The Journal of GIS Association of Korea, Vol. 16, No. 4, pp. 385-400, December 2008

Invited Papers

A Study on Practicality of R&D Outcomes from the Korean Land Spatialization Program

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ABSTRACT

This study investigates how Korean Land Spatialization Group (KLSG) has controlled and managed its own R&D effectively and what particular elements have made it practical. Korean Land Spatialization Program (KLSP) has produced large amounts of practical outcomes for the intelligent land by collaborative 5 core research projects. The well-harmonized cooperations between proving ground, practical business model, and services oriented integration and others have driven the KLSG to an succeedable management. The active role for practicality is prominent with its usefulness and competitiveness. KLSP is financially and administratively supported from Ministry of Land Transport and Maritime Affairs of Korea (MLTM). By investigating relationships between 5 core research projects involved in the R&D projects of KLSG, it has been found out that R&D projects of KLSG bring forth practicality and commercialization. The results of this study presents strategies of KLSP in conducting research for practicality and commercialization of GIS technology and integrated geospatial information.

Keywords : KLSG, KLSP, Practicality, Proving Ground

요 약

본 연구의 목적은 지능형국토정보기술혁신사업 연구결과물들의 실용화 목표를 위해, “실용화를 위해 고려할 요소는 무엇이며, 어떻게 R&D과제를 관리해야할 것인가?”라는 문제에 집중하였다. 이 연구 사업은 5개의 핵심주관기관과 협력적인 작업을 통해 대량의 실용적 결과물들을 적용한 지능형국토를 지향점으로 하고 있다. 이를 위한 성공적인 R&D관리는 공동실험장, 실용적인 비즈니스 모델, 그리고 통합 서비스의 형태로서 유용성과 경쟁성에 집중하여 협

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동적인 역할을 수행한다. 또한, 이러한 역할정립은 국토해양부에 위탁받아 진행되는 정부주도의 형태이며, 5개의 핵심주관기관과 연계하여 높은 실용화/상업화 목표 달성을 위해 R&D과제를 수행하고 있다. 이 연구결과는 GIS 기술과 공간정보의 실용화방안과 상업화방안을 지능형국토정보기술혁신사업의 전략 분석을 통하여 보여준다.

주요어 : 지능형국토정보기술혁신사업단, 지능형국토정보기술혁신사업, 실용화, 공동실험장

1. Introduction

The Korean government recognized the value of geospatial information by a gas explosion in Daegu in 1995, carried out the first National GIS(NGIS) project (1996-2000) and the second NGIS project (2001-2005), and has been pushing ahead with the third NGIS project (2006-2010). The first and second NGIS projects included development of GIS digital data and GIS technology, which may be the backbone of digital map, thematic map, geographic information, underground facility map, and cadastral map. However, two previous projects only concentrated on development of technology for individual geospatial information and construction of related infrastructure, so that the collected geospatial information could not be utilized as integrated data or for other applications in public and private sectors.

To solve abovementioned problems, Ministry of Land, Transport and Maritime Affairs (MLTM) planned the third NGIS project. The third NGIS project aims at high-practical use of geospatial information such as public services, political decision makings, and making profits in GIS field. Particularly, Korean Land Spatialization Program (KLSP), one of the Value Creator (VC) 10 projects, was planned by MLTM to achieve aims of the third NGIS project. The primary objective of KLSP is to take a lead in technological developments for the realization of "Ubiquitous Infrastructures for Digital Korea.". KLSP consists of five core research projects and one research coordination project to practically utilize and commercialize the results of core research. The five core research projects include (1) geospatial information infrastructure, (2) land monitoring, (3) intelligent urban management, (4) Indoor/Outdoor Spatial Information based on Construction Design, and (5) ubiquitous GIS core software technology.

The objective of this study is to present strategies of KLSP in conducting research for practicality and commercialization of GIS technology and integrated geospatial information. The study analyzed research type, researchers, reports, and Proving Ground of KLSP and proposed a model for practicality. Testing and integrating the results of five core projects, the Proving Ground is one of KLSP's strategy for practicality. In addition, this study tried to show a direction for policy and practicality of GIS technology in the third NGIS project.

