Test Bed Application and Site Analysis to Apply Intelligent Unit Technology

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ABSTRACT: Give high priority to the technologies that can be directly applicable to the U-City development projects which are in progress by many central and local governments. Create a real world product at the end of R&D phase by testing prototypes in test-beds or test-labs.
Recently, new construction technologies have been developed, but they are rarely being applied to the construction filed. In this paper, the basic design was examined so that various technologies can be selected through a test-bed, analyzed for the real situation, and applied to actual construction sites.
Improve productivity of regional and urban construction exercises and improve competitiveness of related products and services using IT-based telemetering/GIS technology.

Keywords: Test Bed, Large-Scale Estate, Unified System, Ubiquitous

1. INTRODUCTION

1.1 Purpose & Necessity of Research

Demands on technology that provides obtained/processed precise configuration information of construction process including not only geographical information on construction site for improvement of safety and execution of large-scale construction businesses but also location information of construction factors (labor, equipment, materials, and etc.) have grown geometrically. Accordingly, development of location recognition technology that can find the location and trace the movement of construction resource between actual spaces of construction design and site, technology similar to videogrammetry used to obtain information on shape, and measurement technology for transformation and displacement of facilities during construction is required.

For construction and management of u-Land and u-City, demand for precise spatial information about land is steadily increasing, and a quicker renewal is being required. In particular, recent changes in land are fundamental to for large-scale construction businesses, and in order to reflect such changes quickly on land space DB, GIS technology and construction process composed of design-construction-management-maintenance must be intimately linked. Therefore, it is necessary to look for ways of improvement and for connection to GIS DB related to existing community facilities based on accumulated experiences on preceding construction by exchanging DB information with GIS community facilities and to operate test beds of unified system for large-scale community facilities.

2. IMPORTANCE OF R&D

2.1 Technological Aspects

Most of the patents related to location/configuration acquisition technology are for the certain industry. Since such technology is still new to the construction industry, it is important to apply location/configuration acquisition technology to the construction industry. It is necessary to provide various location/configuration information to manage cutting-edge construction projects by developing advanced convergence systems which are not limited by space, can acquire 1m-level locations in harsh environments such as construction sites, obtain sub-meter coordinates by matching construction drawings and pictures, and measure in millimeters with displacement and deformation sensors. Such technology will be source technology for automatic driving equipment, progress management for precision construction, and construction robotics.

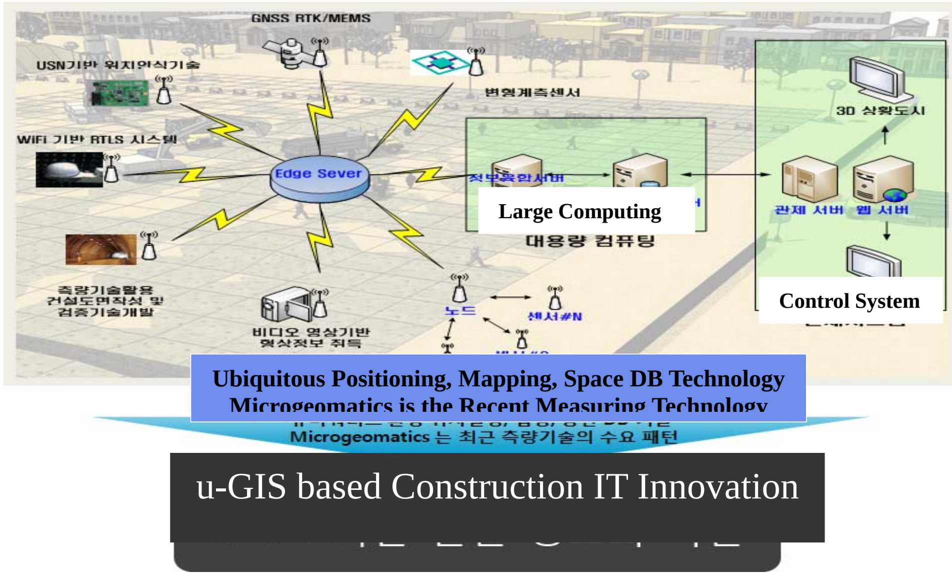

Fig. 1 Location Integration System for Large Complexes

2.2 Economic and Industrial Aspects

It is expected that this technology will make a great contribution to building advanced cities and entering overseas high value markets. In Korea, this technology is necessary to encourage privatization of infrastructures and maximize profits by reducing operational costs.

