

# ***InSciTe Adaptive: Intelligent Technology Analysis Service Considering User Intention***

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**Abstract.** This paper describes *InSciTe Adaptive*, which is a technology intelligence service developed by KISTI. *InSciTe Adaptive* supports not only technology analyzing and forecasting based on diverse types of information such as paper, patents, reports, ads, web resources and so on but also user adaptive and guiding service by intelligent recognition of user preference. *InSciTe Adaptive* includes 7 services focusing on technologies, products, organizations, and nations: (a) Technology Navigation, (b) Technology Trends, (c) Core Elementary Technology, (d) Convergence Technology, (e) Agents Levels, (f) Agents Partners, and (g) Technology Roadmap. These services were implemented by combining Semantic Web technologies with text mining technologies.

**Keywords:** Semantic Web, User Adaptive, Technology Trends Analysis, User Intention, Technology Prediction.

## **1 Introduction**

The precise information analysis and new opportunity discovery are very important for future forecasting, future countermeasures decision, and future plan establishment. However, as the amount of information in science and IT field increases exponentially every year, data analysis about that information or extraction of new opportunity from documents, papers, patents, etc. becomes more difficult and complicate. Until now, there have been researches regarding information analysis of mass data and new opportunity discovery [1-5]. Traditional studies had focused on information analysis and conclusion deduction based on the scenario method or the Delphi method or AHP method. These methods are based on non-systematic process and dependent to subjective opinions of experts.

For overcoming limitations mentioned above, many systematic and objective methods are suggested such as Foresight and Understanding from Scientific Exposition (FUSE) [6], Combining and Uniting Business Intelligence with Semantic Technology (CUBIST) [7], Text Mining Software for Technology Management (VantagePoint) [8], and so on. These projects aim to support decision making by

analysis, pattern recognition of scientific documents. However, many researches and projects focus on information analysis and are insufficient to support new opportunity discovery or future forecasting.

Korea Institute of Science and Technology Information (KISTI) [9] have researched regarding information analysis about science and technology field, and technology opportunity discovery since 2010. Technology opportunity means a chance of technical innovation [10] and technology opportunity discovery indicates activities that search where such a chance exists. Recent global competition among technologies is summarized as a process of a discovery and preoccupation of technology opportunities. Therefore, it can be said that core competitiveness of a country or a company on research and development lies in their ability to analyze and apply technology opportunities. To discover technology opportunity, *InSciTe Adaptive* adopts Semantic Web technologies as a framework for representing and managing semantic data and also employs text mining technologies as a tool for automated and intelligent acquisition of semantic data. It analyzes web resources as well as digital contents on science and technology including academic papers and industrial patents, detects technological issues and discovers emerging technologies.

*InSciTe Adaptive* includes following information resources. We use 2 storages such as a relational database for raw data such as papers, patents, and web resources and semantic storage for relational information among technologies, products, organizations, and nations.

**Table 1.** Information Resources in *InSciTe Adaptive*

Storage	Resources	Number	
Relational Database	Papers	9,765,199	
	Patents	7,615,819	
	Web Resources	IDC Press	599
		Wikipedia	4,975,426
		InformationWeek	2,316
		Gizmag	16,840
		Tech Review	5,330
		IEEE spectrum	3,173
		technewsworld	9,844
		DiscoverMegazine	608
		NewYork Times	124,100
		BBC	37,073
		Fox news	10,749
		CNN	19,769
		Thomson Reuters	3,409
USA Today	38,925		
EtnEws.com	14,259		
Semantic Storage (RDF)	Technology-Product-Organization-Nation Triples	418,403,672	

## 2 User Adaptive Features

*InSciTe Adaptive* includes 2 user adaptive features: user modeling and user pattern recognition. The user modeling is the first part of *InSciTe Adaptive* service and consists of 4 levels questions. By analyzing answers of questions, the system can classify user as one of groups and suggest suitable starting service. The user pattern recognition is applied to each service in *InSciTe Adaptive*. The system analyzes user's service usage pattern and suggests related technology which is useful to users or the next services.