2. Literature Review

There are previous studies to provide systems for R&D management of public organization. STEPI (2000) pointed out evaluation methods of national R&D projects for tightening up national innovation systems. The study of STEPI analyzed theory, existing systems, and case studies of R&D evaluation and proposed an evaluation system. A Study (2003) of Price Water House Consulting and Canadian Fuel Cell emphasized commercialization for technology, the results of R&D projects. Based on planning stage to expect future demands, this study proposed base systems for each stage in developing technology. However, many previous studies concentrated on construction R&D projects. It is not easy to apply the studies to GIS R&D projects.

MLTM (2005) conducted a study, an introduction method of quality indexes for geospatial information, for management methods and evaluation indexes of GIS projects. Yu et al. (2003) studied methodologies related to cost-benefit analysis for GIS. The study included processes for GIS project management, evaluation methodologies of GIS projects, and practice manuals of GIS projects. However, these studies focused on only evaluations for practicality of GIS projects.

To solve abovementioned problems, Heo (2006) developed TPM (Technology Portfolio Map) for KLSP and selected unit research projects in each core projects. In addition, he made RFP (Request for Proposals) for each unit research project for practicality of developed technologies. Using case studies of advanced countries, Park (2006) suggested an evaluation methodology and evaluation indexes for construction R&D projects. Park (2005) analyzed applicability of logic model, which is used for evaluating national R&D programs in Korea and US, and Lee (2006) studied methodologies for portfolio of R&D investment for practicality.

Studies related to commercialization with business modeling in national R&D projects are divided into two classes, studies for evaluation and cost-benefit analysis and studies for transfer and dissemination for developed technology. For evaluation and cost-benefit analysis for developed technology, Byon (2006) studied analysis systems for increasing applicability, using national R&D projects and Kim (2003) analyzed economic effects of developing models for evaluation systems of R&D projects. Both proposed results of studies which included various models for R&D investments, indexes for technology, and applicability of developed technology. For studies for transfer and dissemination for developed technology, Ministry of Commerce, Industry and Energy (MCIE, 2004) analyzed transfer, dissemination, market, and infrastructure to make policies for commercialization, management, and applicability of technology.

If abovementioned previous studies and GIS projects are combined, the strategies for practicality and commercialization can be divided into studies for evaluation of developed GIS technology and studies for the business modeling of GIS industry. To contents of KLSP, it is composed of five core projects and collaborative 15 sub-contents(Table

Table 1. Collaborative Contents of KLSP

Research Title	Contents
1 Core Project (Geospatial Information Infrastructure)	R&D on Innovative Management of Geodetic Reference Frameworks
	R&D on Integrated Equipments for Constructing Geospatial Information
	R&D on Constructing Next Generation Digital Maps
2 Core Project (Land Monitoring)	Base Technology Innovation for Aerial Monitoring
	Base Technology Innovation of Ground Monitoring
	Development of Integrated Monitoring Systems
3 Core Project (Intelligent Urban Facility Management)	R&D on Management of Underground Facilities in an Intelligent City
	R&D on Management of Urban Ground Facilities based on Ubiquitous IT
	Integrated Platforms of Geospatial Information for Intelligent Urban Management
4 Core Project (Ubiquitous GIS-based Construction Technology)	R&D on Renewal of Geospatial DB with a Construction
	Construction of Indoor Space DB with Application of a Construction
	R&D on Object Interlocking of a Construction Blueprint and Indoor Space
5 Core Project (Ubiquitous GIS Core SW Technology)	Processing and Managing u-GIS Geospatial Information
	R&D on the Next Generation Visualization for u-GIS
	R&D on Providing Customized Land Information

1). For studies for evaluation of developed GIS technology, public and private sectors emphasize importance of efficient evaluation and management of developed GIS technology, and government also try to make policies and systems for increasing investments in GIS field. For studies for the business modeling of GIS industry, the extents of business modeling are still vague in Korea. So they try to make base model for commercialization of national GIS projects.

3. Analysis of KLSP

Intelligent Geographical Information Program is one of the VC-10 (Value Creator 10) projects which shares Ministry of Land Transport and Maritime Affairs's vision of "Better Life Quality for the Future Society." The R&D project, including 5 core research projects, contributes to a successful accomplishment of KLSG using a technology innovation based on u-GIS.

The results developed in this project, such as an proving ground, Business model of commercialization, outcome management, and management system for R&D portfolio will contribute to create new markets and to improve the global competitiveness of Korean intelligent land information.

