A Study on Information System for Science of Science and Technology Policy

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***Abstract*—As social, economic, and cultural environments have rapidly been changing, uncertainties and complexities have also increased with regard to research and development projects. Issues are across various fields and interconnected with different problems, which makes it harder to plan and design R&D projects and to estimate their effects as well. Linear and sequential approaches are not appropriate to deal with these changes. Rather, circular and simultaneous perspectives with more precision and rigor are needed. To this end, more information should be gathered and all parties concerned should be required to cooperate. It becomes essential to establish a science's evidence based and integrated system supported by all parties concerned for high quality and effective policy making.**

Keywords-Technology Policy, Decision Making System, Knowledge, R&D management

I. SCIENCE OF SCIENCE POLICY

Some of the advanced countries have recognized challenges and started to run a variety of programs such as science of Science and Innovation Policy to create the 3rd generation innovation systems for science and technology. The concept and term of Science of Science and Innovation Policy was first brought up and coined by Dr. Marburger of American Association for the Advancement of Science (AAAS) in 2005. This was based on the recognition that it is indispensable to understand complex relationships between R&D investments and innovation together with their consequent improvements of competitiveness and social benefits for policy effectiveness [1].

Among governing bodies attempting to make policy decisions scientific are Science of Science and Innovation Policy(SciSIP) of the US and European Innovation Scoreboard(EIS) and European Research Area WATCH of EU. Value-based technology innovation such as 'knowledge intensification and creative design' becomes more important in securing competitiveness of businesses and nations. All these factors increase the needs for IT infrastructure and in-depth studying of intellectual business system which support policy decision making based on scientific evidence [2].

However, the linear approaches to technological innovation model and policy supporting instruments so far have clear limitations to effectively deal with these technical changes and complex issues.

II. DESIGN OF DECISION MAKING SUPPORT SYSTEM

Current researches has stemmed from systems dynamics based on systems theory and feedback thinking, and evolved into cybernetics and automatic control mechanism. Interdisciplinary researches on new models of knowledge-based dynamics and policy aid have been required more than ever as high-technologies have converged and policy management system has changed [3]. In this paper, we propose mechanisms to achieve the service provision of Science of Science Policy. For this purpose, current processes are analyzed to identify factors, which need to be improved and analytical methodologies are also defined [4]. Then, major components are developed to effectively support the processes according to each methodology [5]. Evidence-based knowledge is utilized in the activities of policy adoption, implementation, and evaluation including decision-making [6]. When designing specific integration models, each Situation(S) is represented by unit of Topic(T), which equals Term(T) used in natural language. The integration model conducts text-mining by processing all documents and texts within the system into natural language, resulting in abstracting representative terms. This generates a knowledge model through analysis of relations between topics and layered structures of resources. Related to processes and tasks of the knowledge model, an Address of document repository is defined as a process and Task is defined as a name of the specific document directory.

The model which generates knowledge models automatically is defined as below:

Policy Making Supporting Model : M = {Process, Task, Resource}

Process : P = Document Repository {$Address_1$, ... $Address_n$}

Task : T = Document Directory {$Name_1$, ... $Name_n$}

Resource Element : Topic : E = Mining {$Term_1$, ... $Term_n$}

A component of a process is defined as task flow and relation and is designed so as to combine an integrated information system and service. With regard to collection of

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policy information, information has been collected on the basis of a component supporting tasks. Knowledge base integration of policy information has progressed through structuration of task-specific data and information as shown in Table I.

TABLE I. CONFIGURATION OF SYSTEM

Process	Components
Technology Policy	-Integrated information retrieval and Management -Technology monitoring / Trend analysis on a real time basis -Combined wire-wireless service
Forecasting	-Community for future prediction -2D matrix Delphi survey -Visualization of Roadmap
Planning	-Medium and long-term plans, database on policy trends, other data query
Investment strategy	-DB for investment planning on a micro level and process supporting -Project analysis and management -Links to information on R&D programs
Validity analysis	-Benefit analysis of R&D -Instruments for ripple effect analysis -Instruments for cost/paper analysis
Investigation analysis	-Unified search function for statistical indices -DB of statistical tables and graphs
Program coordination	-Program track records / Budget planning supporting -Budget requests, DB of mid-term project plans and deliberation materials
Program evaluation	-Query for in-depth evaluation results -Expert committee management

III. SYSTEM DEVELOPMENT

Specific policy processes and task connection models are needed for effective service structure, and integrated process maps should be designed to address components and information such as for example data and documents. The service of Science of Science Policy aims to improve the efficiency and reliability of producing policy alternatives. It is very important that while utilizing massive data and sharing instruments, we analyze various functions. Therefore, a component-based development method is appropriate and it should be comprised of unitary system for organic combination of the services. For example, various reference information is needed on fields, stages, and targets to be used both as a forecasting basis and for validity analysis. However, a particular expert or outdated data have been the only materials that policy community has depended on. Improved science policy support systems cause improvements in the effective activities of the proportion of researchers with the report, as shown in Table 2. Thus, the new service for technology analysis helps produce more objective and timely materials of technology value analysis and validity analysis through information on technology trends and massive database analysis on publication, patents, and market as shown in Table 3. For this reason, the database we reference provides 2.68 million data on publication, patents, and market and analysis of 0.34 million items of documents on policy trends.

TABLE II. RELATED DATA OF INNOVATION POLICY

Activity	Current	Improved	Change
Ration of searchers	28.8%	48%	+19.2%
researchers n tasks	32	55	+71%
improvement	2	7	+250%
Num. of reports	85	102	+20%
R&D projects	1.5	2.2	+46%
per researcher	0.2	0.3	+50%

TABLE III. RELATED DATA OF INNOVATION POLICY

Patents	Market	Statistics	Total
2,608,385	2,151	129	2,681,546
Knowledge analysis	Prediction experts	Validity experts	Evaluation experts
3,242	1,030	298	2,425

IV. CONCLUSIONS

This study has established an integrated knowledge base of policy support for the service of Science of Science Policy by standardizing and specifying processes. This approach has required organizing and comprising the specific functions on a basis of component units according to demand from stakeholders such as major information demanders, its users request patterns and policy decision makers. In turn, these works have made it possible to create the service of Science Policy which can control major policies on a real-time basis by catching and tracking policies' current states in the processes of adopting, implementing, evaluation and thus support evaluation and coordination of them based on objective data.

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