### 2.1 User Modeling

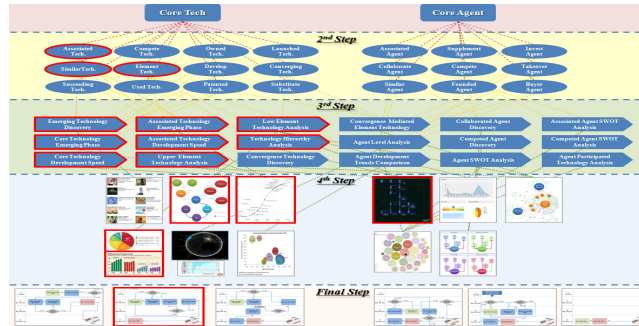


Fig. 1. User Modeling Process

The user modeling process consists of five steps: (a) Key category selection, (b) Constitution element selection, (c) Constitution function decision, (d) Service decision, (e) User group decision. In the 1st and 2nd steps, the system requests the user to manually select options for recognizing the user's intention. For the precise recognition of the user's purpose, the system supports the user's optimized selection based on mapping information constitution elements in the 2nd step and constitution functions in the 3rd step.

### 2.2 User Pattern Recognition

The strength of ontology is to provide related information of one concept. In addition to its basic roles, the *InSciTe Adaptive* uses the ontology to grasp user-interested technologies. User touches a few technologies, products, organizations, and nations in each service to know detail information and the system calculates interesting weight of their related technologies. Let us assume that user watched three technologies (T1, T2, and T3) and two organizations (O1 and O2) in order. Each one has related technologies with relations such as 'elementary,' 'develop' and so on. If a technology(s) appears  $r$  times or more in  $n$  recent contexts, the system considers it as user-interested technology(s). Figure 1 and Table 1 depicts the example.

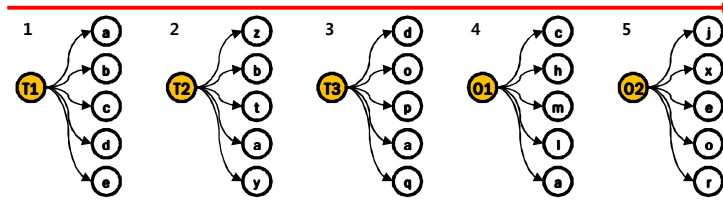


Fig. 2. Relationship between technology and technology

Table 2. User Pattern Recognition Process

	a	b	c	d	e	f	g	h	i	j	...
1 (T1)	1	1	1	1	1						...
2 (T2)	1	1									...
3 (T3)	1			1							...
4 (O1)	1		1					1			...
5 (O2)					1					1	...

### 3 Technology Focusing Analysis

InSciTe Adaptive includes 3 technology focusing analysis services: Technology Trends, Core Elementary Technology, and Convergence Technology. Each service focuses on technology analysis and relationship among related technologies.

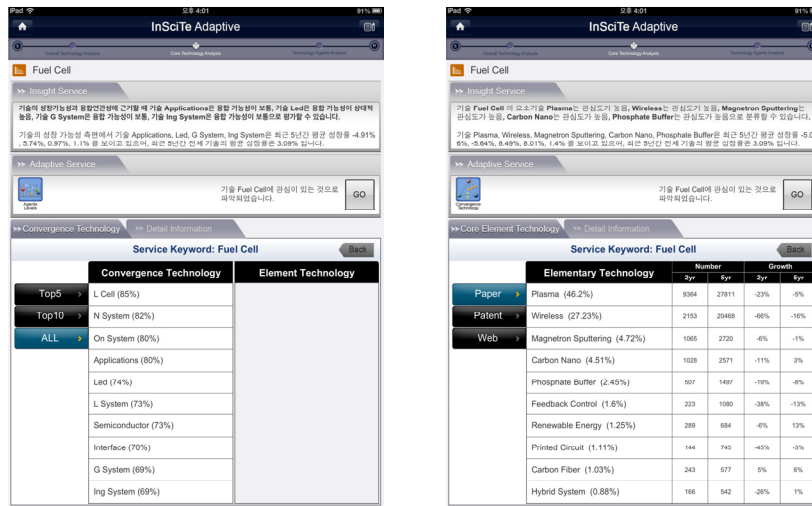


Fig. 3. Technology Focusing Services (Core Elementary & Convergence Technology)

