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Study on Decision-Making Factors of Big Data Application in Enterprises: Using Company S as an Example

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Abstract

With vigorous development of global network community, smart phones and mobile devices, enterprises can rapidly collect various kinds of data from internal and external environments. How to discover valuable information and transform it into new business opportunities from big data which grow rapidly is an extremely important issue for current enterprises. This study treats Company S as the subject and tries to find the factors of big data application in enterprises by a modified Decision Making Trial and Evaluation Laboratory (DEMATEL) and perceived benefits ─ perceived barriers relation matrix as reference for big data application and management of managers or marketing personnel in other organizations or related industry.

Keywords: Informational Technology, Big Data, A Modified DEMATEL, Decision-Making Factors.

1. Introduction

With vigorous development of global network community, smart phones and mobile devices, enterprises can rapidly collect various kinds of data from internal and external environments. The data increase by one time every 20 months(Lee et al., 2013). According to prediction of IDC (International Data Corporation), global well-known consulting institution of IT (Information Technology) and telecommunication industry, 2013 will be the first year of application of big data(Vesset et al., 2012). In 2013, big data IT expenditure will be up to USD$ 34 billion. IDC also estimated that market scale of big data will grow from USD$ 3.2 billion in 2010 to 16.9 billion in 2015. Average annual growth rate is 40%(Gartner Inc., 2012). How to discover valuable information and transform it into new business opportunities from big data which grow rapidly is an extremely important issue for current enterprises.

According to Einav & Levin's research(Einav & Levin, 2013), the reports of media show how big data will change business, government and economy. Immediate acquisition and processing of great amount of data is the key capacity of many kinds of business application. Analysts and researchers must make progress continuously, guide the significant research and analytical technique in the organization to selection and explanation of correct figures

and make sure that the budgets are distributed to the most related and reliable figures(Marks, 2013). Since demand for big data analysis increases significantly, classification algorithm of data mining technique plays extremely important role. Big data analysis requires more characteristics of data set, including structure of data, diverse data sources and percentage of data updating frequency(Kwon & Sim, 2013).

Deloitte's research(Deloitte, 2012). suggested that Big-4 accountant firms investigated CIOs (Chief Information Officer) in the world and demonstrated that up to 39% enterprises continued research on big data in 2013~2014. About 35% enterprises did not have introduction plans and only 7% enterprises had the intention of introduction or trial. The data shows that currently, big data are still at the stages of idea development or conceptual demonstration. Enterprises do not have confidence in participation in actual application. In 2012, Harvard Business Review indicated that current big data application encounters real technical challenge. However, challenge of big data management is more significant(McAfee & Bryjolfsson, 2012). Biesdorf et al.(2013).suggested that big data and advanced analysis easily resulted in expensive but ineffective solutions. Therefore, big data application is important and is future trend. However, currently, it is uncertain and exploration of decision-making factors of big data application in enterprises is the motive of this study.

Thus, previous data demonstrate that various factors will influence big data application in organizations or enterprises. It is worthy to find the factors. Hence, this study treats Company S as the subject and tries to find the factors of big data application in enterprises by a modified Decision Making Trial and Evaluation Laboratory (DEMATEL) and perceived benefits ─ perceived barriers relation matrix as reference for big data application and management of managers or marketing personnel in other organizations or related industry.

2. Literature Review on the M&A process and achievements

Regarding factors of big data application in enterprises, this study first reviews definition of big data. Secondly, by big data application, it proposes perceived benefits and perceived barriers of big data application.

2.1. Definition of big data

Big data analysis means big data saving, transfer, decomposition, reorganization, analysis and visual presentation of volumes of immediate and diverse structural and non-structural data of enterprises. It adopts business analytics, develops business intelligence and creates business value. Big data are generally defined as 3V, (1) Volume means processing of data above TB (Terabyte, 12 power of 10), including saved data, data of transaction, different types of forms and statistical data; (2) Velocity means processing of data with different demands of speed, such as batch processing, close time processing, real time processing, streaming processing; (3) Variety means diversity of data, including classified structural data, non-classified non-structural data (such as images, music, films, articles and social discussion) and semi-structural data(MIC, 2012). Miele & Shockley(2012) suggested that the fourth important dimension of enterprises is Veracity and it emphasizes importance of processing and management of some uncertain data. Hence, big data processing means a series of processing of different types of data instead of single data processing technique.

