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Finding Industries for Big Data Usage on the Basis of AHP

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AHP 기반의 빅데이터 활용을 위한 산업 탐색

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Abstract Big Data is gathering all the attention from every business community. Pervasive use of machine-to-machine (M2M) applications and mobile devices bring an explosion of data. By analyzing this data, the private and public sectors can benefit in the areas of cost reduction and productivity. The Korean government is actively pursuing Big Data initiatives to promote its usage. This paper aims to select industries which fit for the development of Big Data with a verification of the experts. The analytic hierarchy process (AHP) is applied to systematically derive the opinion of more than 50 professionals. Medical / welfare, transportation / warehousing, information and communications / information security, energy, the financial sector have been identified as promising industries. The results can be utilized in developing Big Data best practices thus contributing industrial development.

Key Words : Big Data, AHP, Industry Analysis, Industry Selection, Industry Evaluation

요 약 빅데이터가 다양한 산업 분야에서 모든 관심을 끌고 있다. 사물과 사물 간 연결과 모바일 장치들의 용도 확대는 데이터의 폭발적인 증가를 불러오고 있다. 이러한 데이터를 분석하여 민간과 공공 분야에서는 비용 절감과 생산성 분야에 있어서 혜택을 누리고 있다. 한국 정부는 이러한 활용을 촉진하기 위해서, 빅데이터 산업발전전략을 활발하게 추진하고 있다. 본 연구는 빅데이터의 적극적인 육성이 필요한 산업 분야를 전문가의 검증을 통해 선정하였다. 전문가의 50여명의 체계적인 의견 도출을 위해 계층분석법(AHP)을 적용하였다. 분석 결과 의료,복지, 운송/창고 보관업, 정보통신/정보보안, 에너지, 금융 분야가 빅데이터 적용이 유망한 것으로 확인되었다. 도출 결과는 앞으로 빅데이터 시범사업으로 인한 모범사례의 발굴 등에 활용되어 빅데이터 산업 발전에 기여할 것이다.

주제어 : 빅데이터, 계층분석법, 산업분석, 산업선정, 산업평가

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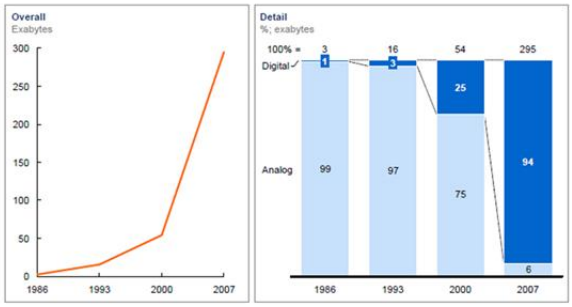
1. Introduction

Because of the development of information and communications technology (ICT) such as the spread of machine-to-machine (M2M) [1] applications and the evolution of mobile devices, typical data such as multimedia and social network content are exploding. M2M installation has rapidly increased since 2000 according to [Fig. 1]. Proportion of digital sensors was also increased dramatically. Not only the original content but also content consumption information such as secondary processed data are massively produced. As data traffic increases, collecting, analyzing, preserving, and applying data have become more important. Big Data [2, 3, 4, 5, 6, 7] does not simply indicate large-volume data. Its definition has expanded to include the process of extracting and applying valuable information. The characteristics of Big Data can be summarized with 3Vs [8, 9, 10] volume of data requiring data storage of at least terabytes; data processing velocity (determining the status of real-time processing of the data, if necessary); and variety of data types such as typical, atypical, and semi-typical data [11, 12]. The global Big Data market in terms of its related market (infrastructure, software, service) is expected to grow five times in five years (beginning in 2010). With such a trend, the Korean market is expected to grow to a scale of 236 million US dollar in 2015 and expected to reach 585 million US dollar in 2018 [13]. Big Data and other IT convergence technologies can also contribute in increasing the competitiveness of companies including SMEs in which a leadership of CEO effect the adoption of new technologies [14, 15, 16].

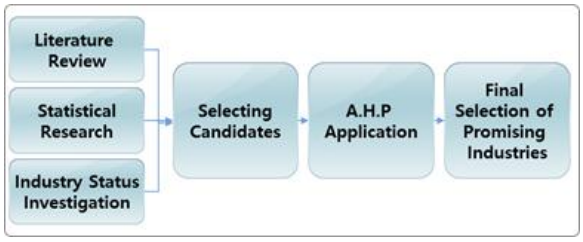
This study aims to recommand promising industries in which Big Data could be used by the opinion of industry experts. The selected industries will contribute to making significant investment decisions for government support and private businesses.