3.1 Collaborative Process

The collaborative process, envisioned by KLSP who is consist of core and unit research institutes, includes 5 core research projects and 15 unit research projects. The program is composed of five major categories of research: (1) Geospatial Information Infrastructures; (2) Land Monitoring; (3) Intelligent Urban Facility Management; (4) Ubiquitous GIS based Construction Technology; and (5) Ubiquitous GIS Core Software Technology. The total budget is one of the world's largest research grant for geospatial information technology R&D, 144.7 billion Korean won (over 150 million US dollars).

International collaboration in the research is considered to be one of the key success factors.

As shown in Table 2, the KLSP is divided into two kinds of institutions, domestic institution (94.6%) and foreign institution (5.4%). It is clear from these table that although the university/Company/Research institution component of the KLSG is important, it shows that the research institution (at 11.9%) is the smallest group in the KLSG, the university sector is major participant of the overall (at 32.7%), and the company sector is the dominant group of participants (at 55.4%), at over half of the projects. These statistics provide an insight into the practical background

Table 2. Summary of the KLSG's Organization

Institution		Domestic				Foreign			
		Univ.	Company	Research	Subtotal	Univ.	Company	Research	Subtotal
1 Core Projects	1 unit	33.3%	38.1%	19.0%	90.5%	4.8%	4.8%	-	9.5%
	2 unit	23.5%	58.8%	5.9%	88.2%	11.8%	0.0%	-	11.8%
	3 unit	33.3%	44.4%	11.1%	88.9%	0.0%	11.1%	-	11.1%
Sub Total		29.8%	46.8%	12.8%	89.4%	6.4%	4.3%	-	10.6%
2 Core Projects	1 unit	54.2%	29.2%	8.3%	91.7%	8.3%	-	-	8.3%
	2 unit	11.8%	64.7%	17.6%	94.1%	5.9%	-	-	5.9%
	3 unit	41.2%	41.2%	17.6%	100.0%	-	-	-	-
Subtotal		37.9%	43.1%	13.8%	94.8%	5.2%	-	-	5.2%
3 Core Projects	1 unit	-	80.0%	20.0%	100.0%	-	-	-	-
	2 unit	-	60.0%	40.0%	100.0%	-	-	-	-
	3 unit	25.0%	62.5%	12.5%	100.0%	-	-	-	-
Subtotal		8.7%	69.6%	21.7%	100.0%	-	-	-	-
4 Core Projects	1 unit	60.0%	40.0%	-	100.0%	-	-	-	-
	2 unit	33.3%	66.7%	-	100.0%	-	-	-	-
	3 unit	22.2%	72.2%	5.6%	100.0%	-	-	-	-
Subtotal		31.4%	65.7%	2.9%	100.0%	-	-	-	-
5 Core Projects	1 unit	18.8%	75.0%	6.3%	100.0%	-	-	-	-
	2 unit	11.1%	44.4%	11.1%	66.7%	22.2%	11.1%	-	33.3%
	3 unit	35.7%	50.0%	14.3%	100.0%	-	-	-	-
Subtotal		23.1%	59.0%	10.3%	92.3%	5.1%	2.6%	-	7.7%
Total		28.7%	54.0%	11.9%	94.6%	4.0%	1.5%	-	5.4%

Table 3. Formality of the KLSG's Execution

Institution	Quantity of the Institution				Rate of the Composition		
	Principal Institute	Cooperative Institute	Commission Institute	Subtotal	Principal Institute	Cooperative Institute	Commission Institute
1 Core	3	35	9	47	6.4%	74.5%	19.1%
2 Core	3	46	9	58	5.2%	79.3%	15.5%
3 Core	3	14	6	23	13.0%	60.9%	26.1%
4 Core	3	32	0	35	8.6%	91.4%	0.0%
5 Core	3	26	10	39	7.7%	66.7%	25.6%
Total	15	153	34	202	7.4%	75.7%	16.8%
Mean	3.0	30.6	6.8	40.4	7.4%	75.7%	16.8%

and context required to support the growth of the industry. While these statistics have a different focus, globalization is based on statistics from different countries, information reported in the two surveys is reasonably similar, given that each has local conditions.

The other useful indicator in the formality KLSG's research execution is the per core project, which has levelled hierarchy (Principal, Cooperative, and Commission unit). Table 3 shows a comparison between the reported percentage use of versus more than one core project is the difference, e.g. 3 core project reported 26.1% occupy of commission. 4 core projects are most, reporting the highest incidence of cooperative set occupy.

