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# PRODUCT MODEL SUITED FOR THE ERP SYSTEM

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## 1. Introduction

The market of the Enterprise Resource Planning (ERP) systems is very strong with great annual revenues. According to [Miller 2004], major ERP vendors are also on the top of the chart for 100 major software vendors. Significant annual revenues enable and strong competition forces ERP vendors to extend the functionality of their products. There is a clear need to support a product development process, since the ERP systems are firmly oriented to manufacturing. Such a need is recognized by several authors [Paul, et al. 1999, Ou-Yang, et al. 2003] and expressed as an incoming issue of the Product Data/Lifecycle Management (PDM/PLM) and the ERP systems integration.

In a purpose to support the product development process through the ERP system, an appropriate product model should be accomplished and implemented. To build such a model, system designers have to consider and rationally select from a set of the PDM functions. A selection has to be performed with a respect to recent computer technologies and nowadays more than ever - with a respect to a recent computer networking technologies. Some of conditions for the selection also include: an analysis of the aimed ERP system user groups involved in the product development process; the importance of the particular function for the ERP user; the importance and compatibility of the particular function within the ERP system; and finally, the possibility to conform considered function or model with present standards like the ISO STEP PDM schema [Ungerer, et al. 2002].

## 2. The ERPIN-M System

The product model discussed in this paper is suited for the particular ERP system: ERPINS-M. ERPINS stands as an acronym for the Enterprise Resource Planning ININ Solutions, while M annotates a version of the ERP system particularly tailored for the metal industry.

The series of the ERPINS systems are developed on the Oracle architecture. The systems are a result of a twenty year long collaboration between the ININ Company and the Mechanical Engineering Faculty, both located in Slavonski Brod, Croatia. The systems are aimed to small and medium enterprises, particularly when enterprises have requirements for which the ERP system has to be specially attuned [Majdandžić 2004].

### 2.1 System Architecture

The ERPINS-M system has a modular architecture built on common Oracle database (Figure 1). It is composed of subsystems and each subsystem is further composed of modules:

- Subsystem BAZAP serves as a storage for common data and codes shared in other subsystems. Included modules are: General Enterprise Data; Organization Structure; Partners Data; Capacity Data; Employees; Currencies and Rates; Working Calendar; Enterprise Dictionary; Units; Classification; Report Generator.
- DEPTO is a subsystem for the definition of products and technologies. It is the mostly affected subsystem with the implementation of the suited product model. It contains modules:

Production Elements; Product Breakdown Structure; Revisions and Versions; Drawing List; Cutting Schemes; Technological Operations; Tooling.

- PROKA subsystem covers sales and calculations with modules for Inquiries, Offers, Contracts, Projects calculations, unit and batch production, Primary plan, Monthly plan, Warehouse of finished products with location, lot and serial tracking.

