Special Issue - 2015

**International Journal of Engineering Research & Technology (IJERT)**
**ISSN: 2278-0181**
**TITCON-2015 Conference Proceedings**

# UML Approach for Modeling and Specifying the Product Structure and Workflow

Shanmugapriya S[1]
Department of Production Engineering
PSG College of Technology
Coimbatore, India

Arunprakash R[2]
Department of Production Engineering
PSG College of Technology
Coimbatore, India

*Abstract*- **This project deals with modeling and specifying the product structure and workflow of pump assembly based on the UML Approach. It highlights the added value of using the object oriented approach for modeling, specifying and implementing the whole management of pump assembly about its entire lifecycle. It also provides the integration of the various dimensions of the submersible pump manufacturing system by specifying product, process and resource data.**

*Keywords— Object oriented modelling; product structure; workflow*

## I. INTRODUCTION

The requirement of single and secured storage of product data of pump enables an early access or allows to share product data with its main contractors and suppliers. The main benefits of using Unified Modeling Language (UML) in an extended pump assembly approach are given below: 1. Reducing lead time and non-quality according to predefined processes, 2. Sharing the right data between the relevant users group regarding the pump development to minimize the iterations, and 3. Improving reactivity and customer supports with a high level of traceability and an efficient product configuration management.

## II. RESEARCH GOAL

UML has been chosen for several reasons. First, it provides complete modelling notation for specifying the product breakdown structure (parts) with related product data (documents). Second, it provides an efficient language for modelling generic workflow with activities and transition criteria before their implementation in a workflow engine.

## III. PRODUCT DATA MANAGEMENT

A PDM (product data management) system manages and stores product design, manufacturing and support data. Two important functionalities of such a system are:

Product structure manager: It stores the whole product data. It manages the bills of material (BOM) and the product configurations. It helps in providing functionalities for linking the various parts and documents in the product structure.

Workflow management: It routes documents to single or multiple user's in-box. Users need to perform a predefined task on the routed document. Workflow can have complex network of task flow to implement a business rule. It can route any type of a document. It controls the flow of the package through the business rule network.

### A. About UML

UML is given by

Unified - Result of unifying the information systems and technology industry's best engineering practices.

Modeling- A number of models are used to describe the system.

Language-Not simply a notation for drawing diagrams, but a complete language for capturing semantics about a subject and expressing the same for purpose of communication.

### B. UML Diagrams

A diagram represents a particular view into the model.

• UML Diagrams comprises of model elements.

• A single model is a complex entity and is difficult to present meaningfully within a single diagram.

• UML defines a number of diagrams so that focus on different aspects of the system independently.

Class diagrams: Shows a set of classes, interfaces and collaborations and their relationships.

Object diagrams: Shows a set of objects and their relationships.

Use-case diagrams: Serve to organize the use cases and actors that encompass a system's behavior.

State-chart diagrams: Focuses on the changing state of a system driven by events.

Activity diagrams: Focuses on the flow of control from activity to activity.

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## IV. PROBLEM DEFINITION

Time to market, high security level, reduced design lead time and enhanced level of quality are becoming the most important business and strategic key elements for product development and manufacturing. Product data management system manages and stores product design, manufacturing and support data. For defining and modeling the product data clearly, the UML (Unified Modeling Language) is used. UML gives a clear understanding about the product structure and workflow and communicates well in heterogeneous environment. By this method, the modeling and integration of product structure and workflow is identified for the Pump Manufacturing. This helps in reducing the complexity of the assembly and making a better design.

## V. PRODUCT STRUCTURE AND WORKFLOW MODELING

### A. Use Case Diagram

The tasks of each involved person have been identified in a use case diagram. This has been carried out based on several interviews of design team members: quality manager, process manager and design manager. It provide a fairly good over view of the user needs and design project running based on data modelling. It gives a snapshot of one aspect of the system. A use case may be small or large. It captures a broad view of a primary functionality of the system in a manner that can be easily grasped by non-technical user. The use cases may be decomposed into other use cases.
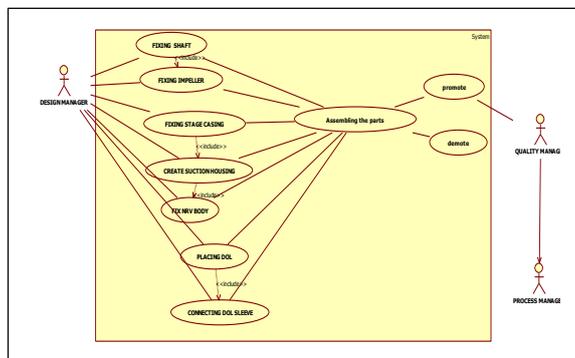


Fig.1. Use case diagram.

### B. Product Breakdown Structure

The product breakdown structure is based on a parts list (including: product, subassemblies and basic components). The product breakdown structure allows the bills of material management and product configurations. Two types of breakdown are as follows:

i.    Design breakdown
ii.   Manufacturing breakdown.

