NETWORK ANALYSIS ON FORESIGHT DOCUMENTS

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ABSTRACT

In this paper, analysis of documents about the research trend in telecommunication and information technology is discussed. A text-mining method which is based on the thesaurus analysis and the network analysis is applied for the number of foresight documents in the field. Those documents are obtained from national foresight activities so called *Delphi Survey* and *Perspective Scenario Building* conducted in 2004-2005 by the Japanese government as a national survey. The results of the analysis are intended for contributing to the political decision making in science and technology policy. The relationship of the documents which are obtained from several different foresight methodologies can be visualized by the proposed technique.

INTRODUCTION AND BACKGROUND

Japanese national budget for R&D in science and technology is annually around 4 trillion yen. This public investment to the R&D is the size of about 15% of over-all R&D spending of the nation. Ministry of Education, Culture, Sports, Science & Technology is mainly in charge of administrations over a large portion of this budget and responsible for funding to the variety of research projects in universities and other research institutions.

In order to allocate this budget effectively, we have to well understand the trend of the science and technology research activities. Foresight survey project such as *Delphi* provides well-established framework for the purpose. Japan has imported the foresight methodology from US in early 1960s and has adopted and enhanced to suite our soil.

The most resent nation-wide foresight activity has been conducted by the Japanese government in 2004-5 over whole science and technology fields. This project is designed for contributing to the discussions on formulating *the 3rd Science and Technology Basis Plan*. The plan has enacted in April 2006 as the 5 years science and technology policy foundation.

The National Institute of Science and Technology Policy in Japan (*NISTEP*) was in charge of conducting this foresight survey. Throughout the project, a large amount of text data has been compiled which explains the dynamics of science and technology research fields. In this paper, we introduce a new methodology to describe the characteristics of research fields.

Recently, the network analysis has been recognized as a popular tool for the research in social science. This technique is applied, for example, to measure the mutual relations of patents produced by

researchers in a certain field [1]. In this paper, the network analysis is applied in telecommunication and information technology for the policy stake-holders to understand the research trend in the near future. We used the network analysis to visualize the relationship among the individual descriptions about the future of science and technology research activities. The proposed methodology is intended for applying the future foresight activities.

METHODOLOGY

At first, we extracted keywords from the descriptions in *Delphi*. For conducting *Delphi*, the 13 research fields are defined for structuring overall science and technology research fields. In each field, there are several focused research areas. For the analysis, keywords associated with a certain area are extracted, and the set of keywords is considered elements of *characterization vector* that describe the position of documents to be characterized.

Since each document is written by different individual writers in *Perspective Scenario Building*, the normalization is necessary for the obtained opinions so that we utilized the *vector* to characterize documents from *Perspective Scenario Building*. According to the appearance of the keywords in each scenario, edges are depicted between nodes. Existence of an edge is calculated by the thresholds. The result of the visualization is shown in Fig.1.

Secondly the mutual relationship among scenario documents is analyzed and visualized. Based on the statistical evaluation, the frequencies of appearance of words in the document set are measured and then the fundamental a set of keywords are chosen. This set contains basic technical terms which define the characteristics of documents. The words are such as “robotics”, “processing”, “information”, “brain”, etc.

The mutual relationship among documents from variety of Scenarios is obtained in the followings. At first, selection of the scenario document is chosen with respect of relevancy to telecommunication and information technology. Then, the vector of the element which characterizes each scenario is measured based on the limited element technique. The public domain computer program called *KH Coder* is used for the purpose. The productions of vectors are calculated throughout the vector set, then the adjunction matrix is obtained. Based on the matrix, by using the *UCINET* software, the network graph representation is obtained. The result of the analysis is shown in Fig.2.

RESULTS OF ANALYSIS

Fig1 shows connectivity strength of 2 different groups of documents. On the left-hand side, we used 9 research areas which are defined through the process of *Delphi* survey by the working group consists of experts.

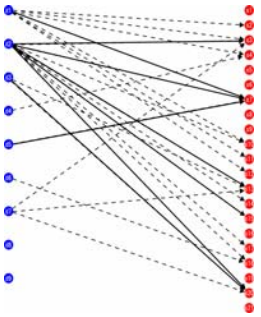

Fig.1 Relations between keywords of research area and scenario documents

Fig.2(a) shows the network graph of scenario documents produced in the *Perspective Scenario Building* project. The nodes of the graph represent scenario documents and the strength of connectivity is above a certain threshold, it is reflected the existence of edge of the network.

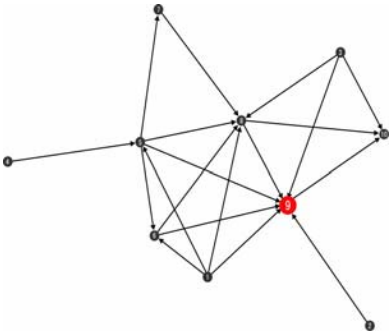

Fig. 2 Relationship of documents in Perspective Scenario Building

CONCLUDING REMARKS

Foresight activities provide important tools for science technology policy formations among economically advanced nations since 1960s. The large amount of documents has been stored and the visualization of stored documents is quite useful for science and technology stakeholders to understand the dynamics of research activities. The methodology explained in this paper becomes available only recently when the PC and related software are provided in reasonable cost. We believe that the analysis explained in the paper contributes for the future foresight activates and would be applied other field of studies.

[1] M. Yarime, "University-Industry Collaboration Networks for the Creation of Innovation", DRUID 2006, Copenhagen, Denmark