-JP 2001-382697 C-JP2001-286573	H-JP 5124504 K-JP 4925591 S-JP 2000-017710
output generating method through forecasting for transmission overload	C-JP 2004-239971 C-JP 2006-002702		
development of system, algorithm and logic for control	K-JP 4010408 H-JP 5301509 KO-JP 4691134	C-JP 2010-532041 C-JP 2006-005212 C-JP 2010-545149 H-JP 2009-283139 H-JP 4943125 H-JP 4787829 K-JP 2000-075204 K-JP 4900654	K-JP 4570418
gear changing method using engine speed signal and shift-down cut-off value while operating brake		H-JP 5017291	
gear changing condition setting method of manual operation in automatic transsmision	H-JP 4823668		
designed layout changing	C-JP 2008-514910 K-JP 2005 125586 S-JP 2007-210326 S-JP 2000-299020 S-JP 2000-296929 S-JP 2008-015338	C-JP 2000-364106 K-JP 2000-180589	K-JP 2008-001014, K-JP 5160267 S-JP 2001-150258, S-JP 2005-338553 S-JP 2004-149411, S-JP 2002-327360 S-JP 2002-088678, S-JP 4295139 S-JP 4249447, Ko-JP 2008-179275 C-JP 2005-379842, K-JP 2003-148696 K-JP 2003-148537, K-JP 1999-284050 K-JP 1998-350741, K-JP 1997-149889 K-JP 4439223, K-JP 3985875 K-JP 3703108, K-JP 2005-376289
standardize the parts of an transsmision			S-JP 2006-249039 S-JP 2005-001809

