Identifying Emerging Technologies in the e-Business Industry
A Needs-driven Approach

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Abstract: Over the last few years, there have been huge efforts to forecast the technological future and emerging technologies, as an attempt to increase R&D efficiency within a limited budget. Therefore, this research purposes to develop a methodology for identifying new and promising technologies and apply it to the field of e-business. Unlike the previous studies taking a technology-driven approach, we take a needs-driven approach starting from future needs and derive a necessary technology to meet the needs. For this purpose, we firstly consider the future major using STEEP analysis. Secondly, the prospective social needs are derived from each major issue and then, the technologies required to meet the core needs are deduced to be a candidate of emerging technologies. Finally, the candidate technologies are evaluated from the viewpoint of feasibility and issues-relatedness, based on which the top 10 most important emerging technologies are determined. The suggested methodology is expected to be utilized as a valuable tool for discovering emerging technologies when considering IT is evolved not only in the form of technology-driven but also in the form of market-driven.

1 INTRODUCTION

In order to have competitiveness in an environment of rapidly changing science, it is important to monitor the development of existing technology and to discover new and promising technologies (Wheatley and Wilemon, 1999). That is, it is necessary for a firm to establish a technology development strategy through emerging technology forecasting to gain a competitive advantage while utilizing limited resources. At the national level, drilling and excavation technologies for the future are also significant in realizing the vision of the future society. At the center of discovering promising technology, are changes in consumer demand and the social environment in the future. In addition to the prospective changes, the speed and directions of technologies are considered to forecast future technology (Martino, 1975).

Such technology forecasting and emerging technology exploration efforts have been actively made across many industry sectors. Among them, it is the IT (Information Technology) sector where the most active forecasting activities are observed. With the latest advances in technology and the fast pace changes that take place in the field of IT every day, technology forecasting is an essential part of business in the field for a firm to survive and to remain competitive.

Looking at the methodologies commonly used for identifying emerging technologies in the IT sector, they seem to be divided into two types. First one is utilizing professionals, which is the method used by Delphi, AHP, and Panel of Experts (Dietz, 1987). The second one is to use predictive technologies to derive trends from technical quantitative data, for example, patents and papers (Harhoff et. al., 2003). Despite the usefulness of these approaches, however, most of the existing studies have had difficulties incorporating the point of view of users who want to practically use technology, considering that most of the previous methodologies are based on predictions from a technological standpoint. Particularly in e-business, which was created by the advances in IT, though its evolution is highly affected by IT itself, the needs of

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main actors in the business also affect significantly the direction of technology evolution.

Therefore, this study proposes an approach to reflecting the needs of the market for exploring emerging technologies in the e-business industry. We use both qualitative and quantitative methods to identify the top 10 most important technologies in the e-business and also provide an illustrative example to verify the feasibility of our approach. The research outputs are expected to contribute to the development of technology forecasting methodology and emerging business opportunities methodology. Also, the study results will support strategic and policy decisions in the e-business industry by providing guidelines for the R&D planning and business strategy to determine priorities of technology development. These days, e-business is being used in the society as a whole. Social trends of various aspects and needs of future users are emerging. This reflects the fact that demand-based forecasting has become important. In this regard, we believe this study may be very timely.

2 LITERATURE REVIEW

This study suggests a foundation for developing a methodology for exploring emerging technologies. For this purpose, a definition of emerging technology is given and the previous approaches to technology forecasting in the e-business sector (IT field) are examined.

2.1 Emerging Technology

Despite the concept of emerging technologies being understood, a sound definition is difficult to find. Various studies from different perspectives have tried to define emerging technology.

First, research on emerging technologies in recent years has seen rapid growth (Corrocher et al., 2003; Porter et al., 2002). It is a useful concept to identify, as scientific technology about reasonable prospects such as speed and direction as well as the scope of technological advances is important to predict in coming years; in fact, emerging research is a guideline for evaluation. Second, emerging technology is a transfer or change in technology that is in process. These transfers or changes may be incremental or radical, and they can be difficult to determine (Day and Shoemaker, 2000; Porter et al., 2002; Hung and Chu, 2006). Finally, an emerging technology gradually increases reliance on basic science (Day and Shoemaker, 2000). Recently, it seems to have become a topic viewed in a positive light. It is described as "the newly emerging technology" (Kontostathis et al., 2003).

Synthesizing existing research on emerging technologies and considering the characteristics of e-business, emerging technologies is defined as the "technologies in the introductory stage to be promising in the mid-and long-term perspective of 10 years, as seen in the country and social issues, and as reflected among worldwide leaders in the e-business industry" in this research.