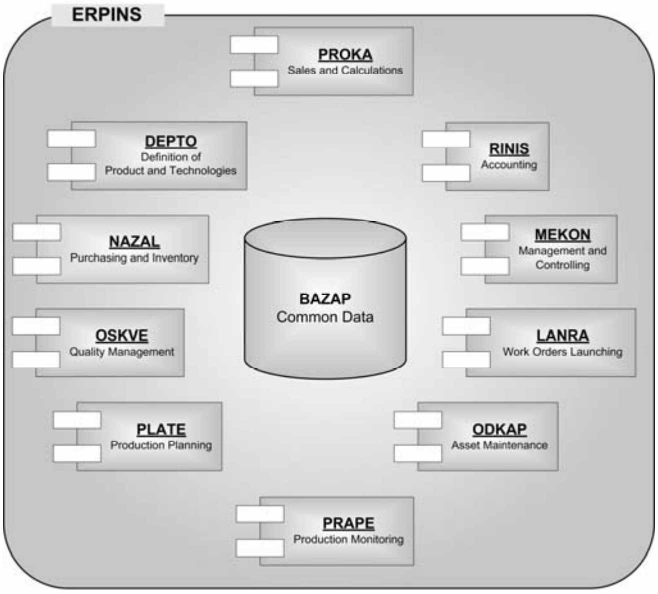


**Figure 1. ERPINS-M System Architecture**

- NAZAL covers purchasing and inventory with modules: Elements; Supplier Selections; Orders; Inquiries; Warehouse; Transport; Inventory Process.
- PLATE enables production planning with modules: Planning; Plan Variants; Multilevel Planning.
- PRAPE subsystem for production monitoring contains modules for: Project tracking (Project Manager); Tracking of unit and batch production; Operation condition; Work-order condition, Bar code; Impact and production costs.
- LANRA covers work orders launching with modules for: Production launching; Documentation checking; Reservation of material and capacities; Time between operations.
- OSKVE supports quality management with modules for: Quality aberrations monitoring; Rejects and finishing costs; Input material control; Tracking of lots and necessary certification; Instrument gauging; Customer complaints; Reclamation to suppliers; Laboratory tracking.
- ODKAP is a subsystem for asset maintenance. Included modules are: Assets catalogue with technical data; Maintenance technology; Plan and condition of preventive maintenance considering working or time cycles; Corrective and planned maintenance; Maintenance costs.
- RINIS covers accounting.
- MEKON subsystem covers management and controlling with modules for: Reports and graphs for management; Revenue and expenses tracking; Analysis of offered, agreed and supplemental calculations.

## 3. Suited Product Model

In a considered ERP system, the general concept named as "Production Element" is placed in the very basis of the system. The production element is defined as a basic element of the product definition that could appear in production and according to it enterprise resources are allocated. If the object-oriented approach is used, the production element could be seen as an abstract class from which derived classes inherit basic attributes and methods. The suited product model could be presented very clearly through Unified Modeling Language (UML) class diagrams [Booch, et al. 1999].

Figure 2 shows the simplified product model suited for the considered ERPINS-M system. The main attribute of the production element is a unique identifier – *ID*. The attribute *Origin* determines if it is an own element or if it comes from outer suppliers. The *RoleInProduct* attribute specifies the role of the element in product at the time of delivery: built in product as a normal role, packaging or spare part.

The attribute *Sort* helps to extend a set of classes used to describe a product structure (Compound Production Element, Product, Assembly and Part) for the demands of technology definition. It specifies if a particular production element could appear in a structure of other production element as a raw material.