The product breakdown is provided for clear understanding of the product structure. The shaft, impeller, stage casing, suction housing and NRV body are obtained by a same subassembly. In manufacturing breakdown, right objects must be mapped correctly. For example, right

turning has to be matched for right welding. There are two product breakdown structure: they are joint product and mixed product breakdown structure.

The joint product breakdown consists of separate viewpoint for design and manufacturing breakdown. Thus it is complicated to manage consistency between data throughout the lifecycle.

The mixed product breakdown consists of single viewpoint for both the design and manufacturing breakdown. It avoids duplicating data: the shared data integrates into the common part of the product breakdown.
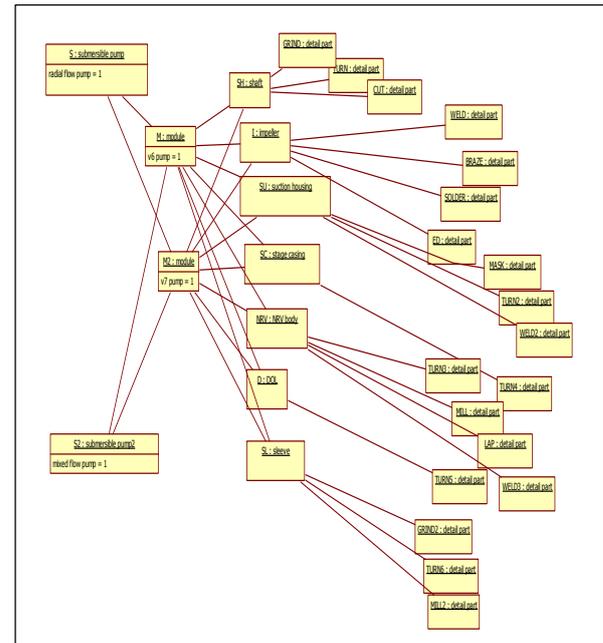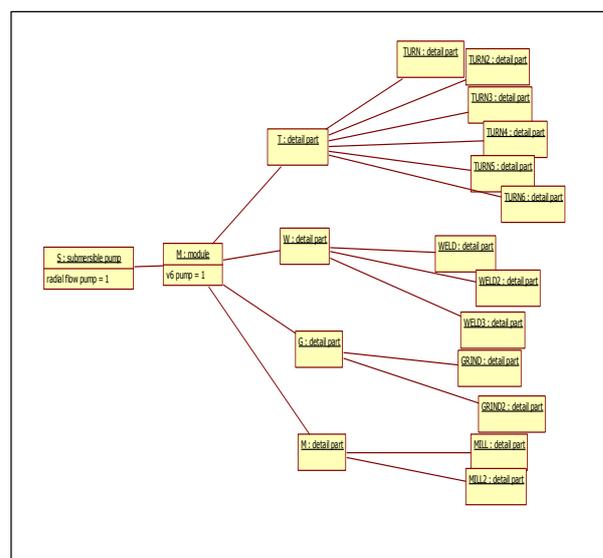


Fig.2. Object breakdown for design breakdown.



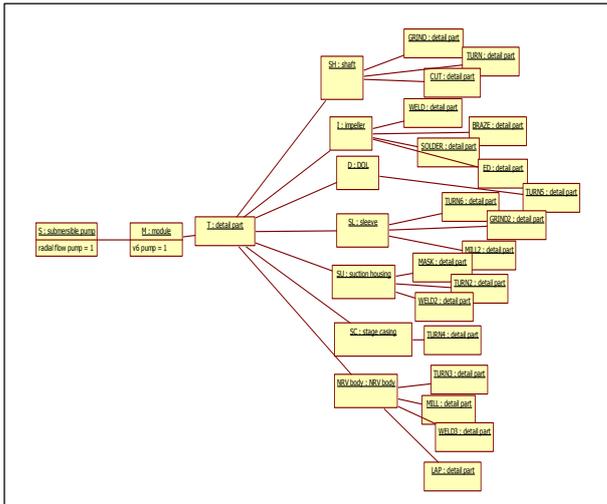Fig.3. Object breakdown for manufacturing breakdown.

Fig.4. Object breakdown for mixed product breakdown.

