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A Method of BIM Based Interface Management

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Abstract

The Interface problem appears diversely due to extreme complexity, non-standardized production, and design& production to meet an owner's needs. The Interface problem is often linked to the problems, such as construction delay and cost increase, etc., which is known to have a harmful influence on construction in the aspects of project performance or building quality. In addition, the Interface problem arises between people, organizations, physical factors, and components, and it's possible to solve such an Interface problem through the boundary condition management between such factors in the project.

Many researchers give a definition to Interface, but it's difficult to give an accurate definition of all sorts of Interface because the Interface problem is very diverse and complicated. IFC File includes BIM information, and the information included in IFC File can be confirmed through IFC schema. IFC schema expresses the attribute information of an object, and the relationship between an object and the other object. Accordingly, it's possible to define the Interface arising between objects and to draw the management plan through IFC schema.

This study defined the Interface problem through the research on the existing Interface, and consideration of the existing research which connected Interface with BIM, and suggested the plan that makes it possible to define and manage the Interface problem between objects by analyzing IFC structure through IFC schema.

This study hopes that these research materials could be effectively utilized for Interface management between objects at the construction field which uses BIM Model for the time to come as this study suggested the plan that makes it possible to define and manage Interface through IFC schema. However, this study conducted its research by limiting the scope within the Interface between objects, so there is the need to do research on the plan that could make it possible to define and manage the Interface problem like people and organizations through BIM later.

Keyword: IFC, Interface Management, BIM

1. Introduction

The Interface problem is characterized by variety, extreme complexity, and design and production adjustments to meet owner needs. Interface issues can result in construction delays, increased expenses, etc. The Interface problem is also known to detrimentally influence the performance of a project or building quality(Al-Hammad, 1990, Chen, Q. et al, 2008, Nooteboom, 2000, Pavitt, T.C. et al, 2003). The Interface problem can be addressed through management of the boundary condition between entities such as people, organization, physical elements, components, etc(Nooteboom, 2000). Many studies have been done to define the Interface problem in construction projects(Laan, J et al, 2000, Pavitt, T.C et al, 2003). Defining all the various types of Interface, however, is difficult because it of the large variation and complexity(Chen, Q. 2010).

Recently, studies have investigated BIM and Interface management. These studies tend to be effective Interface management methods that use the visual characteristics of BIM. BIM is defined by objects that reflect physical and functional characteristics in a shared digital representation according to ISO/DIS 29481-1. IFC (Industry Foundation classes) is an international standard file format that facilitates information exchange between participants in the construction industry. An IFC file contains objects that describe physical and functional characteristics in a BIM model. The IFC schema defines attribute information connected to an object and associative relations with other objects. As such, we can define Interfaces using the associated relationship of each object that appears in an IFC schema.

This research reviews the existing literature and research on connecting the relationship of each object in an IFC schema. We also suggest an Interface management method using IFC.

2. Literature Review

2.1 Interface Define

In the construction industry, an Interface appears between various contractors, contractor and manufacturer, and the main contractor and subcontractor(Mortaheb, M., et al, 2010). Some researchers define the Interface as a common boundary or the connection between two organizations of a company, which have an individually different influence(Wren, D., 967).

Other researchers define the Interface as a thing that requires a physical, functional adjustment or cooperation between more than two subjects(Huang, R., et al, 2008).Other definitions of an Interface include the connection between parts, or the relationship between component materials or process components. In the literature, there is no general agreement as to the definition of Interface.

In actuality, the complexity of various Interfaces, diverse organizational structures, and frequently unfinished documents make it difficult to clearly define an Interface. We found no studies that investigated such problems and how to define an Interface. Nonetheless, what is more important is that there is lack of a standardized Interface classification scheme(Chen, Q., et al, 2008).

2.2 Interface Classification

Awakul and Ogunlana (2002) commented, “Interface can be divided into external Interface and internal Interface. The external Interface arises from cooperation of diverse organizations while internal Interface arises when one organization carries out work.” In addition, Morris (1983) divided Interface into static & dynamic Interface while Laan (2000) divided Interface into functional, physical, and organizational Interface. Looking at this, Interface classifications actually are different based on each researcher’s own definition. <Table 1> summarizes various Interface classifications. Different Interface classifications have arisen because research has been done on different part of the Interface problem in a number of categories. Accordingly, it’s necessary to arrange a methodology that makes it possible to define Interface in order to develop an Interface management system.