By combining GIS technology of which development has remained steadily and construction industry, we can expect the expansion of the GIS market.

2.3 Technology Development and Market Share Forecast

Though many experts have argued it is necessary to build space database updating technology based on construction drawings, integrated standard drawing development has yet to be done because construction drawings have not standardized.

Since some of organizations that need to build space databases from construction drawings are using unstandardized limited technology, if we can standardize and integrate space database updating technology based on construction drawings, we can dominate the relevant market.

Since the mobile object monitoring system that combines 3D indoor space databases and indoor position is yet to be commercialized, if we can develop this system, we can dominate the market. Though indoor positioning technology is studied in various ways, as it is not standardized, if we can develop commercial service, we can have market dominance. Also, since intelligent sensor situation recognition technology is in its development stage, it has the potential for market dominance.

The RFID/USD industry for disaster prevention is expected to have a huge impact on distribution, IT, wireless communications, semiconductors, and software (infrastructure) industries. In the future, technology focus will move from tags to infrastructures to manage information collected from tags.

3. APPLICATION PLAN FOR R&D

In this report, construction sites as processes related to buildings and large infrastructures, and outdoors as construction outcomes are selected for the space scope for research. By selecting various buildings and large structures expressed in construction drawings, labor, equipment and material locations as the objects of this technology, standard and technology that convert 2D CAD drawings into 3D GIS databases; real-time updating system for national space information database; Web technology to provide users with related product development and space information; technology to establish, store, manage and analyze indoor space information; application service technology based on indoor space information; technology to draw and verify construction drawings with indoor space information; and database technology to apply location/configuration information collected from construction drawings and various sensors are selected as the functional scope of technology development. As the ultimate goal of this report, the researchers put emphasis on commercializing developed technology by operating test beds.

In this paper, advanced measuring instruments are employed to draw construction drawings; cutting-edge positioning technology is used to get real-time positioning information between construction elements and structures based on construction drawings; and actual space matching technology to decide the configuration of structures is developed so that we can manage test beds for integrated systems for complexes to improve IT levels in the construction field and develop practical systems and services for technology dominance.

