Framework for Product Lifecycle Management Integrated with Enterprise Resource Planning

B. N. Prashanth[1] R. Venkatram[2]
[1,2]Department of Mechanical Engineering
[1]Amrita School of Engineering, Bengaluru, Amrita Vishwa Vidyapeetham, India [2]East Point College of Engineering and Technology, Bengaluru, India

Abstract— Product Lifecycle Management (PLM) is extended to handle the information of product throughout the lifecycle of the product. During the design phase, engineers want immediate approach to product data as well as specifications, engineering variables and documentation wherein a PLM system is very crucial. PLM tracks and handles Bill of Materials (BOM), documentation of product, part information, engineering changes and revisions, likewise as compliance information and easy information approach by the members of team. To serve several design iterations, before the design reaches the working model and production phases, PLM additionally proposes a flexibility to be bigger. A business management tool, Enterprise Resource Planning (ERP) is employed to satisfy the requirements of the various aspects of an organization as well as human resources, distribution, client service, finance and accounting, and production. Additionally, by delivering better processes, ERP system upholds numerous departments inside the organization.

Integration module can be developed through Enterprise System Integration which includes creating or modifying the user, cluster and organization, setting up or modifying the rules to access management, creating and modifying the lifecycle, workflows and groups, modifying of RBInfo Files, rules of object data formatting and schemes of list & version. Past this configuration, BOM and part are outlined and monitored within the PLM for the combination. Further, configurations enable sharing the engineering and production information directly through an automatic method which eliminates the tedious and task which appears to be error prone through the hand-entering data, leading to refined integrity information across the firm. Associate degree interchanged atmosphere helps in decreasing the redundant efforts and guarantees that every department is involved within the development and production cycle which have access to present and correct product information.

Keywords: PLM, ERP, BOM, ESI, API, Data, Information

I. INTRODUCTION

Due to manual processes and disparate product data, the organization was running into information inaccuracies. Each and every engineering, document, operations and internal control members of the team were following their hand-entered design & operations information in separate databases. The databases being synchronized was a long task and well-tried to be a substantial resources strain. The organization which had ERP system to track all of the business activities which are operations-centric like planning, purchasing, financials and work orders. However, the ERP didn't direct their needs of design engineering. The company lacked a system which helps in understanding the revision management and engineering modification processes. So as to realize management of their design of the product and terminate product data that are disparate, the company introduced a system of PLM.

Integrating ERP with PLM permits sharing of engineering & production information directly through an automatic method. It terminates the monotonous and prone to error task of entering the data manually, leading to enhanced information integrated across the company. The integrated surroundings decrease efforts which are redundant and guarantees that each and every department is concerned within the development and production cycle having access to present and correct product information. By PLM & ERP being synchronized, engineering groups are ready to approach the information of business-level from the ERP to assist higher processes of design and production is guaranteed receipt of the foremost present design data for a lot of economical production processes.

A PLM is bought to handle the total spectrum of engineering data in an exceedingly one location through the various design stages. The manufacturer of server enterprise used the PLM to manage the product lifecycle where each and every revision of their BOM give revision management of engineering documents, approvals routed electronically for brand new request for parts, handle and alter their engineering modification orders, and management accepted list of manufacturers changes. A lot of significantly, the PLM aided in closing the space between engineering and production. By providing information being shared directly with the ERP, changes if any created within the PLM were exchanged to ERP automatically such a way that engineering and producers were invariably in synch.

The main objective is to develop a framework for PLM to be integrated with ERP. The capacity to share information directly between both the surroundings and data being pulled from ERP into the database of PLM gave engineers clarity into widened data as well as value, inventory, seller standing and lead times. Approach to the present variety of data allowed engineering for value analysis to be performed, product availableness, and early in their cycle of design or development compliance, serving to build higher design choices and eliminate late stage redesign which appears to be costly.

II. STUDY OF SYSTEM ARCHITECTURE

The system architecture is three-tier application architecture designed and optimized for the deployment of business information applications. The consumer tier is that the presentation layer of the design and uses third-party internet browsers presenting a mix of HyperText Markup Language, JavaScript, and Java applets to accomplish user tasks. The middle tier, is that the application tier and provides the business logic to support the mandatory transaction

processes. This tier is made up of third-party web servers, such as Apache, a servlet or jsp container such as Tomcat and the Java-based method servers. The third tier uses a Database Management System to store structured and unstructured data. Other data to consider for mass storage include the external file vaults, the Lightweight Directory Access Protocol directory, and the Retrieval Ware indexes.