3.2 Construction of KLSG Proving Ground

KLSG Proving Ground, where all projects' result are integrated and tested, has one integrated portal system providing various research results and services. In order to work together, the project's results in one-conditioned site and platform must be designed and developed to be interoperable with each other. Each KLSG project organized into 5 core and sub-projects has different character and is developed and managed by the different research institute. Because of these properties, the common systematic frame needs the system integration so that these heterogeneous project's results can work together. First of all, we regarded the project as a specific system and divided abstractly those systems into the procedure with the flow of data or information. And then we tried to find the complicated specification of each procedure. By clarifying these specifications of procedures, we could design the structure and infra-structure of proving ground and select the proving elements and the control center type(Table 4).

(1) Proving ground of the 1st core project

The objective of the 1st Core Research Project 'Geospatial Information Infrastructure' is to develop

Table 4. Elements Type of Proving Ground

<table>
<tr><th>No.</th><th colspan="2">Procedure</th><th>Definition</th><th>Sub-item</th></tr>
<tr><td>P-1</td><td colspan="2">Acquisition</td><td>Acquiring phase of a various sensor data</td><td>Sensor specification
Sensing item, Sensor data
H/W, S/W</td></tr>
<tr><td>P-2</td><td colspan="2">Transmission</td><td>Transmitting phase of an acquired sensor data to Server system/Control center</td><td>Communication method(Cable/Wireless)
H/W, S/W
Communication infrastructure</td></tr>
<tr><td>P-3</td><td>Archive</td><td rowspan="3">Control center</td><td>Archiving phase of Transmitted data to DBMS/File system</td><td>H/W, S/W
Modules, Functions</td></tr>
<tr><td>P-4</td><td>Process</td><td>Processing phase of raw data in DBMS for the purposing service</td><td>H/W, S/W
Modules, Functions</td></tr>
<tr><td>P-5</td><td>Service</td><td>Phase of providing(Service) processed data</td><td>Service platform, H/W, S/W
Modules, Functions</td></tr>
</table>

technology and management systems for advanced geodetic reference frameworks with three main sub-projects : (1) Innovative Management System of Geodetic Reference Frameworks; (2) Development of Integrated Equipments for Constructing Geo-spatial Information; (3) Development of Next Generation Digital Maps. These technologies will utilize the control center system of the KLSG proving ground, as well as the basis of other research projects. The result of Core Research Project 1st is focused on the technologies of procedures 'Acquisition', 'Transmission', 'Archiving' and partially, the procedures 'Process' and 'Service' (Table 5).

Table 5. Proving items : 1st core project

Representative results	Proving items in the procedure				
	P-1	P-2	P-3	P-4	P-5
Integrated geodetic reference point administration system	○	○	○	○	○
Ubiquitous reference point					
Precise Korean geoid model	○		○	○	○
GNSS+VLBI+SLR data integration				○	
Territory border management system			○	○	○
3D laser scanner	○	○		○	
Multi-looking aerial digital camera	○	○		○	
Multi-channel ground penetrating radar(GPR)	○	○		○	
Underwater spatialization equipment	○	○		○	
Next generation digital map & management system				○	○

(2) Proving ground of the 2nd core project

The objective of the 2nd Core Research Project 'Land Monitoring' is to develop technology for real time monitoring of the Korean peninsula, focusing on all procedure. Especially the sub-project 'Data acquisition of Land Monitoring' is the technologies with in the procedure of 'Acquisition(monitoring)' and 'Transmission', sub-project 'Data Processing & Applying of Land Monitoring' is focused on the rest of the procedures(Table 6).

(3) Proving ground of the 3rd core project

The 3rd Core Research Project 'Intelligent Urban Facility Management' is to develop the USN (Ubiquitous Sensor Network) based management systems for the urban facilities of ground and under-ground dealt with the whole procedures from 'Acquisition' to 'Service'. In the sub-project 'Development of USN-based Monitoring System for Urban Facility Management', the technology using the USN node collects the management data of urban facilities like guard-rails, U-poles, or sewage pipelines, this is mainly developed about the procedures 'Acquisition' and 'Transmission'. Another sub-project 'Development of Centralized Urban Facility Management Platform' is the technology processes, archives, services the management data from the sensed USN data (Table 7). Korea Institute of Construction Technology (KICT) managed the 3rd core project, and constructs and operates the USN test-lab for urban facility management to verify their own technology in Il-san, GyeongGi -Do.