2.2 Emerging Technology Mining

To examine the efforts of emerging technology mining in the field of e-business, we examined the efforts in the field of IT by taking technological perspectives. Currently, various methodologies have been developed in the IT fields, but mainly from a technology standpoint. Interestingly, in the IT fields, many attempts have been made to discover emerging technology based on quantitative data. First, the filing of patents and publications is rich in the field, which is essential to take a data-driven approach. Second, because the technology life cycle is short, changes can be easily detected from the data. Finally, quantitative analysis is relatively easy in terms of cost and effort.

The relevant studies can be grouped into three categories depending on the type of data being used. The first category is based on the citation data. Carpenter et. al. (1981), Albert et. al. (1991), Harhoff et. al. (1999), and many other studies have been conducted in this field. The second category uses the growth trends in patents and publications. The work by Carrocher et. al. (2003) is representative. To derive emerging technologies in the field of information and communications, two periods, 1995-96 and 1998-99 were examined using patents. The third type reflects composite indicators, as in work by Harhoff et. al (2003).

Qualitative techniques in the field of IT include the Delphi and scenario techniques. First, in case of the Delphi technique, it is easy to predict long-term time series data or forecasts for a wide range of technical areas due to high utilization in the industry (Dietz, 1987). Second, a scenario that describes the future potential of complex information enables policy-makers to understand its advantages (Kees, 2002).

Previous studies examined emerging technology patents in the process of selection techniques such as Delphi and most often approached the issue from the perspective of technical and systematic analysis of

the actual needs in the industry. In this study, the technical standpoint could not derive the hunt for technology from the public's needs; quantifying qualitative data to derive an emerging technology process was applied.

3 METHODOLOGY

3.1 Research Framework

The proposed emerging technology mining process consists of four phases in this study (see Figure 1).

First, identifying future issues (Step 1) involves identifying mega-trends of the future through extensive literature review (research paper, outlook report) from the point of STEEP (Social, Technological, Economic, Environmental, Political) views. As a result, we note that issues of necessity will rise over the next ten years.

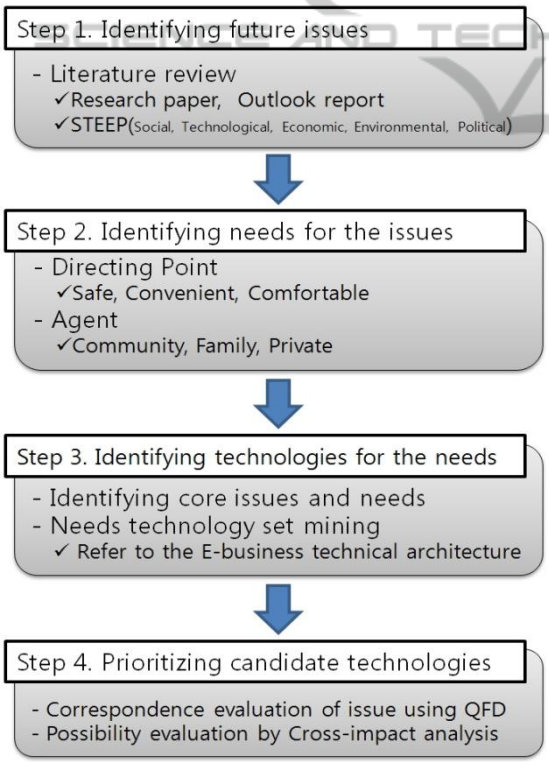

Figure 1: Research Framework.

Second, identifying needs for the issues (Step 2) includes a variety of perspectives among several users, such as the state, community, family and the private user. We note that needs are driven by the pursuit of the ultimate goal. These goals include a safe life, a convenient life, or a comfortable life ten years from now.

Third, to identify technologies for these needs (Step 3) core issues and needs of the future are determined by a questionnaire based on the results of Step 2 (needs technology set). We derived element technologies for the realization of core needs, referring to the technical architecture that has already been developed and is being used in the e-business sector. We develop a final technology set in which the elemental technologies were merged.

Finally, prioritization of candidate technologies (Step 4) involves analyzing 'issues relatedness' about candidates of emerging technologies using QFD (Quality Function Deployment). We evaluated 'Feasibility' using the cross-impact analysis in the e-business sector and derived final emerging technology.

