# Integration of a Manufacturing Model with State-of-the-art PDM System

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**Abstract**

Product Data Management (PDM) systems and manufacturing models operate independently does not constitute powerful solution in a distributed and collaborative product development and manufacturing environment. In addition there is also lack of research issues addressing the implementation of conceptual design and process planning stage to utilise PDM system, which offering collaborative development in a World Wide Web. To ensure competitive advantage, comprehensive system integration is needed in order to support and enhance the product development and manufacturing activities.

This paper focuses on research concerned with providing this level of support through the use of an in-house manufacturing model and a commercially available PDM system. In particular it focuses on fundamental concept of the overall system integration ideas and methodologies. The manufacturing model and PDM system are based upon, respectively, the CAPABLE Aggregate Process Planning System developed by Design and Manufacturing Group, University of Durham and PTC Windchill.

**Keywords**

Distributed and Collaborative System Integration, Manufacturing Model, PDM System, XML

## 1 INTRODUCTION

In manufacturing industry, many challenges such as reducing time-to-market and cutting costs directly affect the company and the life cycle of a product. The way to achieve this is by effective communication within the enterprise right from the beginning of product design to manufacturing. Inarguably, communication is vital for decision supports on product development process, which is one of the main factor contributes on product quality, cost and delivery. The way to improve communication is to adopt extended enterprise concept, hence, the application of distributed and collaborative product development and enable to re-use of engineering and manufacturing knowledge.

Over the last few years, more efforts have been established into this type of research due to the fact that many companies have distributed their product development to locations with knowledge force and expertise [1]. Apparently, it is claimed that about 70% of time has been wasted on product design and development stages are spent on searching for information to help decision support and engineering analyzed [2]. This kind of information can be categorized as customer requirements, market trends, existing product data, materials and manufacturing capability [3]. It is therefore, vital to have an overall integrated information system to support these activities.

Based upon such circumstances that this paper concerned on research issues to identify how Product Data Management (PDM) systems can be integrated with manufacturing model in order to facilitate the effectiveness of product development. The primary objective of using PDM System is due to its functionality, which enables collaboration through communication to share data internally, as well as with partners such as vendors and suppliers etc. While the Manufacturing Model can provide the support of capturing design and manufacturing information from early stages of product development which currently does not and inadequately supported by any commercially available PDM System.

## 2 THE MANUFACTURING MODEL AND PDM SYSTEM OVERVIEWS

The manufacturing model consists of CAPABLE Aggregate Process Planning system, Knowledge Management Capability, Process, Resource and Product Models [4]. The main mechanism of the manufacturing model is the CAPABLE Aggregate Process Planning which is used to determine a specific plan on initial design and development stage. The Product Model is currently under developing by Cranfield University. Brief reviews of the systems functionality are described as follows.

- CAPABLE Aggregate Process Planning

The system used a simulated annealing algorithm to produce realistic manufacturing plans depends upon

manufacturability [5]. Manufacturing capabilities such as process and resource availability can be configured and change accordingly.

- Process and Resource Models

Process model capturing capabilities of manufacturing processes such as process parameters and manufacturing knowledge. While resource model capturing resource availability requires to produce a particular feature etc.

- Knowledge Management Capability

The capturing of engineering and manufacturing knowledge enables the system storing experience, geometry or features and data related to a product that can create the ability to re-use product knowledge and reduce development iteration

- Product Model [6]

The product model consists of an AP-224 modeller has the ability to generate concept models based on ISO-STEP machining features and selectively generates process plans, it then can be exported to downstream applications such as CATIA and PRO/Engineer for detailed design. This model formed as part of the manufacturing model with CAPABLE Aggregate Process Planning System, Resource and Process Models.