Table 6. Proving items : 2nd core project

Representative results	Proving items in the procedure				
	P-1	P-2	P-3	P-4	P-5
Real-time aerial monitoring system using UAV	○	○			
Change detection using multi-resolution image			○	○	
Extraction of urban info. & change detection using aerial/satellite Lidar			○	○	
Ground data sensing system	○	○	○	○	
Environmental data sensing system	○	○	○	○	
CCTV video data sensing system	○	○	○	○	
Temporary land monitoring system using public transportation	○	○	○	○	
Prove vehicle based monitoring system	○	○	○	○	
Geo-spatial data updating system				○	○
Land change data portal system				○	○
Korean peninsula monitoring system			○	○	○
forest fire monitoring system			○	○	○
river pollution monitoring system			○	○	○

Table 7. Proving items : 3rd core project

Representative results	Proving items in the procedure				
	P-1	P-2	P-3	P-4	P-5
Underground Facility Sensor Network(UFSN) package (Sensor-Node, Gateway)	○	○	○		
Intelligent UFSN management system			○	○	
USN pakage for urban facility (Sensor-Node, Gateway)	○	○	○		
Intelligent urban facility monitoring system			○	○	
Integrated platform for intelligent urban spatial information system			○	○	
Service standard for intelligent urban spatial information system					○
Urban object service network					○
Context awareness for urban system				○	

(4) Proving ground of the 4th core project

The 4th Core Research Project 'Indoor/ Outdoor Spatial Information based on Construction Design' is to develop the conversing /integrating technique between construction CAD data and GIS data for the national digital map updating, the indoor spatial awareness technique. Though the sub-projects 'Development of Renewal System of Geo-spatial DB based on Construction Design' and 'Acquisition and Application of Indoor Spatial DB' develop the 'Process' and 'Service' focused technologies, the 4rd core project has plans to build the test-lab that included the whole procedure from 'Acquisition' to 'Service'(Table 8).

Table 8. 4th core project

Representative results	Proving items in the procedure				
	P-1	P-2	P-3	P-4	P-5
CAD to 2D/3D GIS data conversion system			○	○	
Construction CAD data based GIS application system			○	○	○
National digital map updating system using Construction CAD data			○	○	
Indoor spatial DB construction system			○	○	
Indoor spatial information management engine			○	○	
Indoor spatial awareness test-lab	○	○	○	○	○
Real-time, low-cost, precise positioning system using GNSS/MEMS	○				
WiFi based construction real time location system(RTLS)	○		○	○	
IEEE802.15.4a based positioning system platform	○		○	○	
Video image based construction CAD data verification system	○		○	○	
Construction resource information service		○	○	○	○
Simple structure deformation sensor	○				

(5) Proving ground of the 5th core project

The 5th Core Research Project 'Ubiquitous GIS Core Software Technology' is to develop the GIS software in the ubiquitous computing environment by processing, storing, representing and providing geo-spatial data. The 'Process', 'Service'-centered technologies would be used as the main operating software for the control center of KLSG Proving Ground(Table 9). The result of the sub-project 'Processing & Management of u-GIS Geospatial Information' plays an important role the basic geo-spatial DBMS for KLSG control center must be designed the software that can be used interoperable with the various spatial data generated from other core projects.

4. Analysis of KLSG's Achievement

On a recent large projects(KLSP) to implement a NGIS, Korean Land Spatialization Group found that some of the GIS developers were designing and developing a method to build relationship between business model and R&D portfolio, that they had a very practical GIS system which did just that. In addition, it is also useful to the understand the initiatives undertaken by the government agencies in different jurisdictions, in that their strategies often have a substantial impact on the practicality for those industry. There are a number of methodologies currently available on the market which provide a comprehensive approach to developing a practical strategy. Typically, these methodologies are based on approach to which has a focus on to 'Infrastructure', 'R&D', and 'Commercialization' step(Table 10). Each step in this process is

Table 9. 5th core project

Representative results	Proving items in the procedure				
	P-1	P-2	P-3	P-4	P-5
U-GIS data management system			○	○	
GeoSensor data management system			○	○	
U-GIS data integration & analysis software package			○	○	
Mobile U-GIS data management system			○	○	
U-GIS data visualization system			○	○	
U-GIS data augmented-reality(AR) system			○	○	○
User oriented geo-spatial service model and content system			○	○	
Geo-digital right management(DRM) system				○	○
U-GIS platform for user oriented geo-spatial data proving service			○	○	○
Mobile application for user oriented geo-spatial data proving service				○	○