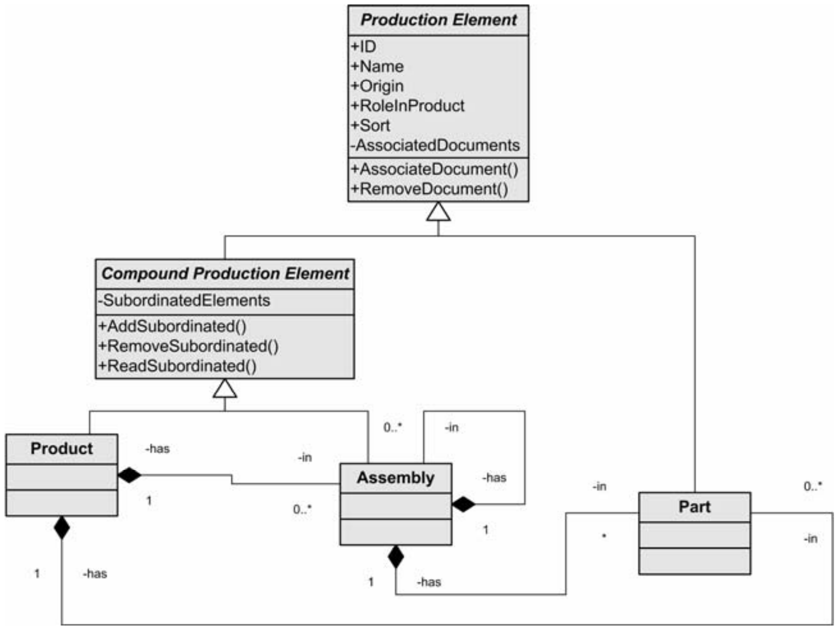


**Figure 2. Suited product model representation**

The abstract class *Compound Production Element* is included in the product model with a purpose to simplify the class organization and implementation in the ERPINS-M system. It determines hereditary class members (attributes and methods) that enable derived classes to have subordinated elements. *Product* and *Assembly* are classes whose objects could have subordinated elements, i.e. objects could have a structure. The member list *SubordinatedElements* contains identifiers of subordinated elements in the first level. If a particular subordinated element is also a compound, it has its own list of subordinated elements. To obtain a full structure of compound elements, it is necessary to iteratively read the lists of all subordinated elements

Objects from class Part could not have subordinated elements, i.e. they could not have structures. Therefore, the class Part is not derived from class Compound Production Element but directly from the top class *Production Element*.

In a modern process of product development, the product structure is for the most of the time built in parametric and feature based CAD systems. Such systems use more document and document types to describe product models. The usual document types are: assembly model, assembly representation, assembly drawing, part model and part drawings (Figure 3). Those documents often have internal file associations, for example a part drawing file usually depends on a corresponding part model file. To support the process of product development, the ERP system must provide an electronic vault with a capability to associate documents with production elements but also with routines for tracking internal file dependencies within the same production element. Routines for tracking internal file dependencies are closely dependent on used CAD system in a particular enterprise. Tracking dependencies on different document levels should not be accomplished through internal file records, but through product or assembly structure as it is stored in the ERP system.

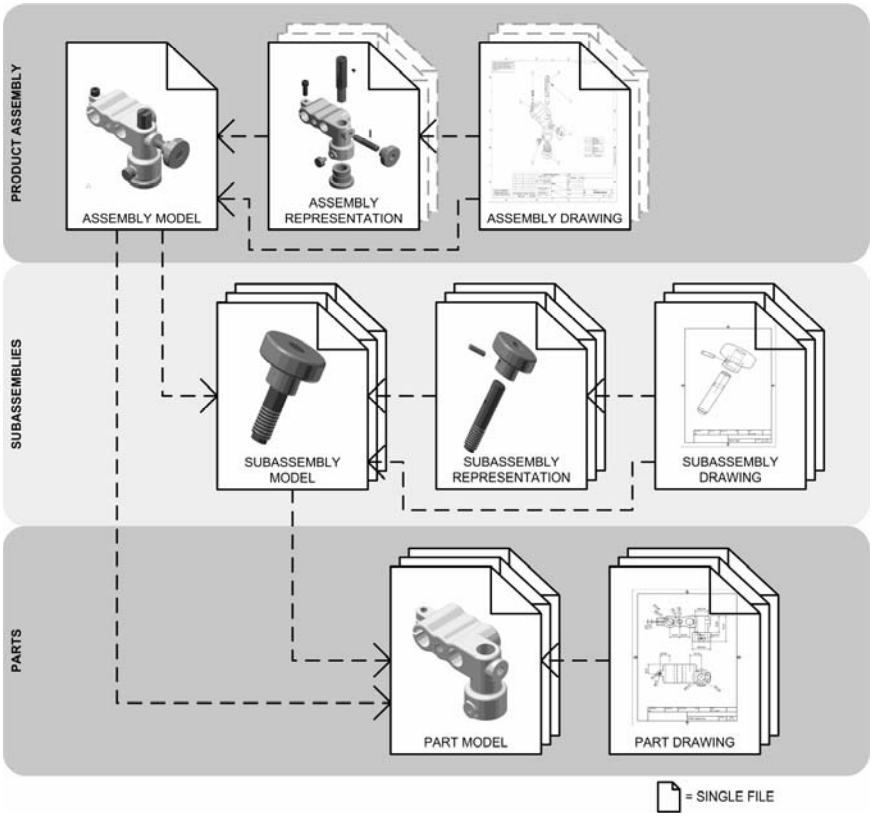


**Figure 3. Sample product CAD files**

The basic demand for a successful vault implementation in the ERP system is that all documents associated with a product and production have to be stored and controlled through the vault. The basic relationship which must be satisfied within a vault model for the ERPINS-M system is that with every production element (product, assembly or part) several documents could be associated. Thereby, a particular production element does not need to have even a single associated document, but could have more of them. Thus relationship between them could be expressed as 1:{0..N}. Seen from the opposite direction, from a document to production elements, a particular document could belong or be associated with one or more production elements, but also does not need to belong to any, in which case it is an independent document. Figure 4 shows the proposed vault model which is recently implemented in the ERPINS-M system.