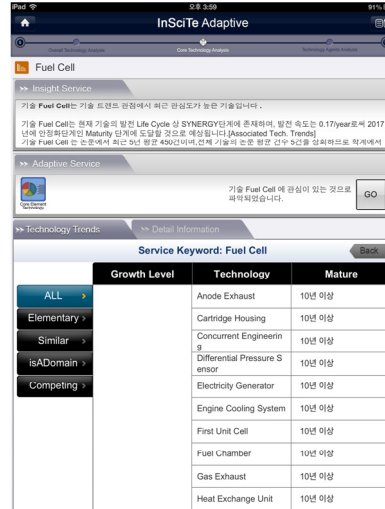


Fig. 4. Technology Focusing Services (technology trends)

### 3.1 Technology Trends

The technology trends service analyzes technology emerging status, development speed and forecasts when a technology can be reached into the maturity step. The technology trends service is based on 3 analysis models: technology life cycle discovery model, technology maturity forecast model, and emerging technology discover model. The TLCD model decides emerging phase of a specific technology and the TMF model forecast development speed of a specific technology. The ETD model decides whether a specific technology is emerging technology or not.

### 3.2 Core Elementary Technology

The core elementary technology service analyzes various elementary technologies of a specific technology. Elementary technologies are extracted by papers, patents, and web resources separately. Because companies usually are focusing on applying patents but universities are focusing on publishing papers, elementary technologies by papers and patents create totally different results. Each elementary technology has relative share ratio and this service evaluate emerging degree of each elementary technology.

### 3.3 Convergence Technology

The convergence technology service discovers candidate technology for convergence such as 'Augmented Reality + Car = Smart Car'. Convergence technologies are extracted based on sharing degree of element technologies. If the one technology has

same element technologies with the other technology, both of them can be converged in the future. The convergence technology service is the typical forecasting service which analyzes current status of each technology and predict future blueprint. In addition, the service evaluates each candidate convergence technology based on convergence proportion between candidate technology and search keyword given by users.

## 4 Agent Focusing Analysis

*InSciTe Adaptive* includes 2 agent focusing analysis services: agents levels and agents partners. In this service, the agent means company, university, and institution. Each service focuses on agent analysis and relationship between agents and technologies.

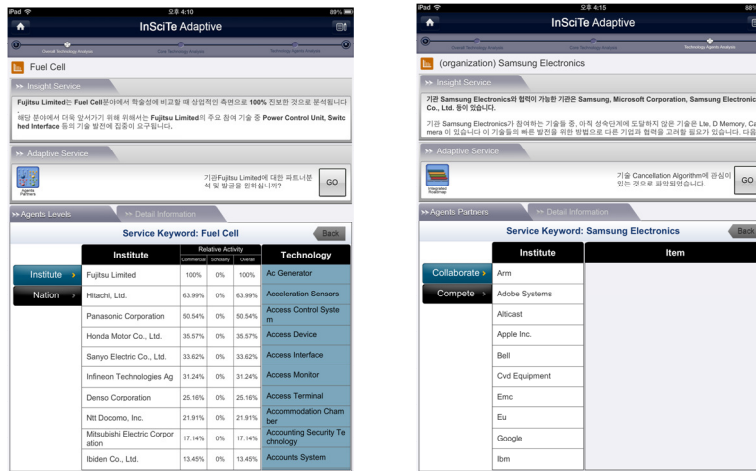


Fig. 4. Agent Focusing Analysis (Agent Levels, Agent Partners)

### 4.1 Agent Levels

The agent levels service provides relative rank of organizations and nations for given technology. The service has two dimensions analyzed by commercial and scholar aspects and the dimensions are calculated by the amount of patents and papers. In addition, the service evaluates agents based on overall ratio which summarizes both dimensions. Moreover, the service provides technology list of selected organization or nation. User can understand which agent approaches commercially or scholarly to a given technology.