Table 10. Integration Step for Practicality

Step	Infrastructure				Application		Commercializing		Total
	Basis Technique	Manage-ment	Standard-ization	Design & Analysis	Module Technique	Application Technique	Product	Services	
Frequency	0	1	1	1	4	12	32	6	57
Rate	0.0%	1.8%	1.8%	1.8%	7.0%	21.1%	56.1%	10.5%	100.0%

focused on:

- **Infrastructure** : i.e. understanding the needs of the organisation to meet operational, standardization and statutory outcome.
- **Application** : i.e. understanding the module technique and application required to support the practicality needs.
- **Commercializing** : i.e. understanding the product and services required to the marketing and selling.

Focused on the projects classification, KLSG's achievement is composed of 57 outcome. The table 11 shows a comparsion between the re-

Table 11. Classification on Outcome Characteristics

Outcome Characteristics		Infrastructure				Application		Commercializing		Total
Product type	Technical type	Basis Technique	Manage-ment	Standard-ization	Design & Analysis	Module Technique	Application Technique	Product	Services	
process	New									0
	Convergence									0
	Improvement						1			1
	Sub Total	0	0	0	0	0	1	0	0	1
software	New						2	3	1	6
	Convergence					2		4		6
	Improvement						1	2		3
	Sub Total	0	0	0	0	2	3	9	1	15
System (invisible)	New		1							1
	Convergence			1						1
	Improvement						1			1
	Sub Total	0	1	1	0	0	1	0	0	3
System (visible)	New					1		2	1	4
	Convergence				1	1	3	9	3	17
	Improvement							1		1
	Sub Total	0	0	0	1	2	3	12	4	22
prototype	New						1	1		2
	Convergence						3	10	1	14
	Improvement									0
	Sub Total	0	0	0	0	0	4	11	1	16
Total	Sum	0	1	1	1	4	12	32	6	57

ported Frequency use of one versus more than one KLSG's achievement is the difference between the bar frequency and 57 outcome. It is clear that product is undergoing substantial growth and, although the numbers of KLSG's achievement are increasing, this outcome segment remains dominated by Intelligent Geographical Information Program.

Over 65% of outcomes to the commercialization (product 56.1%, services 10.5%) consistently report that they occupy as an integral part of their achievement. The commercialization across each industry sector, normalised for numbers of resposes per sector, is as shown in the Table 11, showing those who do classify outcome characteristics(left column). And For those respondents who indicated that they had a product and Technical type, the distribution of Infrastructure/ Application/Commercializing was reported as shown.

Fig. 1 shows, the use of joint count provides a simple and quick way of a quantitatively the relational degree of 15 unit research project. This method is applicable to nominal data only. Because the statistics are based on comparing the actual and expected counts of various types of joint between adjacent outcome for practicality having the same or corelation value, the nominal data appropriate for this method are limited to binary data. Binary data are those with only two possibilities as high/low incidences. To simplify the description, let's use gray(high value > 4) and white(the other value) to indicate the two possible attribute values associated with outcome of unit research institution.

Main body of research and previous analysis are important factors for industrialization of national R&D projects. Evaluation models should be made to check completion rate of technologies. KLSP proposes a evaluation model with nine practicality factors and nine competition factors to evaluate developed GIS technologies. Practicality evaluation is changed for high-practical use of national GIS projects from what a consulting company suggested.

Fig. 2 shows, Practicality evaluation is changed for high-practical use of national GIS projects from what a consulting company suggested. Competition evaluation focuses on contribution of technology, showing contribution rate(a Criterion of Rate : Son, 2008, Technology Commercialization).

- TF = (Utility + Competitiveness) / 2 × Industrial Factor
- **15% ± : Average Technology Impact (Average)**
- **30% ± : Above Average Technology Impact (High Class)**
- **45% ± : Exceptional Technology Impact (highest grade)**

Technology Factor (TF) evaluates practicality and competition with 100 points respectively and applies GIS industry indexes to show technical effects from industry's value. KLSP may provide not only practicality related to national GIS policies, but also various applied results.