2.2. Application of big data

In 2011, market scale of big data server is about 1.2% of global servers. However, in 2015, prevalence rate will be up to 2.9%(Vesset et al., 2012). Although technology has been the service promoter of big data, the broader benefits are associated with the potential business value of big data. For instance, IBM Watson assists with doctors' auscultation by big data to avoid the errors(IBM, 2013). American president, Barack Obama, successfully planned several fund raising activities with his campaign team by big data and collected USD$1 billion(Scherer, 2012). Netflix conducted long-term big data analysis on all online rental streaming films by embedded dynamic analysis and monitoring, successfully recommended the films to customers and promoted them(Gantz & Reinsel, 2011). UPS developed the best route planning by data analysis to avoid unnecessary turns and idling of engine. UPS thus saved millions of gallon of oil(Lovell, 2077). In addition, big data is applied to satellite navigation transportation or personal transportation(Oliver et al., 2013). By big data, Google engineers analyzed and predicted the explosion of flu in the winter of certain year in the U.S. and even precisely positioned the states(Ginsber et al., 2009).

Based on the previous case, big data allow many enterprises to develop excellent goods or services and even have business plans. However, at present, why do the enterprises rarely apply big data? Hence, it is worthy to study the benefits and obstacles of big data application.

2.3. Perceived benefits and perceived barriers of big data application

According to report of ISACA(2013), big data analysis significantly and positively influences product R&D, market development, operational performance, clients' experience and loyalty and market predication and affects privacy, global legal governance, ownership of personal data, transparency, value distribution, etc .

Spakes(2013) suggested big data and prediction analysis is challenging for many industries. However, highly efficient analysis helps customers produce key reports in many fields. The benefits are the following: (1) detection, prevention and recovery of financial fraud; (2) calculation of risk of large-scale investment portfolio; (3) execution of high-value marketing activities; (4) improvement of delinquent account.

Research of Russom(2013) on TWDI demonstrated that up to 89% enterprises suggested that BDM (Big Data Management) is an opportunity. In addition, the investigation shows that benefits of big data management include data analysis, fraud examination and risk quantification. Big data samples and diverse data sources might lead to broader data analysis or data, data warehouse and data storage; better message exploration and development of new data application.

Research of Russom (2013) on TWDI suggested that obstacles of big data management include insufficient talents or skills, lack of infrastructure of data management and immaturity of type of data and sources. It is extremely difficult to introduce, control or management new technology. It lacks the business sponsorship and attractive cases. Design and framework of solution are challenging and it requires long-term work, complicated data integration and construction of big data management system. In addition, without reliable data management team, organization or enterprise, it will be difficult to establish function of big data.

According to Olavsrud(2013), PricewaterhouseCoopers (PwC), top 4 global professional consultant, has investigated 12 countries and 1,108 subjects of different industries regarding application of big data. The subjects were mostly IT and enterprise leaders. 75% of them worked in organizations with annual revenues more than USD$1 billion. PwC realized 4 major obstacles of big data of enterprises: (1) blind following of importance of big data visualization; (2) more investment on data collection than data analysis; (3) shortage of talents; (4) lack of system which treat information immediately. Venkatraman(2013) suggested that the most significant obstacle for British enterprises to be benefited by big data analysis is the lack of appropriate facility of data center and successful cases of business.

Based on the previous literatures, this study reorganizes common factors and perceived benefits and perceived barriers of factors of big data application in enterprises, as shown in Table 1.