The architecture is rather complex which consists of components such as PDMLink, File Vault, InfoEngine, Visualization Services, DBMS, Java, Apache, Tomcat, Aphelion Directory and Optional modules.

Figure 1, shows PLM solutions product architecture, what are the different modules and technology platform in PLM.

Figure 2, describes the ESI architecture, how the ESI middleware plays a major role for the data exchange between PLM and ERP systems.

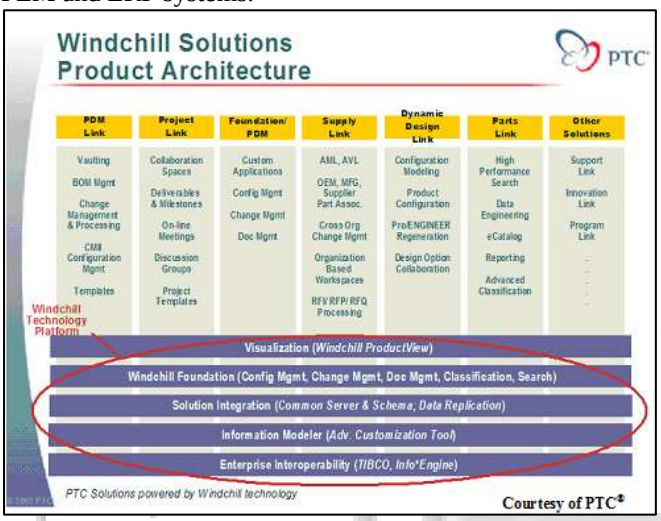

Fig. 1: PLM Product Architecture

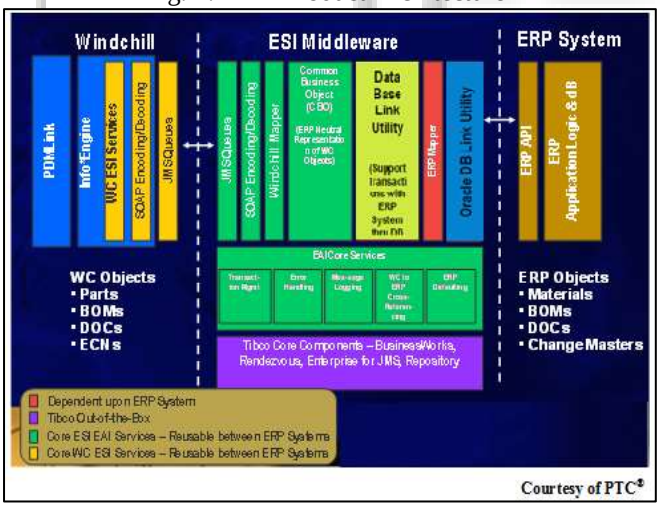

Fig. 2: Enterprise System Integration (ESI) Architecture

The following are the necessary PLM Modules:

A. PDMLink

PDMLink aggregates, controls, and leverages digital product data throughout the lifecycle of the product, creating it simple for everybody concerned within the process development of product to access current exact product data in an exceedingly sort of formats through one web-based supply.

B. ProjectLink

ProjectLink provides a comprehensive, real-time project management and collaboration infrastructure for all members of the extended product development team, both inside and outside the enterprise.

C. PartsLink

A primary business goal for several organizations of manufacturing is utilizing the design and strategic sourcing so as to cut back product value and time introducing it to market. PartsLink permits the organization and classification of internal element libraries and makes them accessible through some Web-based surroundings that's tightly integrated with alternative PLM solutions and CAD tool.

III. PLM IMPLEMENTATION

Implementation phase constitutes the following sub-phases: a) Detailed Scoping, b) Installation & Configuration of PLM Modules, c) System Integration & Testing and, d) Deployment and User Acceptance Testing (UAT).