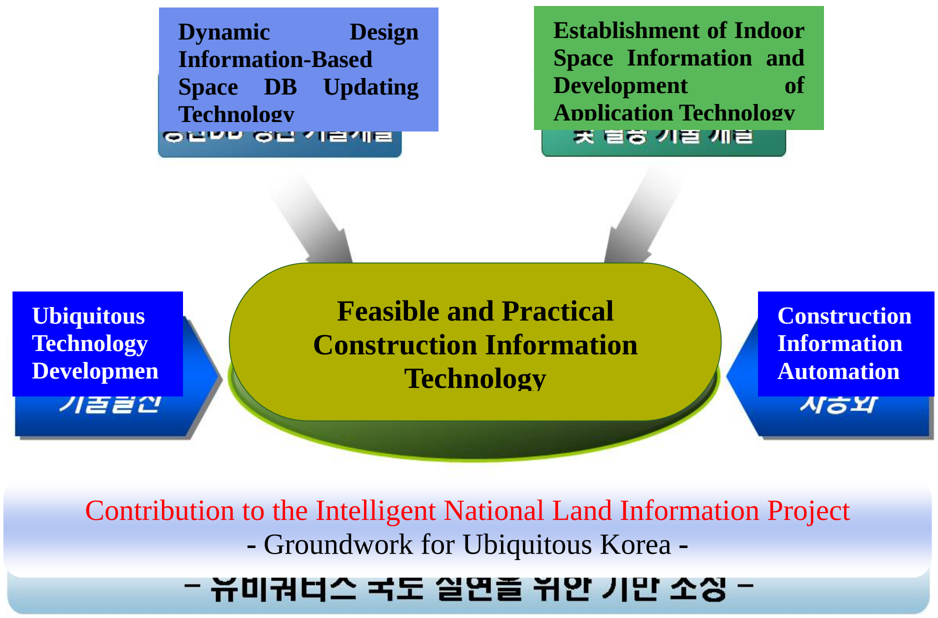

Fig. 2 Application Plan and Final Goal

4. PRIORITIES IN THE CONSTRUCTION SITE

By seeking GIS database integration and improvement plans based on accumulated design and construction experience and providing design, construction and experience to build the location and configuration database, we will provide space and time information about construction to design effective real-time sensor networks and build the foundation to run the integrated system for positioning labor, material and equipment in the complex.

To decide the priorities of equipment, labor and materials in the construction site, evaluation standards and first/secondhand impacts on construction sites are considered. Basically, evaluation methods are divided into two methods - one based on economic factors and the other on non-economic factors.

To decide priorities, available methods are 1) Benefit Cost Analysis, 2) Goal Achievement Matrix Analysis, 3) Cost-Effectiveness Analysis, 4) Balance-Sheet Analysis, and 5) Concordance Analysis.

Many methods can be used to decide priorities. In this report, first, average costs on equipment, labor, and materials are collected to decide priorities based on economic standards. Then, to take non-economic factors into account, assuming the frequency of equipment, labor and materials use is preference in the construction site, we decided priorities by taking a poll in the construction site for the use frequency of equipment, labor and materials for each construction type. Finally, data collected from above two steps are compared based on its costs and preference to decide final priorities.

4.1 Labor Priorities

To calculate the appropriate amount of labor, we can use the macro method or micro method. As the macro method is relatively easy, first, we use the calculation method based on productivity ratio and conduct a poll for use frequency.

Labor priorities are decided as follows. Among decided priorities, priorities 1 ~ 12 are listed.

1) Frequency of use: Number of labor use based on estimates
2) ① (Individual frequency of use/ Total frequency of use)*100
3) Cost: 2008 labor cost presented by the construction association (Unit: KRW)
4) ② (Individual labor cost / Total labor cost)*100

Table. 1 Example of Labor Priorities

Kinds	Frequency of use	①	Cost	②	①+②	Priority
Ordinary Labor	398	36.182	60,547	1.535	37.717	1
Special Labor	163	14.818	80,531	2.042	16.860	2
Scaffolder	55	5.000	107,592	2.728	7.728	3
Measuring Engineer	36	3.273	156,425	3.966	7.239	4
Welder	49	4.455	97,714	2.477	6.932	5
Measuring Industrial Engineer	36	3.273	135,359	3.432	6.705	6
Head Worker	48	4.364	80,830	2.049	6.413	7
Plumber	36	3.273	98,857	2.506	5.779	8
Measuring Technician	30	2.727	92,543	2.346	5.074	9
Rail Engineer	23	2.091	86,117	2.183	4.274	10
Boring Engineer	22	2.000	83,739	2.123	4.123	11
Stone Engineer	8	0.727	133,053	3.373	4.101	12

4.2 Equipment Priorities

To calculate the appropriate amount of equipment, we can use the macro method or micro method. As the macro method is relatively easy, first, we use the calculation method based on productivity ratio and conduct a poll for use frequency.

Equipment priorities are decided as follows. Among decided priorities, priorities 1 ~ 12 are listed.