Table 1: Perceived benefits and perceived barriers of big data application

Perceived benefits	Perceived barriers
Advanced data analysis in market prediction	Understaffing or insufficient skills
Acquisition of more business value	Confidentiality of personal data
Acquisition of better message exploration	Concern of cost benefit
Prevention of fraud and reduction of risk	Lack of complete business application cases
Development of new products	Uncertainty about function of big data
Execution of high-value marketing activities	Ineffective big data processing
Improvement of delinquent account	Lack of appropriate facility and management of data center

3. Research Method and Framework

3.1. Research Method

This study adopts a modified Decision Making Trial and Evaluation Laboratory (DEMATEL) proposed by Wu et al.(2011) to explore perceived benefits and perceived barriers which influence factors of big data application in enterprises and result in the related causal relation graph. Steps are shown below.

Step 1: Construction of direct-relation matrix

The first direct-relation matrix Z is n × n matrix of pair comparison of influence directions and standards. z_{ij} means effect of factor i on factor j. Matrix is shown below:

$Z = [z_{ij}]_{n \times n}$ 。

Step 2: Construction of standardized direct-relation matrix

Standardization is conducted by direct-relation matrix obtained in Step 1. Factors of matrix X are multiplied by coefficient S. $X = [x_{ij}]_{n \times n}$ and $0 \leq x_{ij} \leq 1$. By Eqs. (1) and (2), we obtain standardized direct-relation matrix and all diagonal line factors are 0.

$$X = S \times Z \qquad (1)$$

$$S = \frac{1}{\underset{1 \leq i \leq n}{MAX} \sum_{j=1}^{n} z_{ij}}, \; i,j = 1,2,\ldots,n \qquad (2)$$

Step 3: Construction of total influence- relation matrix

With standardized direct-relation matrix X, by Eq. (3), we can calculate total influence- relation matrix T. I is unit matrix.

$$T = X(I - X)^{-1} \qquad (3)$$

Step 4: Development of causal relation graph

Through Eq. (4), (5) and (6), total of row and line refer to D and R.

$$T = [t_{ij}]_{n \times n}, i,j = 1,2,\cdots,n \qquad (4)$$

$$D = \left[\sum_{j=1}^{n} t_{ij}\right]_{n \times 1} = [t_i]_{n \times 1} \qquad (5)$$

$$R = \left[\sum_{j=1}^{n} t_{ij}\right]_{n \times 1} = [t_j]_{n \times 1} \qquad (6)$$

Step 5: Drawing of causal relation graph

Causal relation graph can be drawn by ($D+R$, $D-R$) of concentrated data. Centrality ($D+R$) of cross axle is developed from R added by D. Cause of vertical axle ($D-R$) is R subtracted by D.

3.2. Research framework

Perceived benefits and perceived barriers in research framework are treated as two different themes. By DEMATEL, we obtain the causal relation (see Figure 1). The result of causal analysis can become "relation matrix of perceived benefits ─ perceived barriers" which is treated as causal relation graph as internal interpretation. Research framework of this study includes 3 steps: (1) selection of factors of perceived benefits and perceived barriers which influence big data application; (2) construction of first direct-relation matrix by DEMATEL, standardization of the first direct-relation matrix and accomplishment of total relation matrix; (3) establishment of "perceived benefits─ perceived barriers matrix".