A. Detailed Scoping

The scope of the implementation and the functional points of the requirements are recorded for all the requirements defined in the scope including ERP Integration. The requirements captured will be recorded in the Business capture worksheet which will in turn be converted into a Functional Description Document (FDD). The FDD will be reviewed with the customer, which will form the basis for solution design and act as a reference document for the complete implementation of the project. Once the FDD is finalized, the requirements are analyzed and the solution for implementation is defined. The solution definition will be documented which will have both high level and low level design details and the output document is the System Description Document (SDD). The FDD and SDD will form the basis for deriving various other documents like detailed project plan, test plan, test cases and deployment plan.

B. Installation and Configuration of PLM Modules

To get started with installing the PLM solution, internet platform components, aphelion directory, and InfoEngine needs to be installed first.

Later the PLM solution which includes installing of database software, Services, and one of the solution components. After installing the PLM solution, many of the other products can be installed in any order.

Installation of PLM Solution and its necessary modules on development, testing and production environments is done as per the Client requirements.

Figure 3, provides a general picture of the product installation order. The steps assume that the installation is done for all products on the same server:

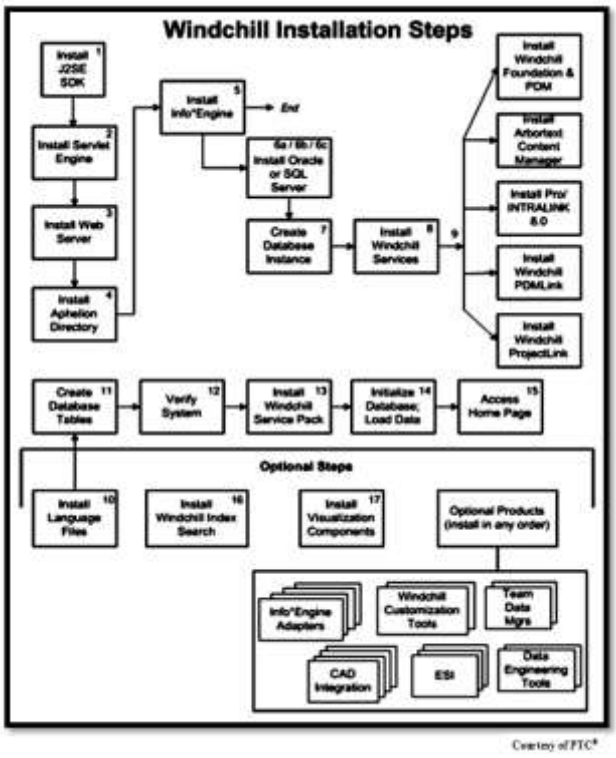

Fig. 3: Installation Steps of PLM

In the development stage, certain CAD softwares are integrated with PDMLink, visualization Services for Design Collaboration are installed and configured and finally the methodology for cleaning up CAD data and loading existing CAD data to PDMLink are established.

Basic configurations, process, product structure management, change management process, parts classification using PartsLink, search and reuse, APQP, requirements management, NPI, status reports, supplier collaboration, data loaders and data for ERP includes users and groups creation, setting up access management rules, lifecycle creation, workflows and teams, RBInfo files, object format rules, listing and versioning schemes etc., are designed as per the SDD & FDD for the PLM modules.

C. System Integration and Testing

Integrating all the configurations on the server and making associate degree surroundings for conducting an integration testing for verifying the operation of the configurations as per purposeful necessities. This stage is also being called as alpha testing stage. Testing of each of the functionality will be conducted against the test cases and the results will be recorded. Necessary corrections for the non-conformities during the testing will be done. After having the system corrected in all aspects, a build will be created which will be used for deployment on the Test server for carrying out the user acceptance testing.

D. Deployment and User Acceptance Testing (UAT)

Preparing the test server and deploying the build on the same. Validating the build deployment and giving a go ahead for the user acceptance testing to start. Facilitating the user acceptance testing process wherein the client's key users would perform the testing against the pre-defined user acceptance test cases and results will be recorded. Necessary corrections for the non-conformities during the testing will be done. After having the system corrected in all aspects, a build will be created which will be used for deployment on the production server.

IV. PLM AND ERP INTEGRATION

PLM and ERP integration phase constitutes one of the below sub-phase:

A. Data exchange between PLM & ERP systems

For exchanging of data between PLM and ERP systems, firstly the ERP Connector needs to be configured. To configure ERP connector, the following steps are performed: a) Starting of all the servers, b) PLM shell is opened and some of the commands are executed followed by the instructions and c) ERP Connector is registered with PLM by executing some of the commands.

