# Chapter 5
# Product Modelling in the Building and Construction Industry:
## A History and Perspectives

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## ABSTRACT

*This chapter provides an overview of product modelling in the Building and Construction (BC) industry based on authors' experiences gained from various conducted research projects and also taking into account results of other research projects. This chapter starts with an introduction and background of the subject area in terms of motivation, industrial needs and requirements. This is followed by an overview of a historical background of the subject area. In this historical background we distinguish five generations of product modelling developments. The first generation of product modelling developments is characterized by the influence of previous expert and database developments and by the constituting high-level constructs (e.g. EDM, BSM, RATAS and GARM). The second generation of product modelling developments can be characterized by the development of detailed aspect systems and supporting frameworks for data exchange and integration (e.g. IRMA, ATLAS, COMBINE, PISA and IMPPACT). The third generation product modelling developments can be characterized by its focus on collaborative engineering support by means of the application of middleware and client/server technology (e.g. SPACE, CONCUR, BCCM, VEGA and ToCEE) and the development of the IFC. The fourth generation of product modelling developments is heavily influenced by the Internet and Web Services standards such as XML, SOAP and UDDI and related business models such as eBusiness and eWork (e.g. bcXML, ifcXML and eConstruct). The next (fifth) generation of product modelling developments will be based on the emerging semantic web standards such as OWL and RDF, and based on the concepts of ontology*

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*modelling as experienced in ongoing (European) projects such as SWOP. After this historical overview, an analysis of the characteristics of interesting conceptual product approaches is presented. Here we discuss the Standardisation, Minimal Model, Core Model, NOT, Vocabulary and Ontology product modelling approaches. Followed by an analysis of a number of specific conceptual product models and how the basic product modelling constructs (i.e. semantics, lifecycle modifiers and multiple project views) are implemented. This chapter ends with a discussion about some ongoing projects (COINS, CHEOPS and SWOP) in the context of future trends.*

## 1 INTRODUCTION

A number of research and development activities have been carried out during the last few decades in order to pave the way towards a complete so-called CIC (Computer Integrated Construction) environment. The development and use of national or more importantly international standards for exchanging and sharing electronic information have become an important issue regarding the technical integration aspects of CIC. Since the late 1960's a number of standards for electronic data exchange have been developed including IGES (Initial Graphics Exchange Specification), DXF (Drawing eXchange Format) and much more. Although some of these standards are still in use and also supported by most CAD (Computer Aided Design) systems, they are not suitable for CIC. Although IGES provided a very practical solution for CAD data exchange, it was not capable of capturing the complete product data in order to enable more sophisticated automation of building products and processes. In order to overcome the weakness of IGES, the US Air Force ICAM (Integrated Computer-Aided Manufacturing) program developed a new product data exchange format standard, called the PDDI (Product Definition Data Interface). The purpose of PDDI was to develop a mechanism that supports the direct and complete exchange or sharing of a product model amongst computer applications, without human intervention. Although PDDI was a research exercise, it contributed greatly to the understanding, mechanisms and models for the standardisation efforts within ISO 10303-STEP (STandard for the Exchange of Product model data).

The development of product model standards for the Building and Construction (BC) industry started around 1986 within the STEP AEC (Architecture, Engineering and Construction) group. Since 1986, a number of research have been carried out (mostly under the umbrella of STEP AEC) to develop the required standards and supporting technologies for the BC industry. What all these projects experienced is that modelling approaches used in other industry sectors are often not suitable for the BC industry. They also learned that large models are as vulnerable as dinosaurs to unexpected changes of time, conditions and circumstances. Another conclusion is that current efforts to produce standards for the BC industry were not very successful. One of the main reasons for this lack of success is that STEP AEC proved to be the wrong platform for the development of standards for the BC industry that was unable to agree with and to make a fist within ISO. These led to a number of other initiatives taking over the developments. Each of these efforts was characterized by its unique modelling approach and the implementation of supporting (and emerging) technologies. Concerning supporting technologies, many efforts have been spent since the mid 1980's to allow CADxx to interoperate through an IPDB (Integrated Project Database). In the BC research community several views exist on what constitutes an IPDB, which has resulted in a number of different conceptual approaches in the development of IPDBs. Despite ongoing research in this field and the fact that still a number of problems are not solved, some consensus has been reached about what constitutes an IPDB. It is generally agreed that (preferable internation-