### 4.2 Agent Partners

The agent partners service provides collaborating or competing organizations. Organizations can have both relations because they develop many kinds of technologies and

products. If there are two organizations and one produces 'LCD' and 'tablet pc' and the other produces 'tablet pc' then this organization can have collaboration in terms of 'LCD' for 'tablet pc' but they can compete in terms of 'tablet pc.' This service analyzes collaborating and competing in aspects of technologies and products between organizations. The service users can know organization's relations and their technologies and products which shows the relations.

## 5 Conclusion

This paper describes *InSciTe Adaptive*, a service for technology intelligent analysis and forecasting. It discovers emerging technologies based on technology life-cycle model and analyzes R&D status of research agents in competition or collaboration. Text mining and Semantic Web technologies allow *InSciTe Adaptive* to analyze technological literature automatically and provide such intelligent services.

## Reference

1. Richard, S. (1983). Patent Trends as a technological Forecasting Tool, *World Patent Information*, 5(3), 137-143.
2. Dereci, T. & Durmusoglu, A. (2009). A trend-based patent alert system for technology watch, *Journal of Scientific & Industrial Research*, 68(8), 674-679.
3. Rann, A. (1998). *Handbook of quantitative studies of science and technology*, New York: Elsevier.
4. John, H. (1995). *Technical Change and the World Economy-Convergence and Divergence in Technology Strategies*, New York: Elsevier.
5. Kim, Y., Suh, H., & Park, P. (2008). Visualization of patent analysis for emerging technology, *Expert System Application with Applications*, 34(1), 1805-1812.
6. Foresight and Understanding for Scientific Exposition. (2010). DARPA, [http://www.iarpa.gov/solicitations\\_fuse.html](http://www.iarpa.gov/solicitations_fuse.html).
7. Combining and Uniting Business Intelligence with Semantic Technology Project. (2008). SAP, OntoText, Sheffield Hallam Univ., Innovantage, Heriot Watt Univ., SpaceApplication, <http://www.cubist-project.eu>
8. VantagePoint. (2009). Text Mining Software for Technology Management-Search Technology, Inc., <http://www.thevantagepoint.com>.
9. KISTI, Korea Institute of Science and Technology Information, <http://www.kisti.re.kr>
10. Richard, S. (1983). Patent Trends as a technological Forecasting Tool, *World Patent Information*, 5(3), 137-143
11. Kim, J., Lee, S., Lee, J., Lee, M., & Jung, H. (2011). Design of TOD Model for Information Analysis and Future Prediction, *Communications in Computer and Information Science*, 264(1), 301-305.
12. Kim, J., Hwang, M., Jeong, D., Jung, H. (2012). Technology Trends Analysis and Forecasting Application based on Decision Tree and Statistical Feature Analysis, *Expert Systems with Applications*, 39(12), 12618-12625.

## Appendix

### A. Minimal requirements

- *InSciTe Adaptive* is an application that mainly targets research planners who have responsibility for establishing R&D strategy for future rather than general researchers surveying R&D information. It is very useful when research planners want to find new business areas or emerging technologies dedicated to them.
- The main data source is technical literature such as papers, patents web resources(reports, news, ads, etc.). It currently covers about 9,765,199 papers from IEEE proceedings and journals since 2006 and other proceedings and journals since 2009 and 7,615,819 patents of US, Europe and Japan. We also used many web resources such as news, reports, ads, and so on from CNN, BBC, NewYork Times, Wikipedia, and etc.
- All data used in *InSciTe Adaptive* are represented in RDF format. All entities such as technology terms, research agents and research outcomes are represented in URIs and their relationships are represented in RDF triples. Such entities and their relationships are further processed to derive useful implicit knowledge. The applied Semantic Web technologies give us sufficient flexibility in composing useful technology opportunity discovery services, which is the main advantage of *InSciTe Adaptive* compared to existing analytic tools.

### B. Additional notification

- Current service is a beta version. We are still developing the *InSciTe Adaptive* Service of release version. In addition, we are implementing 2 version of service; text (table) version and chart (diagram) version. The text version service will be completed 18<sup>th</sup>, Oct. and the chart version service will be completed 10<sup>th</sup>, Nov. Please check the schedule and consider it.
- URL of the service is <http://dev1.rntsoft.co.kr:8000/resources/html/index.html>. Current service implemented in Korean, but we will change every part in English until 15<sup>th</sup>, Oct.