Fig. 5: Result of Matrix Analysis

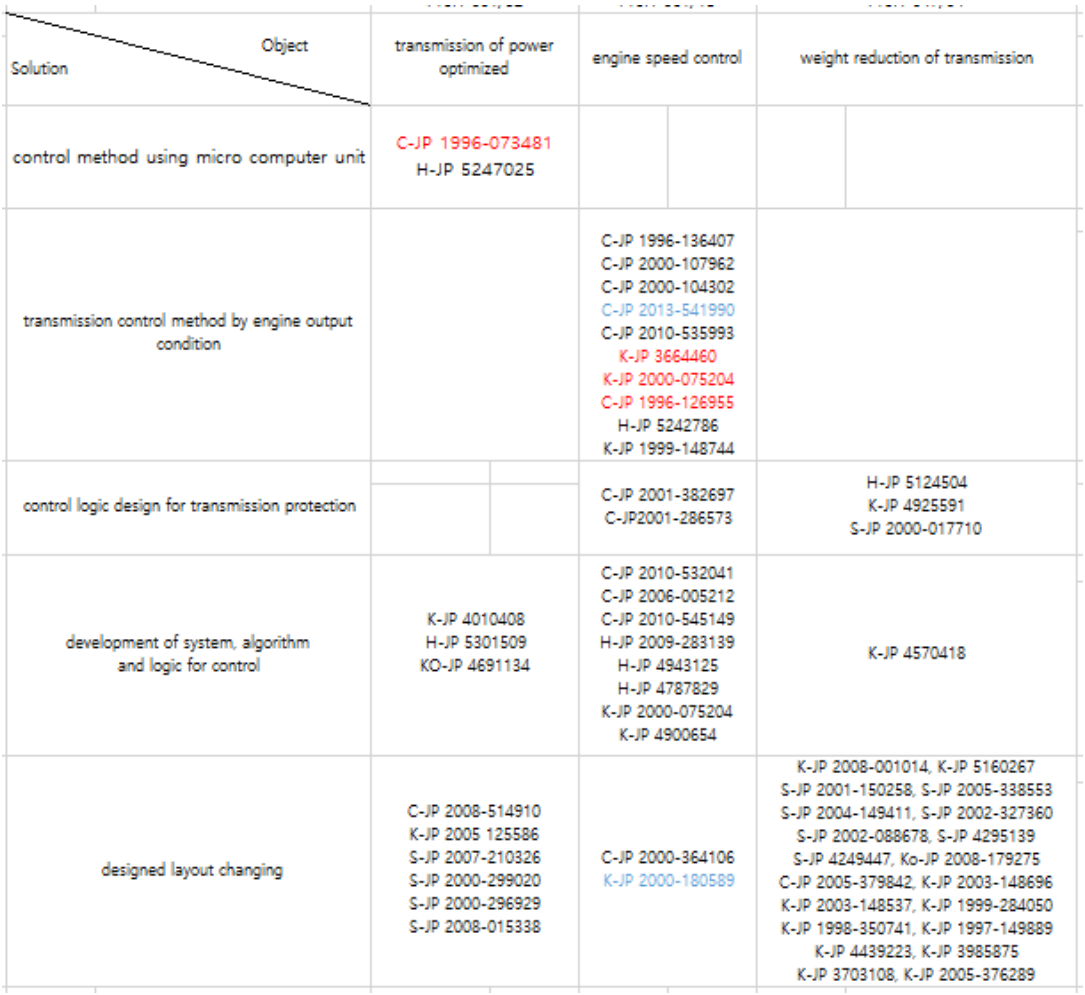

Fig. 6: Re-classified Matrix

Table 1 and 2 show the results of the patent documents clusters by cluster analysis and the core and vacant technology clusters of each.

TABLE I: Core Technology Group Using Clustering

	Engine				Control
Category	Planetary gear system	Clutch and disc drive	Valve body	Hydraulicallyoperated transmission assembly	Electronic control
Keyword	Power, System, Train, Transmission, Vehicle	And, for, method, transmission, vehicle	Control, for, method, transmission	Control, device, drive, for, gear	Apparatus, brake, clutch, construction, controlling

TABLE II: Vacuum Technology Group Using Clustering

	Engine				Control
Category	Planetary gear system	Clutch and disc drive	Valve body	Hydraulicallyoperated transmission assembly	Electronic control
Keyword	Gear, group, motor, product, reduction	Brake, device, for, hydraulic, motor, wet	Braking, drive, enhoance, having, machine	Construction, for, gearbox, gearmotors, housing	Control, engine, method, power, setting

Table 1, which shows the reclassified OS matrix result, indicates the active research on transmission control technology for engine power. It also shows that the research on power transfer unit for miniaturizing and

lightening transmission is active. However, micro computer unit (MCU) for control technology appears to be insufficiently researched.

5. Conclusion

This paper studies on quantitative analysis for establishing new product development strategy. Throughout the research, intellectual property, patent documents, was used as analysis data, then purpose and solution are divided into OS matrix as rows and columns.

First, the OS matrix shows that the research on transmission control technology for engine power system control is actively studied. Power transfer unit, which is about miniaturizing and lightening transmission, is also actively researched. However, researches on control technology using MCU, which is a basic for control, are insufficient. Since it is considered as a source technology, it is strongly necessary to have MCU for efficient control system as well as improving device performance. Therefore, it has to be emphasized to research on control method based on microprocessor to secure the source technology.

6. Acknowledgements

This work was supported by the BK21 Plus (Big Data in Manufacturing and Logistics Systems, Korea University). This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education(NRF-2010-0024163)

7. References

[1] Korean Intellectual Property Office and Korea Invention Promotion Association, *Understanding of Intellectual Property*, Seoul, Korea.: Parkmungak, 2012, ch. 1, pp. 11-20.

[2] World Intellectual Property Organization, "World Intellectual Property Indicators", 2014, pp. 12-19.

[3] J. B. Kim and C. S. Gwan, "Developing of a Structural Model on the Implementation Processing Stage of New Product Development", in *Proc. 2002 Korean Institute of Industrial Engineers spring Conf*., 2002, pp. 212-215.

[4] Melissa A. Schilling, *Strategic Management of Technological Innovation*, 3rd ed. Mc Graw-Hill, 2009, ch. X, pp. 282-285.

[5] Korea Intellectual Property Office and Korea Intellectual Property Strategy Institute, *Intellectual Property Research & Development*, Seoul, Korea.: C&B, 2013, ch. 4, pp. 204-217.

[6] Wips on, Available: http://www.wipson.co.kr.

[7] Galit Shmueli, Nitin R. Patel and Peter C. Bruce, *Data Mining for Business Intelligence*, 2nd ed. New Jersey, U.S.: Wiley & Sons, 2010, ch. 12. pp. 219 – 240.