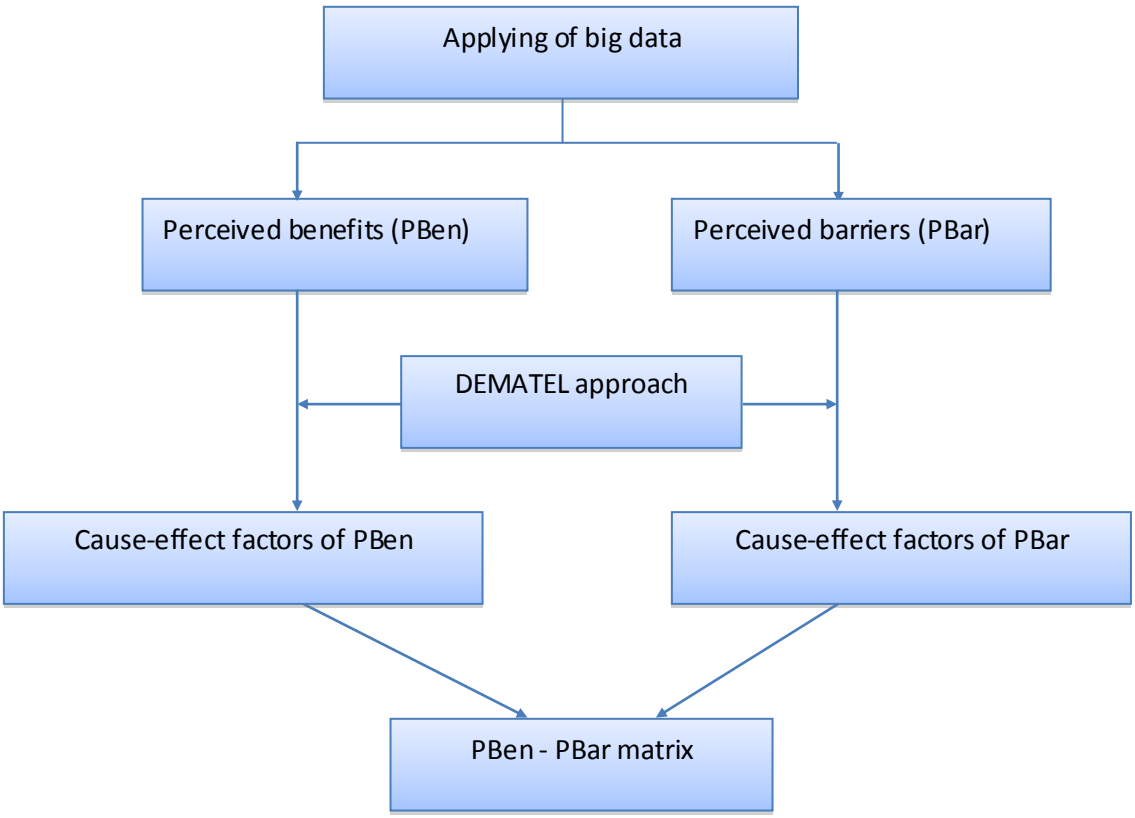

Figure 1: Research framework

3.2. Case company

Company S was founded in 2003. It is currently one of the global leading brands of Memory Card, USB Flash Drive, Card Reader, Memory Module, Solid State Disc and Portable Hard Drive. Company S is devoted to goods of the brand and has successfully sold the products to more than 100 countries in the world. More than 90% revenues are from the products of its brand.

Currently, marketing center of Company S suggests that big data analysis and management can lead to competitive advantage and it considers introducing cloud data integration system and customer relation management system to upgrade management and application of internal database. In Company S, there are two different views on big data

analysis and management. Company S founds decision-making team by framework of this study and the members include 5 supervisors and the functions include marketing, business, information, product R&D and customer service. After the conferences, the members decide to adopt 7 perceived benefits (PBen) and 7 perceived barriers (PBar) proposed by this study as factors of big data application.

It deals with relative causal relation by DEMATEL. The scale includes 5 levels. 0 means no effect, 1 means extremely low effect, 2 means low effect, 3 means high effect and 4 means extremely high effect. By the scale, we investigate and reorganize the decision-makers' direct-relation matrix of effect and standard. Based on the previous Step 2~5, we draw causal relation graph.

4. Results and Discussion

Results of 5 DEMATEL expert questionnaires obtained by this study are shown by matrix. We acquire 5 perceived benefits direct-relation matrix and 5 perceived barriers direct-relation matrix. This study then acquires means of the relations and direct-relation matrix Z of perceived benefits and perceived barriers of DEMATEL analysis, called direct-relation matrix (see Tables 2 and 3). Data of direct-relation matrix are multiplied by the corresponding S (perceived benefit S is $\frac{1}{13.6}$ and perceived barrier S is $\frac{1}{17.8}$) and it is standardized direct-relation matrix X (see Tables 4 and 5). After acquisition of standardized direct-relation matrix X, through formula, we calculate total influence-relation matrix T of perceived benefits and perceived barriers. I is unit matrix (see Tables 6 and 7). In total influence-relation matrix T, total figures of each row refer to D. Total figures of each column refer to R. Addition D and R is D+R (centrality); subtraction of D and R of different lines and rows is D-R (cause) (see Tables 8 and 9).

