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Application and extension of the IFC standard in construction cost estimating for tendering in China

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ABSTRACT

The purpose of this paper is to investigate the possibilities and methods of applying the IFC (Industry Foundation Classes) standard, i.e. the mainstream standard of BIM (Building Information Modeling) data to the construction cost estimating for tendering in China. Through analyzing the existing standards and the IFC standard, the problems of using the IFC standard are identified and the solutions are explored. An information requirement model for construction cost estimating for tendering in China was established, which includes seven aspects of information entities. Then each aspect of the information was expressed by using the IFC standard to verify the completeness of the IFC standard and to establish the IFC-based information model. As a conclusion, the IFC standard can be used to express the information for the construction cost estimating for tendering in China as a whole, but some extensions in the form of proxy elements and property sets are needed. The established information model can be applied to the development of a construction cost estimating software.

1. Introduction

BIM (Building Information Modeling) technology has attracted more and more attention in AEC/FM (Architecture, Engineering and Construction/ Facility Management) field because it introduces a revolutionary technology comparable to CAD that emerged about two decades ago. BIM is designed to facilitate the information sharing among the stakeholders in different phases for better decision [1]. As a major data standard for BIM, the IFC (Industry Foundation Classes) standard published by the IAI (International Alliance for Interoperability) plays an very important role in the process, since it is a standard for sharing data throughout the project lifecycle, globally, across disciplines and across technical applications in the AEC/FM industry [2].

The IFC standard is a complex data standard covering currently nine domains such as architecture, structure, HVAC, electric etc. It specifies the data structure based on 3D geometric model and object-oriented representation. More than 20 vendors of application software are supporting the IFC standard so far so that the data exchange among their relevant products can be realized automatically [3]. However, in spite of its complexity, the IFC standard can support only a limited number of use cases in the AEC/FM industry and more developments are required when it is used for more use cases [4].

With regard to construction cost estimating, which is one of the critical activities for any construction projects, the IFC standard has been applied in various use cases. Faraj et al. developed an IFC Web-based collaborative construction computer environment called WISPER (Web-based IFC Shared Project Environment), which built an IFC-based object-oriented database to help users realize the network integration and sharing of the design, budget, schedule and other information in construction projects [5]. Fu et al. applied the IFC standard in the life-cycle cost assessment. The prototyping system could automatically extract cost estimating data from the design results of IFC files, and then transfer the data to a pre-existing component of life-cycle cost assessment [6]. Sheryl et al. developed an IFC-based cost estimating system. By using the design results of IFC files as input, the system could automatically apply corresponding quota to accomplish cost estimating according to the component geometries and properties [7]. Tanyer et al. developed a tool for 4D model schedule simulation. The tool allowed users to build a 4D model of the project and provides cost estimating function by using the design results of IFC files as input [8]. Yabuki et al. applied the IFC standard in the cost estimating of earthwork and accomplished the cost estimating function according to the 4D model [9]. However, those research works have not addressed the application of the IFC standard in the construction cost estimating for tendering subject to a certain local standard, as well as the extension of the IFC standard upon needs.

The insufficiency of the IFC standard for representing information may not cause major problems in the application areas that are not strongly associated with standards, but it may do for those that have

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