1) Frequency of use: Number of equipment use based on estimates

2) ① (Individual frequency of use/ Total frequency of use)*100

3) Cost: 2008 equipment cost presented by the construction association (Unit: KRW)

4) ② (Individual equipment cost / Total equipment cost)*100

Table. 2 Example of Equipment Priorities

Kinds	Frequency of use	①	Cost (KRW1,000)	②	①+②	Priority
Pump dredger	1	0.197	39,395,795	62.964	63.161	1
Crane	83	16.371	718,755	1.149	17.520	2
Generator	55	10.848	130,485	0.209	11.057	3
Excavator	25	4.931	250,800	0.401	5.332	4
Grab dredger	1	0.197	3,125,119	4.995	5.192	5
Bucket dredger	1	0.197	2,744,291	4.386	4.583	6
Air compressor	17	3.353	54,749	0.088	3.441	7
Crane mounted on truck	17	3.353	41,399	0.066	3.419	8
Excavator	1	0.197	1,898,538	3.034	3.232	9
Rotating excavator	1	0.197	1,898,538	3.034	3.232	10
Caterpillar carne	10	1.972	718,755	1.149	3.121	11
Truck crane	7	1.381	850,000	1.359	2.739	12

4.3 Priorities in Materials

To calculate the appropriate amount of materials, we can use the macro method or micro method. As the macro method is relatively easy, first, we use the calculation method based on productivity ratio and conduct a poll for use frequency.

Priorities in materials are decided as follows. Among decided priorities, priorities 1 ~ 12 are listed.

1) Frequency of use: Number of material use based on estimates
2) ① (Individual frequency of use/ Total frequency of use)*100
3) Cost: Price on the Korea Cost Site (Unit: KRW)
4) ② (Individual material cost / Total material cost)*100

Table. 3 Example of Material Priorities

Kinds	Use of frequency[1]	①[2]	Cost[3]	②[4]	①+②	Priority
Nozzle	1	1.099	3000000	40.623	41.722	1
Square manhole cover	1	1.099	1350000	18.280	19.379	2
Nail	13	14.286	1800	0.024	14.310	3
Bolt, Nut	12	13.187	13560	0.184	13.370	4
Cement	7	7.692	320000	4.333	12.025	5
Circle manhole cover for water lines	1	1.099	790000	10.697	11.796	6
Cross beam	1	1.099	625000	8.463	9.562	7
Rubber ring	7	7.692	34000	0.460	8.153	8
Mortar	6	6.593	53688	0.727	7.320	9
Circle manhole cover for sewage	1	1.099	340000	4.604	5.703	10
Rod	3	3.297	61500	0.833	4.129	11
Pole	1	1.099	198000	2.681	3.780	12

5. APPLICATION PLAN

To develop applicable technology by conducting tests with the test bed, we will carry out various field tests for products produced from this research, maximize their performance, and work with other companies to realize developed technology in integrated product forms.

To use technology and intellectual property rights, it is necessary to seek patent and software registrations; commercialize developed components and final products; add location information, video information and other sensors to analyze situation more accurately; apply ontology databases and Bayesian probabilistic model to develop intelligent situation recognition models; establish space database with trial complexes and develop the open platform that integrate positioning technology, mobile object monitoring technology, and situation recognition technology; and use the developed open platform to create new application solutions such as u-Convention based on indoor space databases and intelligent facility management.

6. CONCLUSION

In this study, to find ways to apply sensor-based advanced measuring technology, ubiquitous technology and GIS technology to construction, we set up business plans and suggestions to improve laws and regulations to develop and apply technology that updates national space databases by converting construction CAD data to GIS space data; develop technology to draw construction drawings with advanced measuring equipment, and use location/configuration databases that collect information from various drawings and sensors; and aims to build package products that enable easy application of developed technology.

Products and technology developed through test beds will be evaluated for their product appealing and potential in the market, and then be used for competitive R&D.

※ Needs for Research

■ Since construction drawings are not integrated with national geographic information, it is necessary to develop technology and products to establish efficient national space information databases.

- Many experts have been arguing that space databases should be updated with construction drawings, and the space information updating and monitoring system based on construction drawings is needed. Once technology for this purpose is developed, it will be commercialized.

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