Table 1 List of the interface problems categorization

Interfaces categorization	Author
Personal, organizational, systematic.	Stuckenbruck, L.C,1983
Static and dynamic interfaces.	Morris, P.W.G., 1983
Time interfaces, geographic interfaces, technical interfaces, and social interfaces	Healy, P .,1997 Wren, D.,1967
Attachment, spatial, transfer, control and communication, environmental, ambient, and user.	Sanchez, R., 1999
Functional, physical, and organizational	Laan, J., et al, 2000
Inadequate contract and specification, financial problems, environmental problems, and other problems.	Al-Hammad, et al, 1990, 1992, 1993, 1996, 1995, 2000
Product and project.	Archibald, R.D., 2003
Physical interfaces, contractual interface, organizational interfaces.	Pavitt, T.C., et al, 2003
Management, experience, coordination, contract, acts of God, and regulation.	Huang, R., et al, 2008
Physical, functional, contractual/organizational, and resource interfaces.	Chen, Q., et al, 2008
Management, experience, negotiation, contract, unavoidable, and law.	Ku, H., et al, 2010

2.3 Information Technology (IT) Based Study Trend

Research on IT-based Interface Management includes the research by Qian et al., (2010) on Interface Management through object-oriented modeling, and Yucheng's (2015) research on Interface Management using BIM. Such research has suggested approaches to connect the information related to the Interface problem using the information that exist in current design documents, or documents and the BIM Model, etc. The research related to BIM suggests a method of forecasting the point where an Interface might arise by using the visual characteristics of BIM. However, such research work has only defined existing problems and suggested some solutions to particular problems, but failed to delve into the basic problem, which is the lack of a standardized Interface classification plan.

3. IFC based Interface Management

3.1 Introduce of IFC Data Model

IFC is a standard information model used internationally with joint development to ensure compatibility for information pertinent to the AEC/FM industry. It is also the model used for management, sharing and interoperability of information that is distributed between

application programs that are used throughout the construction project life cycle, which includes planning, design, construction, maintenance, etc. IFC data model development makes it possible to solve the inter-compatibility problem in different fields of the construction project, and to interchange and share information about a single structure. Overall, it can also further improve profitability for all groups engaged in related fields.

3.2 Characteristic of IFC

The IFC Data Model is a standard model developed thru international agreements, and each country is aggressively participating in the development and utilization of the IFC Data Model. In addition, the IFC Data Model is equipped with requirements form international covenants that have been approved as ISO/PAS 16739. The IFC Model provides the basic-unit-based structure for an information model and also provides a framework for each field in the construction industry to share information. The IFC Data Model is comprised of a hierarchical structure in the order of Domain Schemas, Shared Schemas, Core Data Schemas, and Resource Schemas. This hierarchical structure makes it easier to develop a data model, and aims at providing a modularized structure to suggest criterion that a model developer should observe. In addition, it's possible for the upper class to refer to the lower class between these hierarchies, however, in case of the opposite, restrictive hierarchical relations are applied.

Notably, the Core Data Schemas sets the most general layer within IFC Data Model. The entity defined in this layer can be referred to by all entities in a specific sharing layer and domain layer, providing the basic structure/relations that can make the Model more concrete, while also allowing for general concepts. The IFC Data Model enables users to learn not only the information related to an object, but also information about other adjacent objects through the Shared Schema. Accordingly, it might be possible to define the Interface related to an object by using IFC and utilize the IFC to solve the Interface problem.

3.3 A Method of Interface Management Using IFC

An IFC data model with objects linked to information about the object can be identified through the IFC schema. Fig 1 is inheritance graph of IfcWall. Graph defines the attribute information with the Wall. Also, Graph defines associated information with each attribute though the IfcRelation. So, we check the associated information with wall. Therefore, Interface of wall can define by wall and adjacency wall, wall and window, etc.

Figure 1 Inheritance graph of IfcWall.

Therefore, we can create a classification of Interface for each object (wall, window, door, etc.) criteria and can then define Interface problems that occur for objects associated with other objects and between an adjacent object Interface. Through this process it will be possible to effectively manage the Interface. As the IFC is a file format recognized as an international standard, this Interface classification approach using IFC can also become a standard for Interface management.

4. Conclusion

Interfaces present various challenges during construction and can cause delay, increased costs, etc. Therefore, Interface management is an important part of project success. However, the variety and complexity of various Interfaces can make it difficult to manage and classify Interface issues. This study addressed the Interface problem. First, we reviewed past research in Interface management in the construction industry. This identified that Interface issues as a concern for various participants and that it has been difficult to define an Interface standard. Previous studies have defined and created classifications for particular needs, however, to date there is no general standard for Interface classification. Subsequently, we reviewed the IFC schema and suggested classification thru IFC using an IFC Data Model that represents connection relationships between various objects.

One limitation of the using the IFC, however, is that it only reflects physical relationships. Therefore, other types of relationships are not addressed. We propose that it is also possible to further define and classify such relationships in Interface management by using the IFC. In the future, solutions to Interface issues can be found though the classification of the Interface and by addressing weak points in the IFC as needed.

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