Table 2 : Direct-relation matrix of perceived benefits

initial	$PBEN_1$	$PBEN_2$	$PBEN_3$	$PBEN_4$	$PBEN_5$	$PBEN_6$	$PBEN_7$
$PBEN_1$	0	3.6	3.6	1.2	1.8	2.6	0.8
$PBEN_2$	2.8	0	2.6	1.2	2.8	3	0.6
$PBEN_3$	2.6	2.8	0	1.2	1.2	2	0.4
$PBEN_4$	1.6	1.2	0.8	0	0.2	0.2	1.8
$PBEN_5$	2	3.8	0.8	0	0	1.4	0.2
$PBEN_6$	2.4	3.6	1.2	0.2	1	0	0
$PBEN_7$	0.4	1	0.4	1.6	0	0	0

Table 3 : Direct-relation matrix of perceived barriers

initial	$PBAR_1$	$PBAR_2$	$PBAR_3$	$PBAR_4$	$PBAR_5$	$PBAR_6$	$PBAR_7$
$PBAR_1$	0	2.6	3	2.6	2.2	4	3.4
$PBAR_2$	2	0	1	1.2	1.4	3	2.4
$PBAR_3$	3.4	1.2	0	3.4	3.4	2.8	2.4
$PBAR_4$	1.6	1.6	2.4	0	3.6	3.8	3.2
$PBAR_5$	2.4	1.4	1.6	3.6	0	3.6	2.8
$PBAR_6$	4	2.6	1.6	2.8	3.6	0	3.2
$PBAR_7$	3.6	1.6	1	2.6	2.6	2.6	0

Table 4 : Standardized direct-relation matrix of perceived benefits

norm X	$PBEN_1$	$PBEN_2$	$PBEN_3$	$PBEN_4$	$PBEN_5$	$PBEN_6$	$PBEN_7$
$PBEN_1$	0.000	0.265	0.265	0.088	0.132	0.191	0.059
$PBEN_2$	0.206	0.000	0.191	0.088	0.206	0.221	0.044
$PBEN_3$	0.191	0.206	0.000	0.088	0.088	0.147	0.029
$PBEN_4$	0.118	0.088	0.059	0.000	0.015	0.015	0.132
$PBEN_5$	0.147	0.279	0.059	0.000	0.000	0.103	0.015
$PBEN_6$	0.176	0.265	0.088	0.015	0.074	0.000	0.000
$PBEN_7$	0.029	0.074	0.029	0.118	0.000	0.000	0.000

Table 5 : Standardized direct-relation matrix of perceived barriers

norm X	PBA R_1	PBA R_2	PBA R_3	PBA R_4	PBA R_5	PBA R_6	PBA R_7
PBA R_1	0.000	0.146	0.169	0.146	0.124	0.225	0.191
PBA R_2	0.112	0.000	0.056	0.067	0.079	0.169	0.135
PBA R_3	0.191	0.067	0.000	0.191	0.191	0.157	0.135
PBA R_4	0.090	0.090	0.135	0.000	0.202	0.213	0.180
PBA R_5	0.135	0.079	0.090	0.202	0.000	0.202	0.157
PBA R_6	0.225	0.146	0.090	0.157	0.202	0.000	0.180
PBA R_7	0.202	0.090	0.056	0.146	0.146	0.146	0.000

Table 6 : Total influence-relation matrix of perceived benefits

T	$PBEN_1$	$PBEN_2$	$PBEN_3$	$PBEN_4$	$PBEN_5$	$PBEN_6$	$PBEN_7$
$PBEN_1$	0.556	0.915	0.699	0.313	0.509	0.659	0.201
$PBEN_2$	0.699	0.677	0.618	0.295	0.545	0.655	0.180
$PBEN_3$	0.601	0.728	0.388	0.265	0.394	0.524	0.149
$PBEN_4$	0.316	0.348	0.249	0.106	0.167	0.207	0.190
$PBEN_5$	0.519	0.724	0.405	0.166	0.289	0.454	0.115
$PBEN_6$	0.556	0.728	0.443	0.185	0.366	0.372	0.108
$PBEN_7$	0.152	0.213	0.136	0.169	0.086	0.107	0.046