2-1	2-2	2-3	3-1	3-2	3-3	4-1	4-2	4-3	5-1	5-2	5-3	unit
1.0 ± 0.0	1.0 ± 0.0	1.0 ± 0.0	1.5 ± 0.5	2.0 ± 0.0	1.5 ± 0.5	1.5 ± 0.5	1.5 ± 0.5	2.0 ± 1.0	1.0 ± 0.0	1.0 ± 0.0	1.0 ± 0.0	1-1
2.0 ± 0.0	2.0 ± 0.0	2.0 ± 1.0	2.5 ± 0.5	1.5 ± 0.5	1.0 ± 0.0	1.5 ± 0.5	1.5 ± 0.5	2.5 ± 0.5	1.0 ± 0.0	1.0 ± 0.0	1.0 ± 0.0	1-2
2.0 ± 1.0	2.0 ± 1.0	1.0 ± 0.0	2.5 ± 0.5	2.5 ± 0.5	2.0 ± 0.0	4.5 ± 0.5	4.0 ± 0.0	4.0 ± 0.0	3.5 ± 0.5	3.0 ± 0.0	3.5 ± 0.5	1-3
			1.0 ± 0.0	2.0 ± 1.0	2.0 ± 1.0	1.0 ± 0.0	1.0 ± 0.0	1.5 ± 0.5	2.5 ± 0.5	4.0 ± 1.0	3.5 ± 0.5	2-1
			1.0 ± 0.0	5.0 ± 0.0	1.0 ± 0.0	1.0 ± 0.0	1.5 ± 0.5	1.5 ± 0.5	2.5 ± 0.5	4.0 ± 1.0	4.0 ± 1.0	2-2
			2.0 ± 1.0	4.0 ± 1.0	4.0 ± 1.0	2.0 ± 0.0	1.5 ± 0.5	2.0 ± 1.0	3.5 ± 0.5	1.5 ± 0.5	4.0 ± 0.0	2-3
						1.5 ± 0.5	2.0 ± 0.0	1.5 ± 0.5	4.0 ± 0.0	4.5 ± 0.5	4.0 ± 1.0	3-1
						1.5 ± 0.5	1.0 ± 0.0	2.0 ± 0.0	4.0 ± 0.0	4.5 ± 0.5	4.0 ± 1.0	3-2
						2.5 ± 0.5	2.5 ± 0.5	3.5 ± 0.5	4.5 ± 0.5	5.0 ± 0.0	4.5 ± 0.5	3-3
									3.5 ± 0.5	3.0 ± 1.0	2.5 ± 0.5	4-1
									3.5 ± 0.5	4.0 ± 0.0	2.0 ± 1.0	4-2
									4.0 ± 0.0	3.0 ± 1.0	1.0 ± 0.0	4-3

Indicator of relation :

Indicator	1	2	3	4	5
Relation	Very Low	Low	Mean	High	Very High

Figure 1. Correlation of Unit Research Projects

unit :1-1(R&D on Innovative Management of Geodetic Reference Frameworks), 1-2(R&D on Integrated Equipments for Constructing Geospatial Information), 1-3(R&D on Constructing Next Generation Digital Maps), 2-1(Base Technology Innovation for Aerial Monitoring), 2-2(Base Technology Innovation of Ground Monitoring), 2-3(Development of Integrated Monitoring Systems), 3-1(R&D on Management of Underground Facilities in an Intelligent City), 3-2(R&D on Management of Urban Ground Facilities based on Ubiquitous IT), 3-3(Integrated Platforms of Geospatial Information for Intelligent Urban Management), 4-1(R&D on Renewal of Geospatial DB with a Construction), 4-2(Construction of Indoor Space DB with Application of a Construction), 4-3(R&D on Object Interlocking of a Construction Blueprint and Indoor Space), 5-1(Processing and Managing u-GIS Geospatial Information), 5-2(R&D on the Next Generation Visualization for u-GIS), 5-3(R&D on Providing Customized Land Information)