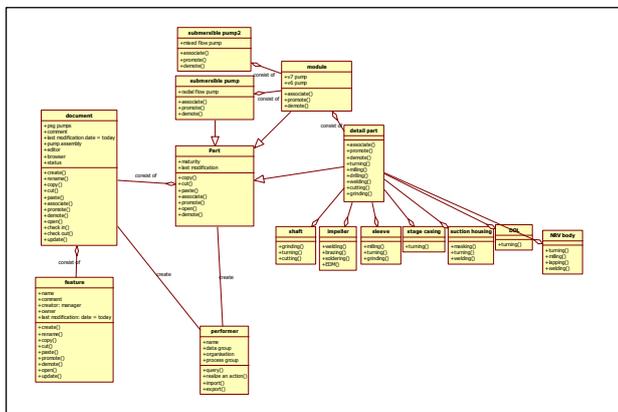*C.  Class Diagram Of Product And Process Structure*



Fig.5.  Class diagram for pump product structure

It helps to understand complex links between metadata. The class diagram highlights how the product is structured in the system and how it is used. The product breakdown will be composed of Part class, its sub-classes, performer and Document class. The performer will be able to use classes for carrying out the activity. The process structure consists of action, activity, performer and software part class.
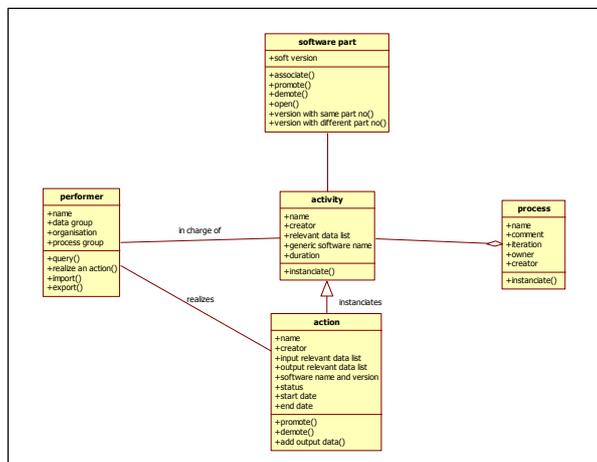


Fig.6. Object breakdown for pump process structure.

*D.  States of a Document*

The state diagram denotes the present state of the document. The owner of the data is in charge of the document. He promotes or demotes the maturity level. The Various States are:

- "In progress" denotes that the data is  modified by an activity

- ''Shared state'' denotes that the data is mature to be used by the process as input for other activity.

- ''Released state'' denotes that data may not be modified further in this configuration.

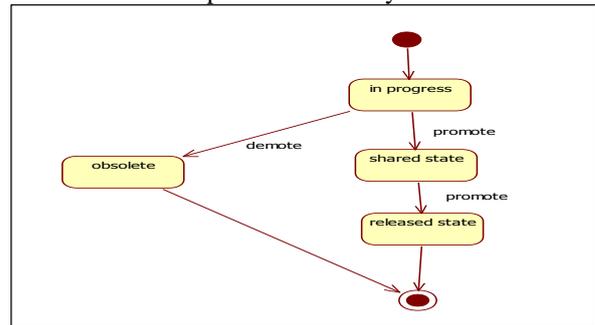- ''Obsolete'' denotes that the data is unable to be used as input for an activity.



Fig.7.  State diagram of a document

*E.  Activity diagram*

It highlights the flow of activities from the start of the design to completion of the pump assembly. It is represented by a single diagram for overall process.
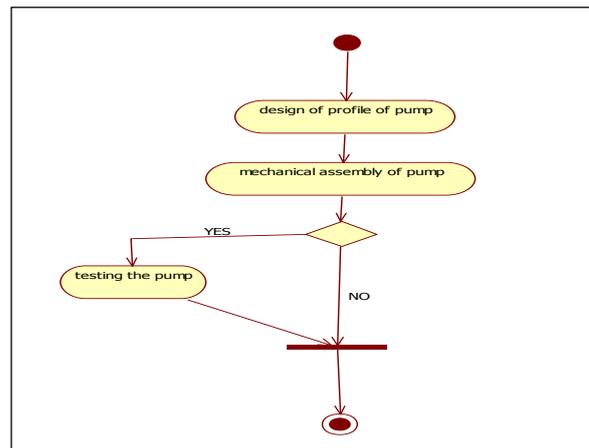


Fig.8.  Activity diagram of a pump

*F.  Workflow Modeling*

Workflow can have complex network of task flow to implement a business rule. It controls the flow of the package through the business rule network. The main goal is to build the generic process with controlled data for each new product development cycle. This web-based system is implemented by creating the front end of the system

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interface using HTML.    The part number gives the description of   individual parts.



Fig.9. Workflow activity of a pump



Fig.10.  Part number details

## VI.    DISCUSSION

From the object diagram, the product structure need not be required when searching for the specific document related to specific part. The workflow process retrieves correct data without any confusion. The class diagram which indicates all the complex links between the metadata. State diagram helps to identify at which state the document is present. Activity diagram relates the whole pump design in a single flowchart.

## VII.    CONCLUSION

The current study aims at highlighting the added value of a UML approach for modeling and specifying the product structure and the workflow. Thus, UML has been chosen for many reasons. First, it provides a complete modelling notation for specifying the product breakdown structure of pump assembly (parts) with related data (documents). Second, it gives generic workflow activities before their implementation in a workflow engine. Finally, UML enables to detail the overall class diagram of the pump system and collaborative design with suppliers in an extended enterprise.

## ACKNOWLEDGMENT

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