- Windchill PDM System

PTC Windchill itself encompasses of many functionalities. However, there is only a few functionalities are applicable for this particular project, these including life cycles and workflows, version control (effectivity), visualization and customization factor [7]:

- Life cycles and workflows
  The ability to define the state of each task activities, while workflow processes determine what happens within each task and also applicable to delegate tasks to specific members within the team. The ability of all team members to comment on the design and add their own “mark-ups”.
- Effectivity (version control)
  Version controls for the design and the ability to see the history or “evolution” of a design through all its iterations.
- Visualization
  This allows different types of product-related information viewed through the enterprise as well as interrogate and ‘markup’ CAD formatted files and on-line conceptual review.
- Customization factor
  This is an object model development tools. The skeleton of the object taxonomy is designed using Rational Rose Unified Modelling Language (UML) in association with Visual Café developing environment.

## 3 INTEGRATION METHODOLOGIES

Figure 1 represents the integration architecture, which consists of different components used in this research. The deployment of Windchill provides an ‘integration wrapper’ for the entire integrated system. It supports an online distributed and collaboration environment with specific functions including product data/document management, version control, workflows and lifecycle. The use of Windchill also supports customisable functionality to enable to further develop CAPABLE system, as it allows the inheritance of its ‘abstract’ classes to be modify and implemented as part of CAPABLE system to adopt the needs in Product, Resource and Process models. Oracle databases server is employed to handle requests, knowledge and models information as well as Windchill functionalities through the use of Java Database Connectivity (JDBC) [8].

The main interfacing mechanism on Windchill PDM is managed by the utilization of running Windchill Applet with a servlet to support Manufacturing Model so that it can communicate with CAPABLE Process Planning [9], [10]. Tomcat deployed as a servlet container in conjunction with a Web server, such as Apache to support Java based and XML implementation [11]. XML (EXtensible Markup Language) is being deployed as the interfacing media on PDM and Manufacturing Model data interchange. This recommendation enables interchanging portions of XML documents while retaining the ability to parse them correctly and, as far as practically concerned, it can be formatted, edited, and processed in useful ways [12].

There are two other third party software will be deployed within the research that including Pro/Engineer and LOCAM (a manufacturing planning system). Pro/Engineer is being used as a solid modeller to display the image of the product through Windchill Visualization functionality. LOCAM is used to generate process planning at a later stage of product design and development, in addition, it also has the ability to take STEP AP224 file generate by the Product Model and outputs XML formatted process plan through Windchill.

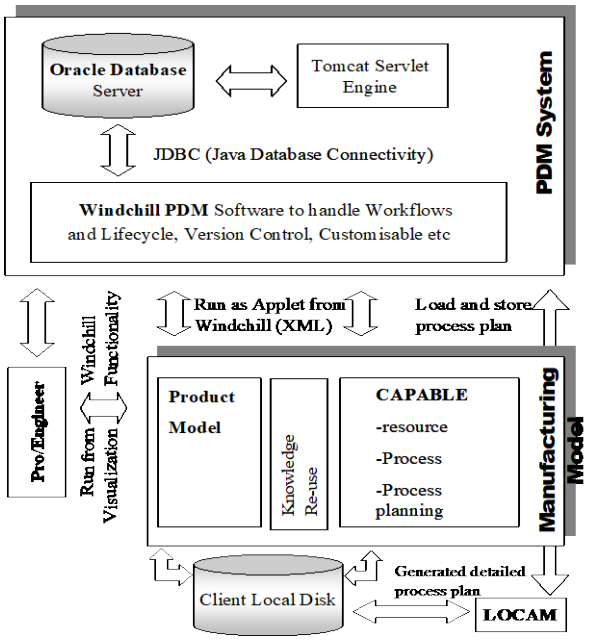


Figure 1:Integration Architecture

## 4 CONCEPTUAL REPRESENTATION OF A DISTRIBUTED AND COLLABORATIVE ENVIRONMENT

Figure 2, illustrated how a typical distributed and collaborated scenario might look. The conceptual diagram aimed to address the ideas of implementing distributed and collaborative product development and manufacturing in a concurrent engineering environment. The Original

Equipment Manufacturer (OEM) and vendors as denoted Company X, Y and Z formed a network of collaboration. The companies are the main collaborators on product development from conceptual to detailed design stage. The major advantage of this framework offered is the ability for the collaborators to communicate and interact over the network through an integrated system. Figure 2, illustrates an example of the proposed activities which indicated that Company X received a product design at the conceptual stage through Windchill and a product model from the OEM. Company X is then start the interrogation process on CAPABLE Aggregate Process Planning.