After configuring the ERP Connector, ERP connector distribution targets needs to be created.

ERP connector supports three types of distribution targets such as File system, E-mail and FTP.

Figure 4, shows the ESI lite architecture, how the business process takes places. In order to form the ERP connector distribution targets, the administrator has two choices.

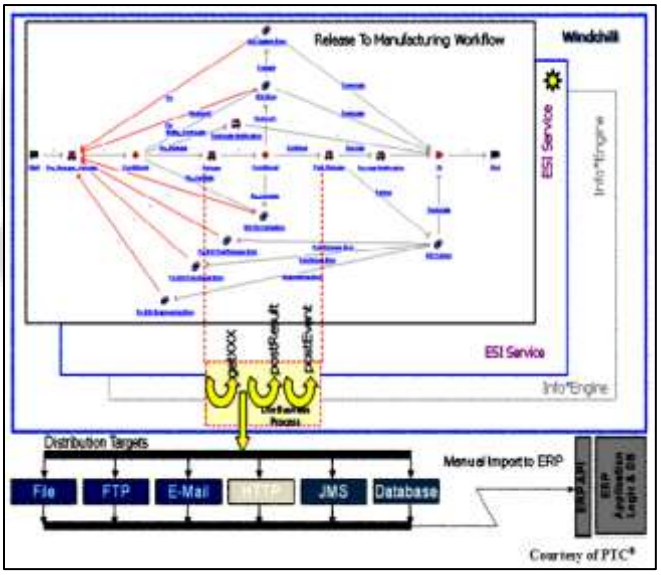

Fig. 4: ESI Lite Architecture Overview

In option 1, ERPConnectorTarget.xml file is edited on the installation by following the comments in the file and PLM shell is opened and some of the commands are executed followed by the instructions.

In option 2, ERP connector distribution target is made by choosing the link on site or organization utility.

Various components that are involved in the system architecture are Client LAN/WAN, PLM application server, PLM database server which also includes PLM tables and custom tables for publishing ERP data, ERP application server, ERP database server which also includes main tables and interface tables.

Figure 5, depicts the typical solution architecture that has been decided for integration between PLM and ERP at client's company.

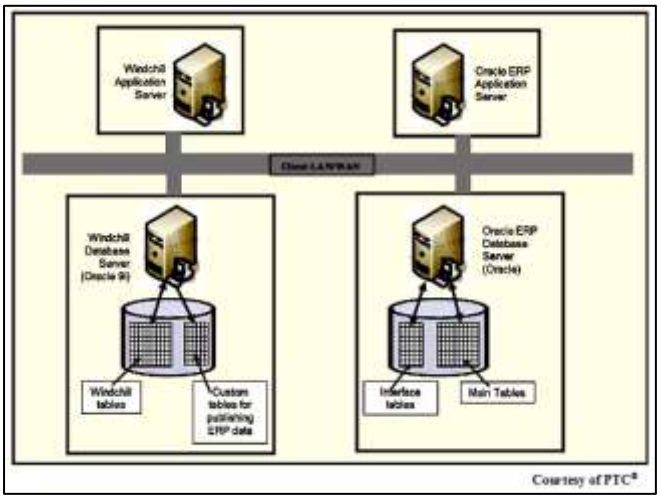

Fig. 5: System Architecture

With the system architecture in place, PLM will publish the part and BOM data to PLM custom tables. ERP will query the PLM custom tables update the part and BOM data to ERP Interface tables. This will be a batch process which will be coded on the ERP side. The connection to query data from PLM custom tables would be established through ERP applications database link.

V. CONCLUSION

The study concludes with a framework development for PLM integrated with ERP. The integrating module is crucial for guaranteeing portability of the data varieties.

Many PLM vendors have integration ways predicated on selling relationships or native technologies, and need a lot of time and expense to deliver the PLM portability needed for fulfillment. Manufacturing organizations should watch out carefully the integrations that need vital investment to custom build business logic & processes, restricted choices within the sort & depth of integrations offered and lack of expertise managing the advanced relationships related to CAD & product-related data during a distributed surroundings.