3.2 Detailed Process

3.2.1 Identifying Future Issues

The point of view of STEEP has the advantage of helping the mixed comprehension across all over the external spectrum in the macro view. Thus, it is easy to determine the candidates of emerging technologies for solving issues that develop primarily from the mega trends of the future as candidate technologies for mining in the e-business sector. We determined the issues of the future through an extensive literature review from the point of view STEEP, as we approached the review from a variety of viewpoints of how all aspects of e-business are changing.

3.2.2 Identifying Needs for the Issues

Next, we derived relevant needs at the level of the issues. Needs are derived from each issue in pursuit of a 'safe life', a 'convenient life' or a 'comfortable life' from the point of view of the 'private user', 'family' and 'community'. Specifically, the needs are determined by the general public, not experts, for ten years from now. Therefore, the questionnaire is expressed as 'Needs about new product and services' or 'Needs about improvement of existing services'. The needs draft is derived through brain storming. If necessary, a FGI (Focus Group Interview) is performed by general people. Or, we could refer to the proposed scenario of the future in several organizations abroad.

3.2.3 Identifying Technologies for the Needs

Next, we derive core issues and needs through general population based on the determined needs set (3.2.2 result). This section considers the most important issues and needs that the general population foresees; it is difficult to satisfy all issues and needs that are deduced from emerging technologies. So, unlike previous studies, we took a survey of the general population, not experts. This is the best feature for an approach based on needs, not technology.

We determine the needs technology from the derived core issues and needs through a survey of the general population. Needs technology, which primarily satisfies needs, is referred to as the technology tree. The technical experts and the industry experts are involved in this stage. Finally, we merge the technologies by needs and eliminate overlapping technologies. Thus, we determine the candidates for emerging technology.

3.2.4 Prioritizing Candidate Technologies

In this section, we determine the final emerging technology through detailed analysis about candidates for emerging technology. The assessments used are the two viewpoints of 'Issues relatedness' and 'Feasibility'. By synthesizing the evaluation of these results, the priorities of candidates are set.

First, 'Issues relatedness' refers to assessing the correspondence between core issues and each technology. If technology is relevant to a variety of issues, the score of 'Issues relatedness' is higher. We proposed use of 'Linking grid' methodology (see Table 1) for the evaluation of the correspondence of issues.

When considering the weight of the issues, the proposed linking grid is measured according to the 'Issues relatedness' of technology by the level of relationship between the technologies and the issues. Table 1 shows the correspondence evaluation matrix; the horizontal axis represents core issues and the vertical axis represents needs technology. We assess the relationship between needs technologies and issues on the matrix by 7-point (very strong association: 7 points, very weak association: 1 point). The weight of the core issues was retrieved from the survey results of the general population. We evaluate the 'Issues relatedness' of candidates of needs technology by multiplying the correspondence by the weight of each core issue.

Table 1: Correspondence evaluation of issue.

	Issue	Issue 1	Issue 2	…	Issue **N**	**Total**
Technology	Weight					
Technology 1						
Technology 2						
…						
Technology **M**						

Second, 'Feasibility' involves assessing the realistic possibility of each technology in ten years. If the realistic possibility is high, the score of feasibility is high. We use the evaluations of experts to determine the feasibility and the cross impact analysis that reflects the relationship between technologies. The realization of e-business correlation techniques, by nature, has a great effect on the realization of other technologies. Thus, in the feasibility analysis of technology, we assess the feasibility of each technology. This is significant as it reflects the conditional probability assessment that when development of any kind of technology is successful, the probability of development of other technology is increased.

In addition, we used a 7-point evaluation index for the evaluation of 'Issues relatedness'(very strong independent feasibility: 7 points, very weak independent feasibility: 1 point; 'A technology' has a strong influence on 'B technology': 7 points, 'A technology' has a weak influence on 'B technology': 1 point). Table 2 shows the cross-impact analysis utilized in this study. The value of cell (i, j) in the matrix means that "When development of 'i technology' is successful, the success probability of development of 'j technology' increases". The value of the independence row means that the realization probability of 'i technology' is disregarded in its effect of other technology.

Table 2: Cross-impact Analysis.

Technology	1	…	N	Total score
1				
…				
M				
Independent feasibility				

As 'Issues relatedness' and 'feasibility' results are normalized, the highest score is '1' and the lowest score is '0' on each score. We are multiplying both results and valued importance of candidates in the higher order. The top 10 technologies according to the previous results are derived as the final emerging

technologies.

