ELSEVIER

Automation in Construction 14 (2005) 491–499

AUTOMATION IN CONSTRUCTION

www.elsevier.com/locate/autcon

Distributed object models for collaboration in the construction industry

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Abstract

Information about products for the construction industry is increasingly often provided to designers in digital ways that enable them to apply the information directly in the design process. Digital product catalogues are provided using various media and formats and several initiatives are taken by the industry and by CAD developers to integrate this kind of information into CAD systems. Generally, current practice is to distribute the information to designers, for example, by using CD-ROMs or a website where the information can be downloaded. In our research, we recognise that distributing information in this manner detaches it from the business processes in the construction supply chain, which is a major disadvantage.

The project presented in this paper concerns the implementation in the Dutch construction industry of a methodology for sharing product information through a distributed object model. The methodology, which is called Concept Modelling, forms a generic basis for the support of collaborative design, but is applied in this project to the integration of information from the supply chain in the design process. Through the distributed object model, design information and product information can be integrated while the actual data objects remain at their source. This enables the supply chain to provide information of a high semantic level to designers while keeping the control over the information and maintaining the relationship of the information with their business processes.

The advantages of this approach in which information is shared, rather than exchanged, are numerous. Redundancy of information is minimised, consistency is improved, and updated information is available immediately. Moreover, design and construction processes can benefit significantly from the dynamic aspects of accessing information that is tied to business processes in the supply chain. For example, product selection during design can be based on latest information on product details, prices, production methods, and variants of products. This information can be provided to designers automatically and on demand.

Keywords: Collaborative design; Product data modelling; Concept Modelling; Distributed object model; Semantic web

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doi:10.1016/j.autcon.2004.09.004

1. Introduction

The availability of adequate product information is one of the aspects in building design that have a large effect on quality and costs of the construction process and of the final building. Design faults are often caused by incorrect or misconceived product information or by improper selection of products because of lacking information. Such mistakes in the design stage can have dramatic consequences for the construction process, when ad hoc solutions or replacements of products in the least case obstruct the process and invariably are cost-intensive, time-consuming, and likely to have a negative effect on the eventual quality. If such mistakes become evident only later, while the building is already in use, the possibilities for correction are often very limited and the costs much higher. A survey by Josephson and Hammarlund [1] shows that 15–30% of all defect costs during production are caused by design mistakes. After construction, during maintenance, design mistakes are the cause of 40–55% of the defect costs. The same study shows that over 60% of the defect costs in construction that are caused by design mistakes can be traced to a lack of knowledge or information.

The quality and availability of product information depend largely on the form and media used to distribute this information. The following aspects determine the value of product information for design:

- Semantics (Is the meaning of the information sufficiently defined and understood?)
- Validity (Is the most actual information available?)
- Format (Can the information be accessed and applied directly in the design context?)
- Timeliness (Is the information found and available when needed?)

Current practice in the supply chain of the construction industry is to distribute product information, for example, in the form of catalogues, either in paper format or in a digital format that is likewise rigid, such as CD-ROMs or documents that can be downloaded from a website. In the more advanced cases, information is produced on demand by web servers and can thus be tailored to specific requests. However, once provided, the information is no longer controlled by the supplier and the consumer of the information has no guarantee of its validity.

The usability of product information in design processes also depends on how well the meaning of the information is understood by the user. Obviously, design support systems require a high level of explicit semantics to be able to interpret and process data.

The research project described in this paper is named *CoDesKs*, for Collaborative Design Knowledge services. The objective of this project is to offer a paradigm for information modelling and communication in design that on the one hand enhances the explicit semantics of information and on the other hand improves the validity and timeliness of information in a collaborative design environment.

2. Distributing product information

The purpose of distributing product information is generally twofold: to communicate about merchandise and to provide details about the technical application and organisational issues concerning the product. There are many reasons why the information concerning a product can become outdated. For various reasons, such as commercial ones, there is a strong urge to innovate, with new models emerging, new materials being applied, new features added, new options, applications, technical solutions, etc. Another cause for the limited validity of product information is its relation to a specific application, for example, in a particular construction project. This relation may have an organisational nature, such as contractual agreements on prices and delivery, or a technical nature, for example, when the applicability of a product depends on technical aspects of the project design.

Distributing product information through catalogues, on paper or in digital format, does not support the demand for up-to-date or project-bound information. Using websites to download product data only improves the timeliness of information; it does not improve its shelf life. More advanced websites are able to produce customised information, taking project- or client-specific data into account, but again this does not improve the validity of the information over time after it has been provided.

The validity of information that a designer obtains from partners in a project can only be guaranteed by