

# COMPUTER INTEGRATED BUILDING DESIGN BASED ON A GENERIC PRODUCT DATA MODEL

## Extended Abstract

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*The paper describes the Finnish OOCAD approach and some related projects based on a generic product data model and exchange format being a basis for implementation of building product models and for exchanging simple product model data.*

## GENERIC BUILDING PRODUCT DATA MODEL (GPDM)

### Requirements for a generic product data model

The generic product modelling approach aims at establishment of common basic concepts for application information modelling and implementation of product model applications, in order to promote development of applications capable of exchanging product model data. Generic in this context means that the product data model is reference model being defined on an abstract level which is independent of application information of various domains.

The basic requirements for the development of the generic product data model called OOCAD-model (Object-Oriented CAD) are:

- genericity i.e. independence of any applications,
- flexible data structures allowing incorporation of new entity types, entity attributes and relationships;
- grouping of information according to any agreed needs
- feasibility for implementation using various software tools (CAD, DBMS etc.).

Basically, the model should support flexible agreement of the scope of the exchanged data, even on construction project level.



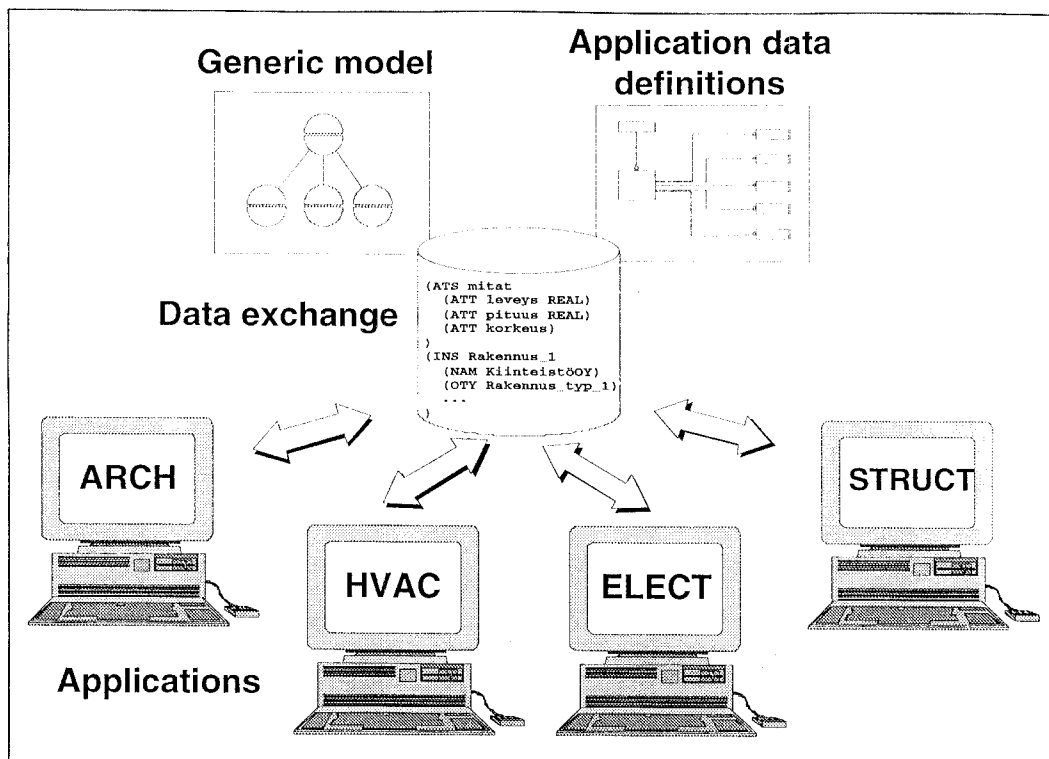


Fig. 1. The components of the generic product modelling approach.

### Description of the model and data exchange format

In the OOCAD approach the product data model has been defined as a generic model, not including any application dependant information. The model defines concepts like: type objects and their occurrences to represent the objects of the building and the use of standard parts, attribute sets and attributes for describing properties of the objects (e.g. shape, material), composition/decomposition and relationships for representing product structure, and groups for any other grouping of data (e.g. according to standard nomenclatures).

The model is accompanied with a data exchange format which is an implementation, or mapping, of the model concepts into an ASCII-file syntax called OXF (Object eXchange Format). For the application development and data exchange, the model provides generic data structures to which the application specific information can be mapped by defining the specific objects and their attributes (names of attribute sets, attributes and their datatypes). In a product model of a specific building (an instance) the attributes get their data values.

### Implementation of the model

The generic OOCAD product data model and its file format has been prototype implemented using various tools, namely CAD system (AutoCAD), RDBMS (dBase IV) and an object-oriented programming language (Actor). In the CAD-system implementation the model concepts, objects and their attributes, product structure, are mapped into CAD concepts like blocks, block inserts, layers etc. allowing creation and management of the product model structure in the CAD

model. So far, the product model data deals mainly with the non-geometric properties of spaces and building parts, and the geometrical properties are managed by basic functionality of the CAD system.

The other two prototype implementations are general purpose product model browsers for managing product models; typical functions being editing of attribute values, copying and deleting objects, and creation of reports (e.g. bill-of-materials) from the product model.

Especially the CAD system implementation of the model has been used as a basis for prototype application development, e.g. quantity take-off from design and management of quality requirements.

## USING THE GENERIC MODEL

The generic product data model provides the basic product model concepts and data exchange format to be shared among applications of the same, or different domains. The same conceptual basis and data exchange format allows exchange of simple product model data between the applications. Besides that, the generic product data model gives some loose guidance for the modelling the application information requirements. It suggest that the focus of the modelling and common agreements in this simple approach should be to first define the object classes, their attributes and objects' decomposition. A standard form has been developed for this purpose.

## APPLICATION OF THE MODEL IN VARIOUS DOMAINS

The OOCAD approach has been used in number of R&D projects in various domains of building design, namely:

- Extracting building part dimensional data from CAD
- Computer integrated building design
- Design of prefabricated concrete buildings
- Management of quality requirements.

Typically this kind of project involves description of the design process and its data flows in the form of IDEF0 activity model, description of application information in the form of EXPRESS/EXPRESS-G -models, and a prototype application, e.g. using AutoCAD, for management and exchange of product model data.

## FUTURE DEVELOPMENTS

The generic product data model and its implementations will be further developed in VTT's 3-year STAR Research Program (Systems Engineering in Construction), in one of its four projects, Product Model Environment for Construction Projects (*PICTOR*). The enhancements of the product data model deal with e.g. class concept which has been missing, subgrouping as a mechanism for nomenclatures besides simple grouping, and enhancements of the basic datatypes.

The PICTOR-project also develops the second generation of prototype implementations based on the generic product data model using various tools: CAD system, relational database and an object-oriented database.

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