Table 7 : Total influence-relation matrix of perceived barriers

T	PBA R_1	PBA R_2	PBA R_3	PBA R_4	PBA R_5	PBA R_6	PBA R_7
PBA R_1	1.187	0.941	0.920	1.258	1.283	1.523	1.370
PBA R_2	0.873	0.532	0.558	0.797	0.833	1.013	0.905
PBA R_3	1.294	0.844	0.750	1.252	1.289	1.423	1.281
PBA R_4	1.182	0.833	0.834	1.051	1.258	1.415	1.272
PBA R_5	1.173	0.800	0.777	1.181	1.049	1.365	1.217
PBA R_6	1.363	0.939	0.859	1.262	1.333	1.337	1.360
PBA R_7	1.137	0.751	0.695	1.053	1.084	1.226	0.992

Table 8 : Centrality and cause of perceived benefits

T	$PBEN_1$	$PBEN_2$	$PBEN_3$	$PBEN_4$	$PBEN_5$	$PBEN_6$	$PBEN_7$	D	R	D+R	D-R
$PBEN_1$	0.556	0.915	0.699	0.313	0.509	0.659	0.201	3.853	3.399	7.252	0.454
$PBEN_2$	0.699	0.677	0.618	0.295	0.545	0.655	0.180	3.671	4.334	8.005	-0.663
$PBEN_3$	0.601	0.728	0.388	0.265	0.394	0.524	0.149	3.050	2.938	5.988	0.112
$PBEN_4$	0.316	0.348	0.249	0.106	0.167	0.207	0.190	1.583	1.499	3.082	0.084
$PBEN_5$	0.519	0.724	0.405	0.166	0.289	0.454	0.115	2.672	2.357	5.029	0.315
$PBEN_6$	0.556	0.728	0.443	0.185	0.366	0.372	0.108	2.758	2.979	5.737	-0.221
$PBEN_7$	0.152	0.213	0.136	0.169	0.086	0.107	0.046	0.909	0.990	1.899	-0.081

Table 9 : Centrality and cuase of perceived barriers

T	PBA R_1	PBA R_2	PBA R_3	PBA R_4	PBA R_5	PBA R_6	PBA R_7	D	R	D+R	D-R
PBA R_1	1.187	0.941	0.920	1.258	1.283	1.523	1.370	8.481	8.209	16.690	0.272
PBA R_2	0.873	0.532	0.558	0.797	0.833	1.013	0.905	5.512	5.640	11.152	-0.128
PBA R_3	1.294	0.844	0.750	1.252	1.289	1.423	1.281	8.132	5.393	13.525	2.739
PBA R_4	1.182	0.833	0.834	1.051	1.258	1.415	1.272	7.846	7.853	15.699	-0.007
PBA R_5	1.173	0.800	0.777	1.181	1.049	1.365	1.217	7.561	8.128	15.689	-0.567
PBA R_6	1.363	0.939	0.859	1.262	1.333	1.337	1.360	8.453	9.303	17.756	-0.850
PBA R_7	1.137	0.751	0.695	1.053	1.084	1.226	0.992	6.939	8.396	15.335	-1.457

According to modified DEMATEL, this study transforms positive value of centrality (D+R) of perceived barriers into negative (see Table 10) and the data are X and Y of coordinates to draw causal relation graph (see Figure 2).

