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Components of Product Lifecycle Management and Their Application within Academia and Product Centric Manufacturing Enterprises

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Abstract

Modern manufacturing companies are utilizing advanced technologies to manage their engineering data to enable them to create products with advanced features faster than ever before. People, culture, product data management (PDM), process management, and project management are combined to achieve synergies within the company. The technological automation of these components is the core of product lifecycle management (PLM). These components are discussed relative to their contribution to a modern PLM vision. Because PLM is a standard method of engineering data management, modern educators must be aware of the methodologies deployed within the modern manufacturing engineering environment to successfully teach engineers.

Introduction

As companies strive to develop products with advanced features in complex configurations and with compressed design lifecycles, they are increasingly relying on tools to help organize their information among the teams of people involved with the project (Vezzetti, Violante, Maria Grazia, & Marcolin, Federica, 2014). PLM strives to enable individuals to be able to access the data that they require to perform their task as efficiently as possible. The strategy to maintain continuity between all data related the engineering specification is one of the goals of PLM. Fundamentally, this vision is implemented through the systematic control of engineering data, process management and project management (Stark, 2011).

Product Data Management or PDM

Engineering specifications begin with functional requirements. From these requirements, engineers and designers can develop the form of the components to execute the function of the system as defined by the requirements. The goal of this design activity is the documentation of the engineering specifications through the creation of computer aided design (CAD) data. The purpose of the engineering specifications are to provide the documentation required to produce the parts and assemblies required to fulfill the requirements of the product. The cornerstone of product realization processes are computer aided design (CAD), Bills of Materials (BOMs) and analysis and simulation data (Stark, 2011; Bosch-Mauchand, Belkadi, Bricogne, & Eynard, 2013). These documents are derived from many sources, and are synthesized to create the fully realized product definition.

It is important to realize that product definition encompasses not only the 3D and 2D CAD, but it also comprises secondary data such as certification reports, supplier specification documents, analysis and simulation reports and information such as emails between engineers and suppliers. The myriad of communications between company personnel both within the company and between the company and suppliers comprise components of the digital story of the part. The challenge of providing continuity to the digital thread of each component is one of the fundamental challenges and opportunities faced by manufacturers with respect to their PLM strategy (Stark, 2011).

One of the core business components of PLM includes product data management (PDM) concepts. The data vault exists as a central repository of information to which users have controlled access. Once a company centralizes the data, it must be controlled to prevent multiple people from attempting to edit documents simultaneously. Additionally, the data must be revision controlled. Centralized vaulting, single user and file revisioning, comprise the core components of a PDM strategy (Stark, 2011).

Process Management

A PLM implementation extends the fundamental capacity of PDM through building process management onto the PDM foundation of file management. After a company can revision control their files, it is desirable to automate the approval processes related to the engineering specifications. For example, typically several people review the CAD data with respect to various aspects such as manufacturability, quality and cost implications. These reviews and approval processes are manual approvals without a system to digitally capture the process. By transitioning to a digital system, the company is able to enforce a standard process for documentation control as well as capturing secondary information such as comments from the team of people who are implementing the parts.

Project Management

The value proposition of the PLM system can further be enhanced through the incorporation of project management methodologies. Because the development of CAD and the approvals related to this documentation are centralized within the PLM system, it can be leveraged to manage new product development projects. For example, a project manager can track the status of the approvals related to the CAD of new parts involved in their project. Through leveraging the PLM system to control secondary data such as test reports and production part approval process

(PPAP) reports, the project manager can gain insight into issues that may prevent their team from achieving the goals they need to accomplish. Through reporting, these insights can be brought forward earlier in the project timeline allowing the project manager to mitigate challenges before they negatively impact the project.

Defining Product Lifecycle Management or PLM

Geceveska, Stojanova and Jovanovski, (2013) define PLM as a comprehensive strategy to be combined with a technological infrastructure to enable innovation. The intent is to enable companies to recycle information across the business enterprise in a way that creates synergies amongst the functional departments. "PLM supports the capability of innovation, creation, management, share, and use of product data, information and knowledge in virtual enterprise networks by integrating people, processes, and technology (p.219)". Stark (2011) defines PLM as "…the activity of managing a company's products all the way across their lifecycle in the most effective way" (p.2). There are many generic definitions of PLM, but they distill into several core components as illustrated in Figure 1.

At the core of a PLM strategy are the people who are employed by the company. These individual stakeholders are the decision makers and the creators of the data that is being leveraged by the PLM system. The company culture determines how open the individuals within the company are to changing from managing the information via independent methods to a single PLM infrastructure (Stark, 2011; Martin, 2015). One of the problems many companies face is that of change management. For example, the actions of personnel in one department greatly impact the ability of others to accomplish their tasks. To achieve greater efficiencies within the company as a whole, the PLM ecosystem may require some individuals or departments to do more work. The receptiveness of this proposal to the discrete departments of the company can determine the success of failure of a PLM initiative. Once the people and the culture are compatible with a vision of a unifying PLM infrastructure, the company can implement a product data management (PDM) system to provide fundamental revision control to engineering and project related data (Stark, 2011). Engineering and business processes can then be defined to allow the company to be able to track the thread of data through the appropriate approval processes within the company (Bosch-Mauchand, Belkadi, Bricogne, & Eynard, 2013). Finally, the data can be consolidated and controlled within the context of the portfolio, programs and projects relevant to the company. The combination of these components provide software, configuration and the willingness to adopt PLM as a strategic methodology for innovation management within the company (Stark, 2011).