There are several steps to be executed in order to obtain optimum development processes. Initial stage is to select the appropriate processes and resources and if necessary to attach re-usable management knowledge on engineering and manufacturing. The system is then display a 'rough' route and QCD (quality, cost and delivery) issues on earliest concept. Once it has been accepted, the next stage is to invoke LOCAM manufacturing planning system. LOCAM is deployed to generate 'accurate' process plan and QCD at the detailed design stage.

This concept provides an sharable information and distributed platform which enable a collaborative design team from different disciplines and locations to make use of "reusable" expertise without consulting directly with the expert. The capability to take the best path for the design from the earliest concept, which is where the potential future success or failure of the project is cast.

## 5 CONCLUSION AND FUTURE WORK

PDM system already is a well established enabling technology for the support of distributed and collaborative product development process. The author foreseeable and believed that with the capability of the Manufacturing Model, which allows generating accurate process planning from conceptual to detailed design stage, the integration of the two technologies would be the foundation of a product's total life cycle.

In this paper a preliminary description of the integration methodologies in PDM and Manufacturing Model has been defined. The next stage of this part of the project is to design an Object Oriented Class Taxonomy (OOCT) to represent the manufacturing processes of the industrial collaborators and subsequently to implement the necessary functionality based upon real industrial data.

## 6 ACKNOWLEDGEMENT

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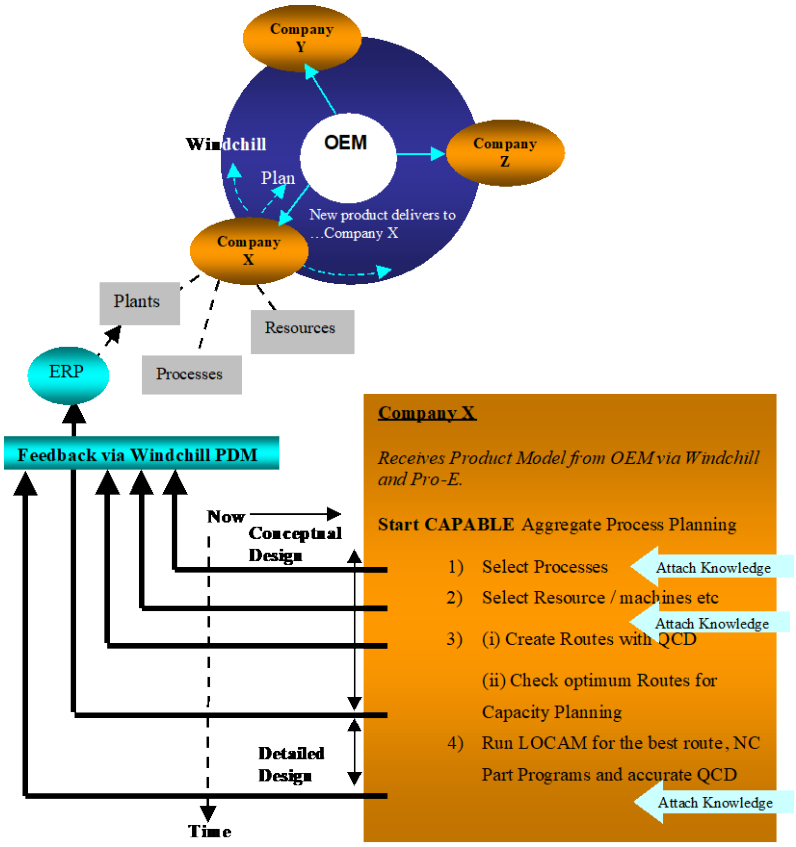


Figure 2: Conceptual Representation of a Distributed and Collaborative Environment

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