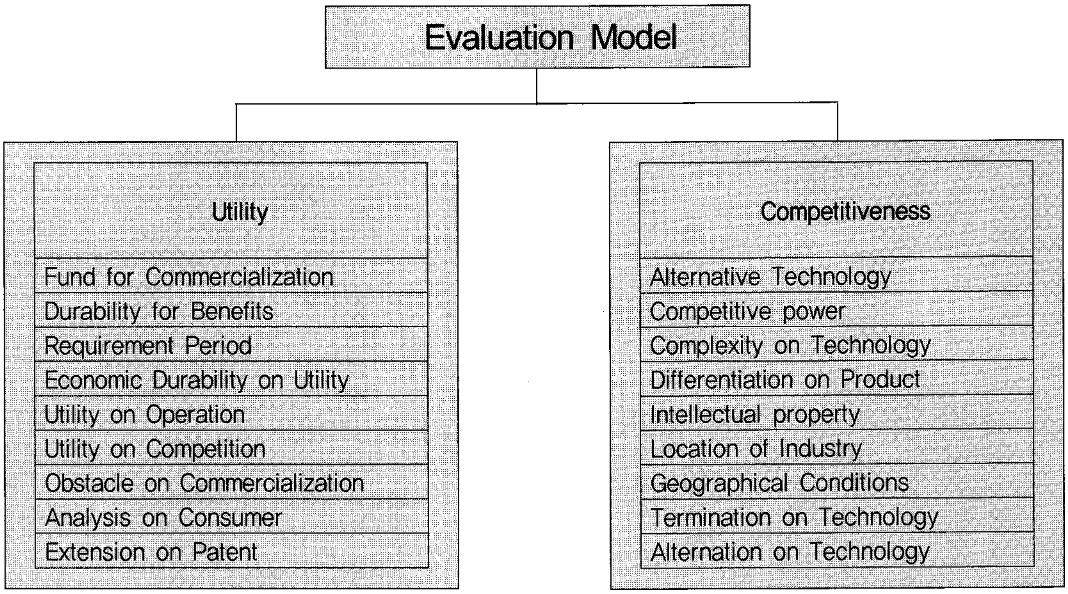

Figure 2. Evaluation Model for Practicality Factors

5. Conclusion

There are many variables to conduct a study for practicality of national GIS project. Public and private sectors try to find methodology on business model for commercialization, evaluation, and management of developed technologies. Particularly, the business model for practicality is divided into studies for value evaluation of technology and economic analysis and studies for transfer and dissemination of technology. Thus, strategies for practicality should be necessary for combining national GIS projects and GIS industry. These strategies may be evaluation and management of technology and business modeling.

KLSP, the third NGIS project, focuses on industrialization and practicality for making profits. To achiever this aim, KLSP is compose of universities (32.7% of all researchers), industry companies (55.4%), research organizations (11.9%), and foreign research organizations (5.4%). Participation rate of industry companies is higher than that of universities. This means that practicality of research can be evaluated in the projects. Thus, unit research projects which have relatively higher participation rate of universities should checked for practicality, while unit research projects which have relatively higher participation rate of industry companies should be managed for accuracy of research.

As a showcase to test and integrate technologies for practicality, the Proving Ground of KLSP is composed of measure, transfer, collection, process, and service. Based on the five forms, the scenarios of data stream for core research projects would be made and utilized as basic information of service model and business model.

After analyzing 57 results of research in KLSP, strategies are divided into building systems, developing technologies, and commercialization. Results which are involved in commercialization stage are composed of 66.6% of total results. Building systems and developing technologies have 5.4% and 28.1% respectively. The most developing type is integration. The type of results are composed of programs (64.9%, system: 38.6%, software 26.3%) and products (28.1%) for testing and integrating in Proving Ground for Practicality.

Main body of research and previous analysis are important factors for industrialization of national R&D projects. Evaluation models should be made to check completion rate of technologies. KLSP proposes a evaluation model with nine practicality factors and nine competition factors to evaluate developed GIS technologies. Practicality evaluation is changed for high-practical use of national GIS projects from what a consulting company suggested. Competition evaluation focuses on contribution of technology, showing contribution rate. Technology Factor (TF) evaluates practicality and competition with 100 points respectively and applies GIS industry indexes to show technical effects from industry's value. KLSP may provide not only practicality related to national GIS policies, but also various applied results. Therefore, the contribution of this study is to check policies for high-practical use through basic analysis in national R&D projects. Focusing on practicality, TF proposed in this study would be utilized for efficient management and evaluation. In addition, TF would show interruption factors, analyze structure of industry, and be utilized as an index which is connected with GIS R&D projects

Acknowledgement

This research was supported by a grant(07-KLSGB01) from Cutting-edge Urban Development - Korean Land Spatialization Research Project funded by Ministry of Land, Transport and Maritime Affairs

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Received (September 11, 2008)
Revised (December 16, 2008)
Accepted (December 17, 2008)