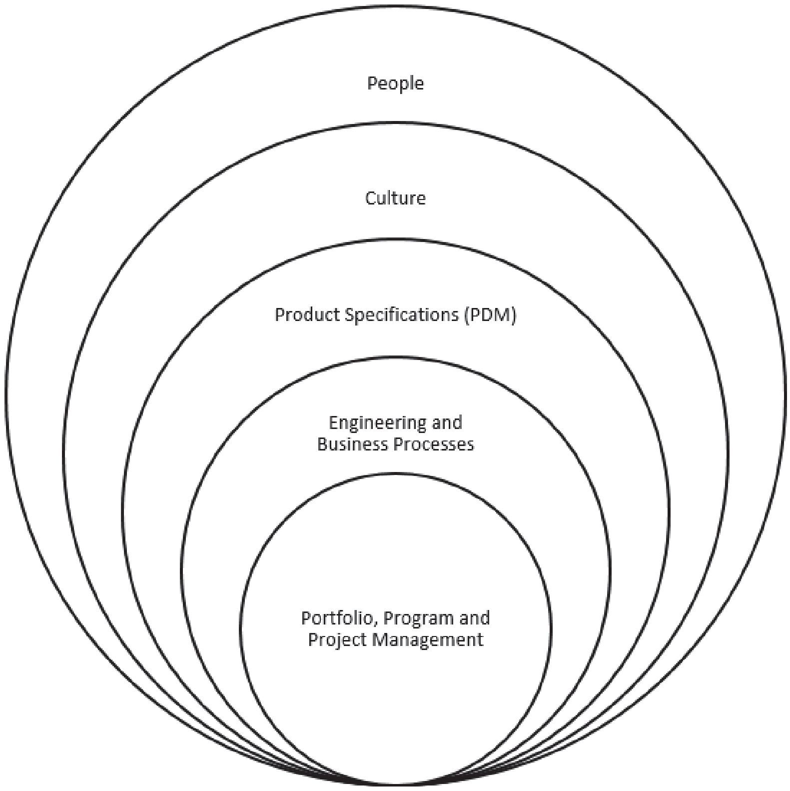

Figure 1. Components of Product Lifecycle Management (PLM) as they are related to each other.

Conclusions

Because PLM is typically a corporate initiative, it may not be feasible for an academic institution to be able to have access to a true PLM implementation. In many cases Information Technology, time, and cost constraints combine to prohibit an academic institution to implement a PLM system. However, while these constraints are significant, it is possible for an academic institution to replicate the core components that a PLM system automates, such as signoffs involved in engineering and business processes.

Academics should work to help students understand the concept of the digital thread of product design data as well as replicating the core concepts of PLM such as revision control, process management and collaboration between individuals. While historically PLM systems have been difficult to implement within an academic setting, the future holds the promise of academic access to PLM through cloud based offerings. Academics will become enabled to build competencies and authentic learning experiences related to collaborative engineering into the curriculum As PLM systems become available to institutions of higher education.

References

Bosch-Mauchand, M., Belkadi, F., Bricogne, M., & Eynard, B. (2013). Knowledge-based assessment of manufacturing process performance: integration of product lifecycle management and value-chain simulation approaches. *International Journal of Computer Integrated Manufacturing*, *26*(5), 453–473. http://doi.org/10.1080/0951192X.2012.731611

Gecevska, V., Stojanova, T., & Jovanovski, B. (2013). Product Lifecycle Management Tools. *Annals of Faculty Engineering Hunedoara*, *1*, 219–222. Retrieved from http://annals.fih.upt.ro/pdf-full/2013/ANNALS-2013-1-31.pdf

Martin, J. (2015). DATA, DATA EVERYWHERE. *Mechanical Engineering*, *137*(7), 46. Retrieved from http://search.proquest.com/openview/c18bcb8f491790c7b7a117e19380397d/1?pq-origsite=gscholar

Stark, J. (2011). Product Lifecycle Management - 21st Century Paradigm for Product Realisation. (Springer, Ed.) (2nd ed.). London Dordrecht Heidelberg New York. doi:10.1007/978-0-85729-546-0

Vezzetti, E., Violante, M. G., & Marcolin, F. (2014). A benchmarking framework for product lifecycle management (PLM) maturity models. *The International Journal of Advanced Manufacturing Technology*, *71*(5-8), 899–918. http://doi.org/10.1007/s00170-013-5529-1