DEVELOPMENT OF 3D INFORMATION MODELS FOR THE MAINTENANCE OF SUBWAY INFRASTRUCTURES

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ABSTRACT: Maintenance of subway tunnels and stations is one of the most difficult areas because of limited allowed inspection time and complex environment surrounding the infrastructures. Congested urban buildings and underground facilities make the construction and renovation of subway infrastructures more troublesome. In this paper, 3D information models including geometry models and their related information were developed for the maintenance of subway systems. Information architectures considered current inspection items and required documentations. 3D models have previous inspection data and damage drawings for inspector's convenience because inspectors have less than 4 hours at night. Mobile devices can utilize the developed models for inspectors due to wireless networks in underground tunnels. Inspected results are transmitted to the facility management system for the assessment of current status of subway structures. Newly proposed system significantly increases efficiency of the inspection and well organized data for the assessment of underground tunnels and stations. Owners of subway systems can utilize the data for the developing new requirements of new subway designs in order to reduce maintenance cost.

***Keywords**: Maintenance, Subway, 3D Information Model, Inspection, Assessment*

1. INTRODUCTION

Life-cycle management of information in construction industry has received increasing attention as a way to minimize costs for operation and maintenance (O&M). In each phase of a project, a vast amount of information is exchanged among the project participants. For example, 2D as-built drawings, operation manuals, submittals are transferred to owners as independent entities. The unlinked data architecture reduces the engineer's productivity to interpret their target structures and increases time to search related information for individual tasks for preparing, executing and reporting the assessment. This lack of integrated collaboration in O&M processes causes inefficiencies and mistakes during the life-cycle management of infrastructures. The National Institute of Standards and Technology (NIST) conducted research on the cost analysis of the inadequate interoperability in the U.S. capital services industry and reported a waste in cost due to the lack of interoperability of systems utilized in the engineering lifecycle[ ].

Recent developments in the use of the Building Information Modeling (BIM) technologies promise to introduce major changes in planning, design and construction processes of the infrastructure projects. 3D information models from sophisticated CAD systems have complementary data such as metadata, quantity take-offs, schedule, drawings, etc. in addition to vectorial data. Collaboration, sharing data and interoperability are the main characteristics of BIM technologies. Information flow from the planning to O&M can enhance engineer's ability to create more sustainable systems for owners.

In this paper, BIM technologies and RFID sensors are applied to the inspection and maintenance works for subway structures. A virtual 3D model contains essential metadata with an identification number, which is linked to a RFID number of an object, and linkage to related documents and drawings for inspection and assessment.

The application improved the productivity of the inspection process and enhanced the reliability of the assessment resulting in cost reduction in the maintenance of a subway system.

2. INTEGRATION OF BIM AND MAINTENANCE PROCESSES

Data models for geometry and its information were developed considering current WBS(work breakdown structure) and OBS (organization breakdown structure) of subway maintenance. Subway tunnels were divided by inspection units and information layers were suggested considering inspection and assessment processes and their outcomes.

BIM technologies are applied to enhance the current inspection and facility maintenance system. 3D models and their linked electronic documents replace preliminary investigation and mobile devices with RFID sensors increase productivity of inspection work in a tunnel at night. Facility managers can assess the subway systems with more integrated information resulting in rational decision of remedial actions.

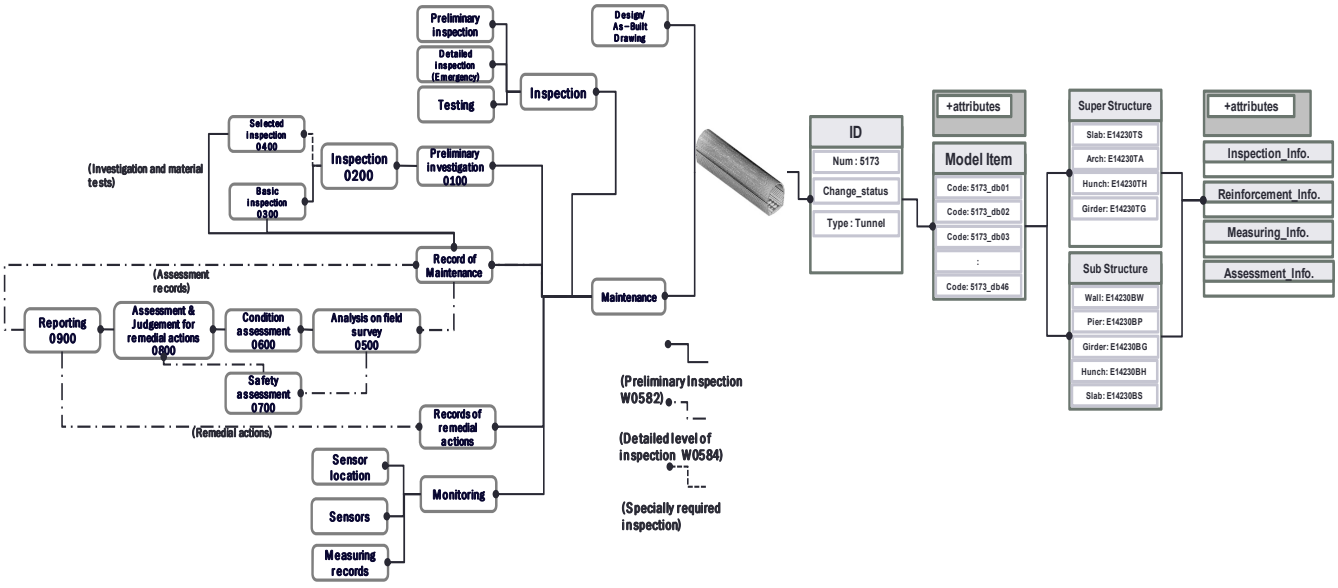

Fig. 1 Integration of BIM models with Maintenance WBS

3. CONCLUSIONS

Building information modeling technology is a process innovation. Operation and maintenance works can be improved in terms of productivity and cost by integrating BIM, sensors and current practices.

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