Table 10 : Centrality D+R of perceived barriers is transformed into negative

	D+R	D-R		D+R	D-R
$PBEN_1$	7.252	0.454	$PBAR_1$	-16.690	0.272
$PBEN_2$	8.005	-0.663	$PBAR_2$	-11.152	-0.128
$PBEN_3$	5.988	0.112	$PBAR_3$	-13.525	2.739
$PBEN_4$	3.082	0.084	$PBAR_4$	-15.699	-0.007
$PBEN_5$	5.029	0.315	$PBAR_5$	-15.689	-0.567
$PBEN_6$	5.737	-0.221	$PBAR_6$	-17.756	-0.850
$PBEN_7$	1.899	-0.081	$PBAR_7$	-15.335	-1.457

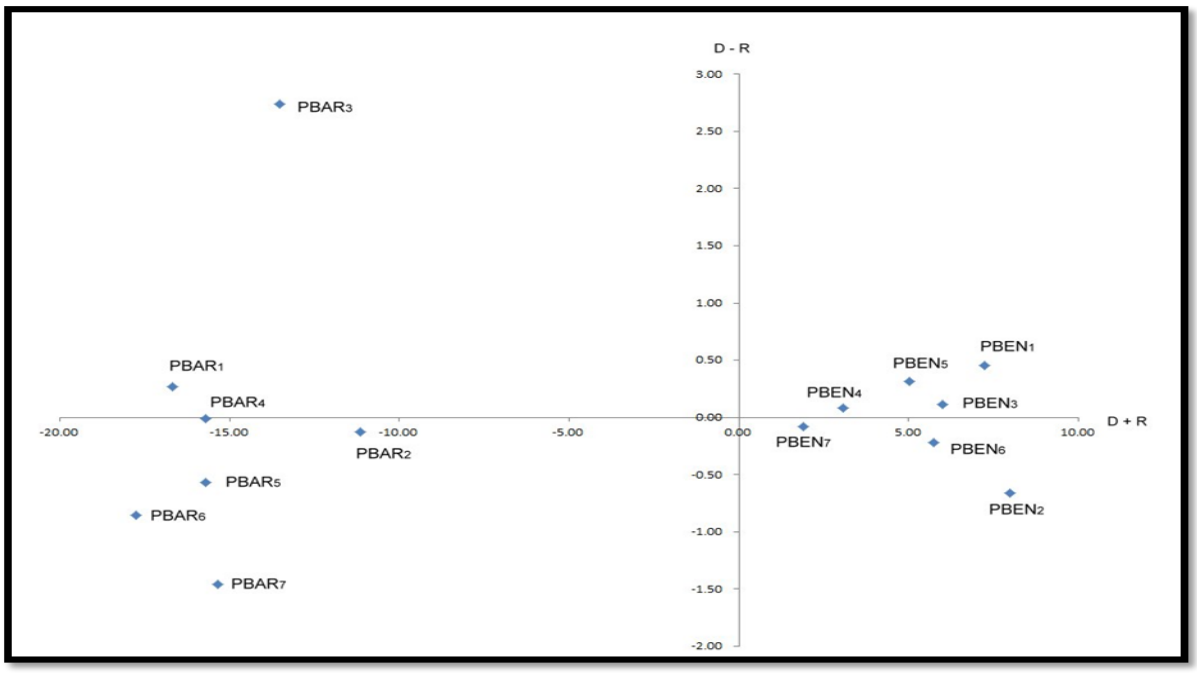

Figure 2 : Causal relation graph of perceived benefits and perceived barriers

Regarding factors of perceived benefits and perceived barriers of big data application in Company S, analytical result of main effects and relations are shown in Tables 11 and 12. Based on Table 11, ranking of importance of perceived benefit factors of big data application in Company S are "advanced data analysis in market prediction", "development of new products", "acquisition of better message exploration" and "prevention of fraud and reduction of risk". "Advanced data analysis in market prediction" with the highest degree of cause matches current challenge of external environment encountered by Company S, such as progress of cloud saving technology and rapidity of wireless network. Management of Company S worries that in the following 2-3 years, some product lines will be eliminated rapidly. Therefore, we should recognize the life cycle of memory goods (such as USB and disc). The result shows that Company S intends to predict future market by big data application.

"Development of new products", the factor as the second cause, matches current development of new product line of Company S. Therefore, the factor will influence the related marketing activities. Only new product development lead to more business values by related marketing activities.