2. Related Works and Methodology

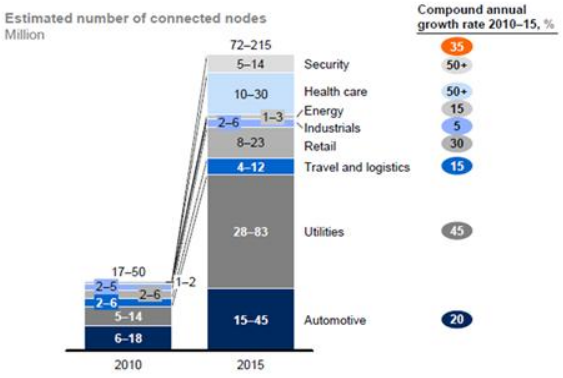
Candidates for promising industries are selected based on a literature review, statistical research, and current social-condition investigation; the data are confirmed by the Delphi analytic hierarchy process (AHP) method. The analysis methodology is illustrated in [Fig. 2], and the details are shown below. There are six major steps of this methodology such as literature review, statistical research, industry status investigation, candidate selection, AHP application, and final selection of promising industries.



[Fig. 1] M2M Sensor Installation [12]



[Fig. 2] Analysis Methodology



[Fig. 3] Atypical Data Increase [12]

(Step 1: Literature Review) Based on the two major studies of Big Data promising industry selection identified in the basic literature review, seven promising industry candidates are selected [Fig. 3]. Data in healthcare, retail, utilities, automotive industries has been increased rapidly according to [Fig. 3].).

(Step 2: Statistical Research) Summaries of similar industries and unknown values are added based on a statistical research result using the five major variables suggested in 2011 by the National IT Industry Promotion Agency.

(Step 3: Investigation of Current Status by Each Industry) Understand status and problems of the major industries using international and national Big Data.

(Step 4: Selecting Candidates) Extract 16 final candidates for promising industries from a literature review, statistical research, and summarized data of similar industries.

(Step 5: AHP Application) Select the promising industries by applying the AHP method (statistical decision of Big Data professionals) to 16 industries extracted as the final candidates.

(Step 6: Final Selection of Promising Industries) Select the top seven promising Big Data business industries using the Delphi AHP method.

3. Industry Analysis

A literature review is conducted to select preliminary candidates for promising industries. Gartner's Big Data investment interest level and planning priorities (2012) and the research results of KB Financial Management Group's data capacity by industry and Big Data potentials (2013) were used for the literature review. The final candidates were selected in the five chosen industries by calculating the potential of the Big Data industries in the GDP scale from the McKinsey and the six promising industries suggested by the Big Data industry development strategies of MSIP, announced in October 2013.

In addition, candidates were selected using statistical data such as index acquisition availability, analytic logistics, IT level (degree), data direction, data fusibility, and so on collected in 2011 by the National IT Industry Promotion Agency, and by reconstructing mean imputation based on overlapping data and missing values. Through a literature review and statistical research, similar categories were identified to select the final candidates of the 16 industries <Table 1>.

<Table 1> Final Selection of Promising Industry Candidates

No.	Final Selection Candidate	Literature Review Candidate	Big Data Promising Industries Selected by NIPA
1	Educational Services (Public)	Medical Health	Educational Services (Public)
2	Medical Health	Public	Medical Health
3	Manufacturing	Distribution	Manufacturing
4	Info. Communication	Production	Info. Communication
5	Natural Resources	Science Technology	Natural Resources
6	Computer and Electronic Devices	Info. Security	Computer and Electronic Devices
7	Logistics/ Transport	Transportation/ Logistics	Logistics/ Transport
8	Finance, Insurance		Finance, Insurance
9	Real Estate, Rental, Lease		Real Estate, Rental, Lease
10	Professional Science Technology Services		Professional Science Technology Services
11	Corporate Management		Corporate Management
12	Construction		Construction
13	Distribution		Distribution
14	Hotel/ Restaurant		Hotel/ Restaurant
15	Other Services (Excluding Public Services)		Other Services (Excluding Public Services)
16	Art/ Entertainment/ Leisure		Art/ Entertainment/ Leisure

Finally, an in-depth survey was conducted with the professionals of Big Data industries. The 16 industries selected with the analytic hierarchy process (AHP) were divided into first area and second area. The survey was conducted with 56 Big Data professionals for eight days, from November 26 (Mon) to December

4 (Wed), 2013. <Table 2> shows 5 major industries selected by Mckinsey and 6 industries by MSIP. Common industries are medical health, retail, manufacturing, geographic Information area.

<Table 2> Result of Literature Review on Promising Industry Candidates

Literature Review Candidate	McKinsey (2011)	MSIP (2013)
Medical Health	Medical Health	Medical Health
Public	Public	
Retail	Retail	Consumption/ Trade
Manufacturing	Manufacturing	Manufacturing/ Process
Science Technology	Geographic Info.	Science Technology
Info. Security		Info. Security
Transportation/ Logistics		Transportation/ Logistics

<Table 3> AHP Evaluation Model (for 16 Promising Industries)

Layer 1(Area)	Layer 2(Promising Industry)
Product	Manufacturing
	Natural Resources/Energy
	Computer and Electronic Devices
	Real Estate, Rental, Lease
	Construction
Service	Info. Communication/
	Info. Security
	Logistics, Transport (Storage)
	Finance/Insurance
	Science Technology Services
	Distribution
	Hotel/Restaurant
	Other Services (Excluding Public Services)
	Art/Entertainment/Leisure
Public (Regulated)	Medical/Welfare
	Educational Services
	Corporate Management (Tax accounting, etc.)