Integrating PLM and ERP might seem to be a frightening task. However, there are several off-the-rack solutions that offer vital capabilities, and for a few organizations all that's required. The advantages of PLM integrating with ERP impact several areas of a business, not simply engineering, and facilitate organizations of all sizes be additional competitive in today's international competitive markets. PLM and ERP integration isn't only for giant enterprises. The enhancements in integrations technology have created these integrations value effective for small- to medium-sized enterprises round the world.

PLM & ERP connected additionally advances and automatize the business processes, reforms the functioning competencies, and produce the chance to feature price not available in the market with remote systems.

ACKNOWLEDGEMENTS

The correspondents pass on their gratitude towards the management of East Point College of Engineering & Technology, Bengaluru and Amrita School of Engineering, Bengaluru, for their continuous assistance and motivation throughout this analysis study.

REFERENCES

[1] A CIMdata Program Review, "Service-Oriented Architecture for PLM: An Overview of UGS' SOA Approach", CIMdata, www.cimdata.com, pp. 1-9, 2006.
[2] Kazuo Hatakeyama, Marcelo Machado, "Integrated Approach Bridging PLM, ERP, SCM in Automobile Industry", Advances in Transdisciplinary Engineering, Volume 4, pp. 739 – 748, 2017.
[3] Press Release, "New Windchill Module Delivers Turnkey Integration to Connect PLM with ERP", www.ptc.com.
[4] Empowering the Future of Business, "Product Lifecycle Management", A CIMdata Report.
[5] Antti Saaksvuori, Anselmi Immonen, "Product Lifecycle Management - Second Edition", Springer.
[6] Windchill 8.0, April 2007, "ERP Connector User's Guide", pp-2-1.
[7] Jung-Ae Kwak, Hwan-Seung Yong, "An Approach to Ontology-Based Semantic Integration for PLM Object", Proceedings of the IEEE International Workshop on Semantic Computing and Applications (IWSCA '08), IEEE Computer Society, pp. 19-26, 2008.
[8] Julien Le Duigou, Alain Bernard, Nicolas Perry, "Framework for Product Lifecycle Management Integration in Small and Medium Enterprises Networks", Computer-Aided Design and Applications, pp.1-14, 2012.
[9] A CIMdata Report, "Service-Oriented Architecture for PLM, an Overview of UGS' SOA Approach", September 2006.
[10] Teamcenter Gateway – for SAP, "A collaborative framework for transforming PLM and ERP integration", www.ugs.com.
[11] White Paper Windchill ESI, "Connecting PLM to ERP and other Enterprise Systems with Windchill ESI", www.ptc.com.
[12] Aberdeen Group, "Enabling Product Innovation: The Roles of ERP and PLM in the Product Lifecycle", November 2005.
[13] Windchill 8.0, April 2007, "Windchill Installation Overview", pp-1-2.
[14] Prashanth B N, Venkataram R, "Development of Modular Integration Framework between PLM and ERP Systems", Proceedings of the 5th International Conference of Materials Processing and Characterization (ICMPC 2016), Materials Today: Proceedings, Volume 4, Issue 2, Part A, pp. 2269-2278, 2017.
[15] Priyanka Gandhi, "Product Lifecycle Management in Education: Key to Innovation in Engineering and Technology", Proceedings of the 11th IFIP International Conference on Product Lifecycle Management (PLM), Product Lifecycle Management for a Global Market, pp. 121-128, 2014.
[16] Windchill 8.0, June 2005, "Windchill Installation and Configuration Guide – Windchill", pp-15-1.
[17] Ding L, Li W D, McMahon C A, "XML-based Representations in Product Lifecycle Management",

Proceedings of the 11th International Conference on Computer Supported Cooperative Work in Design (CSCWD 2007), IEEE Xplore, pp. 762-767, 2007.

[18] Dominik Holzer, "Fostering the Link from PLM to ERP via BIM", Proceeding of the 11th IFIP International Conference on Product Lifecycle Management (PLM), Product Lifecycle Management for a Global Market, pp.75-82, 2014.

[19] Qilin Shu, Chengen Wang, "A Conceptual Framework for Product Lifecycle Modeling", IFAC Proceedings Volumes, Volume 39, Issue 3, pp. 735-740, 2006.

[20] Julius D Golovatchev, Oliver Budde, "Next Generation PLM - An Integrated Approach for the Product Lifecycle Management", Proceedings of the International Conference on Comprehensive Product Realization (ICCPR 2007), Inderscience, pp. 555-564, 2007.