"Acquisition of better message exploration" is the third cause of perceived benefits. According to the original questionnaire, the factors refer to "execution of high-value marketing activities" and "acquisition of more business value". Other factors are insignificant. Hence, total degree of cause is not as the previous ones. The last cause is "prevention of fraud and reduction of risk". Based on result of internal discussion, the factor is not important factor of Company S. Therefore, the average effect is extremely low and we can neglect it.

Table 11 : Ranking of causes of perceived benefits

perceived benefits	Factors	D-R
$PBEN_1$	advanced data analysis in market prediction	0.454
$PBEN_5$	development of new products	0.315
$PBEN_3$	acquisition of better message exploration	0.112
$PBEN_4$	prevention of fraud and reduction of risk	0.084
$PBEN_7$	improvement of delinquent account	-0.081
$PBEN_6$	execution of high-value marketing activities	-0.221
$PBEN_2$	acquisition of more business value	-0.663

According to Table 12, ranking of importance of perceived barriers of big data application of Company S is "concern of cost benefit" and "understaffing or insufficient skills". Main barriers of big data application of Company S are cost benefit and skills. Effect of "concern of cost benefit" is particularly higher than the rest. Company S has contacted with several well-known big data service suppliers and realized that the expenditure of introduction can be enormous, in terms of Return on Investment. Thus, the factor is significant concern for Company S and it positively influences others.

As to "understaffing or insufficient skills" of the second cause, Company S finds that appropriate training or recruitment can solve the problem. Therefore, this study realizes that we can find the obstacles of big data application of Company S by the analytical data. It is useful information for big data service suppliers. If big data suppliers can avoid the barriers or design the related measures, it will be easily adopted by Company S.

Table 12 : Ranking of causes of perceived barriers

perceived barriers	Factors	D-R
$PBAR_3$	concern of cost benefit	2.739
$PBAR_1$	understaffing or insufficient skills	0.272
$PBAR_4$	Lack of complete business application cases	-0.007
$PBAR_2$	confidentiality of personal data	-0.128
$PBAR_5$	uncertainty about function of big data	-0.567
$PBAR_6$	ineffective big data processing	-0.850
$PBAR_7$	Lack of appropriate facility and management of data center	-1.457

According to Figure 2, in the first quadrant, distribution of falling points of perceived benefits of big data is more concentrated. It means that effects of the factors are not significantly different. With the finding, big data service suppliers can be more flexible and provide better customized service to satisfy needs of Company S. Concern of cost benefit of Company S on big data is considerably more significant than other factors. Hence, it is the key factor that Company S finally decides to suspend the introduction. We suggest that big data suppliers propose the most appropriate strategy and solution to main problems of Company S for Company S to easily introduce big data application.

5. Conclusion and Suggestions

This study adopts a modified DEMATEL proposed by Wu et al.(2013) to explore perceived benefits and perceived barriers of big data application in enterprises and develop related causal relation graph. Ranking of importance of perceived benefits is "advanced data analysis in market prediction", "development of new products", "acquisition of better message exploration" and "prevention of fraud and reduction of risk". Ranking of importance of perceived barriers of big data application in Company S is "concern of cost benefit" and "understaffing or insufficient skills". Result of this study can serve as reference for big data application and management of managers or marketing personnel in other enterprises and related industries.

Regarding big data application introduced by Company S, this study proposes suggestions for development and process of 3 phases. Phase 1 is the development. First, we suggest information department of Company S to establish task team of big data application to study analytical structure and technique (Hadoop) of big data and effectively integrate analytical database in the company. Phase 2 is the stage of cultivation. We recognize and contact with suppliers (such as Intel, IBM, Microsoft, Google) of big data solution and rely on subsidy, guidance and cognition of governmental projects in order to explore and predict future market by big data. Phase 3 is the stage of introduction. At this stage, we can make sure if big data application can be introduced by information department in Company S or we should rely on introduction of big data solution suppliers.

As to research limitation, this study only focuses on Company S in Taiwan as the case and the findings and results do not mean the same for other enterprises. In addition, different enterprises have different needs and cognitions of big data and there can be different results. Perceived benefits and perceived barriers of big data adopted by Company S only represent the factors recognized by Company S. Different organizations or enterprises will reveal factors differently and lead to different decisions and conclusions.

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