Documents are identified on the very same way as elements with a unique identifier. Such identification enables ERPINS-M to handle documents as production elements. The attribute *Name* usually has the same name as the associated production element, if there is one. The attribute *Extension* holds genuine document file extensions, while the attribute *Description* holds basic data about an application which is primary used to create and modify documents. For the purpose of coherent data storage, it is convenient to determine the attribute value by reading a document header or the file extension at the time of document storage in the vault. For ERPINS-M users the access to values of the attribute Description is available as read only. The attribute Description is presented in the model as a public member of the class Document so it could seem to be in contradiction with the previous statement. But one should distinguish between access rights for system user and access rights inside the system program code in terms of object oriented modelling.

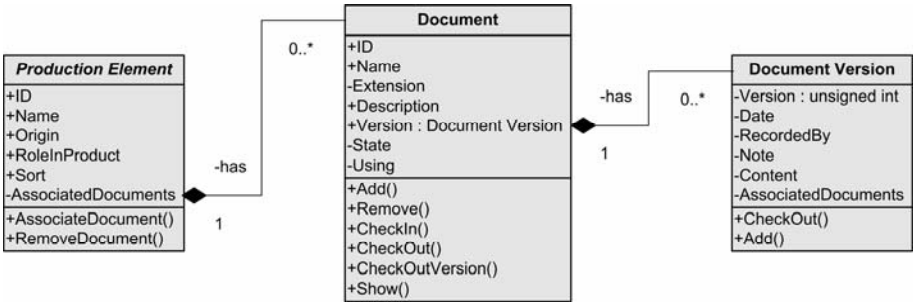


**Figure 4. ERPINS-M Vault model**

The attributes *State* and *Using* are necessary in a multi-user environment to enable document locking. Changes of those attributes happen upon the execution of class Documents methods *CheckOut*, *CheckIn* and *CheckOutVersion* which are used to take out the document from the vault and write changed document back into the vault.

The attribute *Version* together with a class *Document Version* are used for tracking of consecutive document changes through the ERPINS-M system. The version annotation is set up with an integer number. Therefore, the first document version stored in the vault starts with number 1, and every subsequent version gets the number incremented by 1. The attribute *Date* stores the date of a particular version storage. The attribute *RecordedBy* holds the name of the user who stored a particular document version. *Note* enables users to store comments with a particular document version. The attribute *Content,* depending on document storage model either contains an actual binary file or it keeps referenced file addresses. The attribute *AssociatedDocuments* stores the list of vaulted documents, which are in any way associated with a particular document in a level of the same production element. For example, in a sample product CAD model (Figure 3), the assembly drawing file is dependent on assembly model and assembly representation files.

## 4. Discussion

The presented product model is deduced with a purpose to support the process of product development and to extend ERPINS-M capabilities of authorized product data sharing.

During the model development, authors have reconsidered an influence and adaptation possibilities of existing standards in scope of the product development process, mainly ISO STEP PDM data schema and JPDM schema [Yeh, et al. 2002]. An actual specific ERPINS-M system architecture does not allow the full implementation of considered data schemas, because the program code of many of the existing subsystems should be rewritten again from the very beginning. Therefore, only core ideas and concepts of considered schemas are utilized for the presented model.

The data vault model is carried out in such a manner to enable product document handling regarding to product structure management and to enable an association with production elements of the ERPINS-M system. The model complies to specific features and specific architecture of the ERPINS-M system but also with specific features of CAD documents.

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