4 APPLICATION

This section proposes the process of emerging technology mining in E-business. However, the scope of the study is limited to illustrative examples in the wireless communication technologies field among e-business infrastructure technology, because we verify the validity and applicability of the proposed method. Up to now, we have progressed to step 2 in practice. Step 3 includes a hypothetical case for how to apply the proposed process.

4.1 Future Issues

In S.T.E.E.P, deriving the issue of the future through extensive literature review is performed as follows (see table 3). The result can be summarized in three mega trends, such as "The change in population structure and human relations", "The progress of the knowledge Based network society" and "The emergence of new, fusion, energy and eco technologies".

Table 3: Issue mining results.

Category	Future issue
Social	· Changes in population structure · Globalization · Network society
Technological	· Virtual intelligent space · Fusion Hybrid technology · Robot
Economic	· Emotional consumption · Knowledge-based economy · Changes in labor market
Ecological	· Climate change and environmental pollution · The energy crisis · Prolongation of life technology
Political	· Changes in corporate governance · Increased safety risk · Civil Integration

We draw 30 sub-issues from issues of Table 3. We separated the sub-issues into three sections and ten parts for the convenience of needs mining. The results are attached to Appendix 1.

4.2 Future Needs

Next, we draw the needs of the market from sub-issues. However, it is difficult to do so for all 30 sub-issues. Therefore, we grouped sub-issues that were judged to have high similarity in needs into 10 sections, and needs are derived by grouping category.

Table 4 shows an example of the future needs drawn in the Health/Welfare/Senior/Women section that include increase in older people, increase in consumption related to safety/wellness, increase in natural disasters and disease threats, increase in new health hazards, and real-time medical/diagnostic services.

Table 4: Example results of needs mining.

	Safe life	Convenient life	Comfortable life
Private	- Assistive services for seniors / disabled - Accidents and risk prevention services	- Smart mobiles and applications for silver IT - Mobiles and services for momentum measurement	- Secretary mobiles and services for seniors / disabled - Mobiles and applications for preventing dementia
Family	- Mobiles and services for location tracing - Emergency detection and emergency warning system in home	- Information sharing applications between family - As a partner in life, a robot services for home management	- Smart home, Tablet PC - Smart home monitoring and control services
Community	- Wireless health management system - Unmanned security system	- Wireless communication service for accessibility improvements of seniors / disabled	- Silver town operating system - Management system for the seniors

4.3 Emerging Technology Candidates

We carried out a survey targeting five hundred of the general population for core issues and needs of future mining. The survey was undertaken by a professional research firm and was held during the week of January 19-26, 2012. The survey represents the demographic characteristics of Korea. Also, we performed screening for suitable respondents through a few questions in advance due to the nature of the survey, because it required basic understanding of E-business products and services

and the ability of a panoramic view of the future society.

Upon investigation, nine core issues and three core needs of each core issue at the level of sub-issues were derived. Table 5 shows the core issues and needs.

Table 5: Example results of core issues and needs.

Core issues	Core needs
Personalization and the change of values	Personalized service and intelligence equipment
	Implementation of the emotion recognition service
Technology fusion and synergy	Smart Vehicle Service
	Implementation of Smart City (including smart home / building / transportation)
	U-health healthcare services for real-time health service

Primary, wireless technologies are derived to satisfy each need based on drawing core needs. At this stage, several principles are important. First, this should well reflect the context of emerging technology mining. In other words, in this case, we should infer belonging to a relevant technology part and consider satisfying the needs of the wireless technology in the E-business field. Second, we must consider the technology for the gratification of the needs in ten years. So, we should be careful of technology mining in the short term. Third, technology satisfies specific needs and needs to express generalized technology. It is necessary to consider integrated technology that is derived from needs later. Therefore, we draw specialized technology for needs and change the type of generalization. Table 6 shows results of technology mining regarding "Personalized service and intelligence equipment" in "Personalization and the change of values".

Table 6: Example results of technology mining.

Core needs	Needs-based technology	Generalized technology
Personalized service and intelligence equipment	Location and context-aware service platform technology for personalized services	Location and context-aware service platform technology
	Stand-alone signaling and configuration for power control for continuing to receive user information	Stand-alone signaling and configuration for power control

This step is necessary to domain knowledge about technologies and industries because it is performed through an expert survey. Finally, 20 generalized technologies, in other words, candidates of emerging technologies are derived.

4.4 Emerging Technologies

Finally, we evaluated "issues relatedness" and "feasibility" for the 20 candidates of emerging technologies.

Table 7 is a part of issue-relatedness evaluation. First, we wrote the weight of each issue in the evaluation matrix. 43.4, for example, is the weight of "Issue 1" and 18.5 is the weight of "Issue 9".