AHP deals with selecting priorities based on various evaluation methods. Thomas L. Saaty defines the AHP [13, 17] method as a multi-criteria decision model that hierarchically describes a decision-making problem and prioritizes plans based on decisions of decision makers. The AHP method is especially effective when goals, properties, and evaluation methods are intertwined hierarchically and therefore complicatedly. Because most decision-making problems focus on identifying the best solution among conflicting methods, AHP methods are applied in various ways in a variety of situations.

The AHP method has various methodologies based on evaluation method and process, but it is usually divided into three levels. The first level includes the process of breaking down problems such as the final goal of the decision-making problem and the hierarchy structure of property (evaluation method). The second level prioritizes each layer using pairwise comparison. The last level confirms the reliability of the data by estimating the relative weighted value using consistent rates. Here, a relative weighted value is estimated using pairwise comparison; this employs Saaty's eigenvalue method. The measurement index was developed based on the literature review and statistical research. It divided the two layers of the 16 industries from the first and second evaluations <Table 3>.

4. Promising Business Industry Selection Results

<Table 4> shows the evaluation result of the measurement index development and its alternatives using pairwise comparison. This result is reliable because the CR value is 0.071, which is lower than the 0.1 that Saaty suggests.

For the first-level areas, service/0.496 was more promising than other areas such as public regulated/0.34 and product/0.246. For promising industries by area, energy/0.095 for the product area, information communication/0.104 for the service area, and medical, welfare/0.150 for the public (regulated) area were the highest. For the second-level areas, <Table 5> shows the order determined by calculating general importance values applying the entire global value.

<Table 4> AHP Evaluation Result for Promising Industry Selection

Distributing Mode			
Level 1 (Area)	Level 2 (Promising Industry)		
Area Distinction (Local/ Global)	Industry	Local (Area Value)	Global (Total Value)
Product (0.246)	Manufacturing	0.212	0.052
	Natural Resources/Energy	0.386	0.095
	Computer and Electronic Devices	0.192	0.047
	Real Estate, etc.	0.116	0.029
	Construction	0.093	0.023
Service (0.496)	Info. Communication/ Info. Security	0.210	0.104
	Transport/ Storage	0.245	0.122
	Finance	0.181	0.09
	Science Technology	0.103	0.051
	Distribution	0.13	0.064
	Hotel/Restaurant	0.048	0.024
	Other Services	0.039	0.02
	Art/Ent./Leisure	0.044	0.022
Public (Regulated) (0.34)	Medical, Welfare	0.581	0.150
	Educational Services	0.332	0.086
	Corporate Management (Tax accounting, etc.)	0.087	0.022
Total			1
Purpose: Big Data Promising Industry Selection (CR = 0.071)			

<Table 5> AHP Evaluation Global Value Result

Promising Industry	Global Value	Rank
Medical, Welfare	0.15	1
Transport/Storage	0.122	2
Info. Communication/ Info. Security	0.104	3
Natural Resources/Energy	0.095	4
Finance	0.09	5
Educational Services	0.086	6
Distribution	0.064	7

Based on the global value of the AHP evaluation result, the top seven industries with the most importance points were selected as the final business model development areas. The final selected areas include medical/welfare, logistics/transport, communication/media, energy, finance, educational services, and distribution. The Medical / welfare sector can take advantage of the medical record Big Data in making appropriate medical decisions, which can leverage the power of big data. Big Data can solve the problem of matching supply and demand, and redundancy of payment in welfare sector. The Logistics / transport sector may reduce costs by streamlining logistics, the communication / media can develop a public media strategy to take advantage of big data on SNS. Applying Big Data on energy field can enhance the efficiency of energy use. In the field of finance, it is possible to provide a variety of financial products and risk management. The name of each industry was changed to include the general field.

5. Conclusions

This research applied AHP methodologies to identify industries that could benefit from the use of Big Data. In terms specific industries, the service industry had the highest likelihood of benefiting from Big Data. The final selected industries are medical/welfare, logistics/transport, communication/media, energy, finance, educational services, and distribution. In medical industries, u-Healthcare services and medical information services based on accumulated patients and their medical records were found to be promising. In logistics and transport industries, services that use sensor data such as GPS were found to be promising. Furthermore, Big Data analysis application technology will provide new services by analyzing large amounts of communications and financial data. It will also provide educational services to people who have relatively fewer resources. The practical use of Big Data is highlighted in most industries. However, additional interviews identified privacy and data combination issues as well as effects of big-data-related investigations. The study proposes effective industries for big data applications, but do not address the issue of privacy in the areas of Big Data, which is mentioned as a side effect of Big Data. Future research should presents the derivation of algorithms and detail data business models. Future research should also cover the respective fields those not covered in

this study, and provide real-world examples to guide Big Data adoption. Although excluded from this study, manufacturing, education and government/public sectors should be considered as a main adoption area of Big Data since they can drive innovations greatly [18, 19, 20, 21, 22]. It also necessary to analyse the implications and pros and cons for usage cases of Big Data to develop practical insight of Big Data adoption.

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