Next, we analyzed the correlation between technology and issue. Responsiveness by issue of needs 1, for example, means that is closely related to "Issue 1" and is not closely related to "Issue 9" because "Issue 1" is the 7-point and "Issue 9" is the 1-point. We multiplied weight by issue and summed up issue-relatedness in each technology for the total score. Normalized, the highest score is 1 and the lowest score is 0.

Table 7: A part of issue-relatedness evaluation.

Issues / Technology	ID	1	…	9	Total score
	Weight	43.4		18.5	
1		7		1	427.5
…		…			…
20		3		0	279.3

Next, Table 8 is a cross-impact analysis result for candidates of emerging feasibility evaluation. We wrote down the feasibility of each technology in the evaluation matrix. We used a 7-point scale, the response to the feasibility, for ease of response and to assign the appropriate probability according to the barometer(1 point-0, 2 point-1/6, 3 point-1/3, 4 point-1/2, 5 point-2/3, 6 point 5/6, 7 point-1). For example, the probability of technology 1's feasibility is 2/3.

Next, we measured cross-impact between technologies. We used a 7-point scale and converted to probability. The value of the cell (1, 20) is 5/6. This means that the probability of realizing technology 20 is the same as that of realizing technology 1. With a completed matrix, we could derive the probability of realizing (total score) to consider cross-impacts between technology. The probability of realizing technology 1, for example, is 0.67 without regard to relation to other technology. However, it rises to 0.82 when considering relations with other technology. Finally, as for issue-relatedness, it is normalized; the highest score is 1 and the lowest score is 0.

Table 8: A part of technology feasibility evaluation.

Technology	1	…	20	Total score
1		…	5/6	0.82
…	…		…	…
20	1/3	…		0.12
Independent feasibility	2/3	…	1/6	

We synthesized the results of assessments, issue-relatedness evaluation, and cross-impact analysis. The top 10 technologies according to total scores are derived as final emerging technology.

5 CONCLUSIONS

This study uses the needs-driven approach to find future emerging technologies. The contribution of this study is twofold. First, this study has significance in the proposal of emerging technology mining that is important to the social needs of industry, including the e-business industry. This methodology is judged as useful as it applies in evolving technologies based on needs. Second, this study uses the 'qualitative technique', such as future needs mining based on users, for the emerging technology mining process. The 'qualitative technique' is also used in, the correspondence evaluation of technology. The objectivity of this study increased compared to our previous study based on discussions with experts. The strategic value also increased compared to our study based on the database of scientific techniques.

Despite these contributions, this study has some limitations. First, this study requires advanced methodology due to the earlier studies of emerging technology mining in the e-business industry. Through the variety of information collection and processing, we will forecast and design our system so as not to end the study in a one-time effort. At the same time, the system should be designed by the study for the creation of new information. Second, we applied only part of the proposed whole methodology in the application of this study. Becoming an emerging technology requires 'Economic feasibility', 'Technical feasibility' and 'Suitability' in addition to 'Issues relatedness'. Thus, further research needs to be applied to various processes. Finally, we used a needs driven approach, but we need to flesh out the possibility of a methodology to integrate a technologies-driven approach. Recently, an attempt was made to continue to identify a hidden signal early in the technical trend using the database of widespread scientific techniques. Thus, it is very meaningful to identifying emerging technologies in the e-business industry that are used to integrate surveys and patent analysis.

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APPENDIX 1

Table 9: Sub-issues results.

Category	List of sub-issues
Daily life part	· Increase in older people · Increase in consumption related to safety/wellness · Increase in natural disasters and disease threats · Increase in new health hazard · Spread real-time medical/diagnostic services · The personalization and the change of values · Due to globalization, the spread of cultural diversity · Increase in global activity through IT technologies · Diversification of consumption patterns and expansion of emotion-based service · The transition to the mobile economy · Increase in global cooperation activities · Activation of Smart Work · The need for creative talent
Professional technology part	· The beyond learning society · The beyond human relations · The rise of the virtual space based on extreme realism · Technology development for the expansion of cognitive ability · The expansion of intelligent networks all things · The market growth of artificial intelligence · Technology convergence and synergy · The growth of knowledge-intensive industries · The realization of Resource recycling society · The proliferation of smart grid · The utilization of renewable energy
State & social part	· Deepening polarization of social and economic · Increase in transparency · The proprietary of power and information · Deepening of protectionism of the domestic industry · Civil Integration