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A Case Study: Maturity Assessment of Product Lifecycle Management (PLM) Implementation in Malaysia Automotive Components Manufacturing Company

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***Abstract*— Product Lifecycle Management (PLM) adoption is very important for companies to sustain and stay competitive in market particularly to the organizations that involving from design to manufacturing. However many companies struggle with implementing PLM because PLM is rather a concept than a system, as its main purpose is to increase product collaboration for effective product innovation with integrated streamline business processes across all functional departments to achieve operational excellence. In order to improve these challenges, maturity assessment for PLM is carried out prior to the actual implementation permitted to define the effective PLM strategic roadmap in according to the current environment condition. In this paper, case study and maturity assessment for local automotive components manufacturing company was conducted. The results are discussed in the theoretical and empirical aspects. The finding showed the importance and practicality of the PLM readiness to the companies. The assessment required to be comprehensive to cover the readiness of (1) data readiness, (2) process readiness and (3) people, culture and IT infrastructure. In general, the PLM maturity assessment is a useful and beneficial tool in the implementation and development of PLM framework.**

Keywords — Product lifecyle management (PLM), Maturity Assessment and PLM readiness.

I. INTRODUCTION

The initial setup of the local automotive components manufacturers are focusing in original equipment manufacturing (OEM) market and manufacturing the parts and components according to the customers' specifications. The launching of Proton in the early 1980's has catalyzed the requirement in design and development of the automotive components. Based on the independent market analysis report for Malaysia Automotive and Supplier industry in 2012, there are more than 704 automotive components and part manufacturers [1]. However, there are only about 45 vendors in the automotive component industry that has achieved the capabilities and competency to design and develop, source components and parts and manufacture the whole module/component both for the original equipment and replacement markets. Due to the competitive edge and globalization, local automotive components manufacturers have experienced competitive pressure and economic turmoil. The growing of manufacturing capability and lower cost of labors in China and other neighboring ASEAN countries has increased the intensely competitive retail pricing. Therefore, with the demands for faster innovation, higher quality and increased regulation, it becomes apparent that the winning automotive component suppliers will be those with the capability to do product innovation and rapidly come out with

module to win the new program launch by the OEM [2]. The local automotive components manufacturers realize that with the current condition it will be difficult for them to sustain in long run in this competitive environment. This has added pressure especially those who do not have product design know-how and design IP. It indeed is a big challenge for them to extend their business to overseas and go global. Therefore they are looking for transformation and capability to do product innovation. In responding to this pressure and driving towards the globalization, they acknowledge that they need a scalable platform to assist them in this transformation.

II. Literature Review

A. The needs of PLM and its key drivers

Due to the transformation, it has led to the needs for the local automotive components manufacturers exploring the Product Lifecycle Management (PLM) to assist them in achieving product innovation and operation excellence. PLM enables companies to manage information about their products from initial concept through to manufacturing and after-market service within a single source of truth. Moreover, PLM ties together all product-related processes, data and non-product documentation. All elements of product data (requirements, designs, development schedules, sourcing, etc.) are incorporated into the processes undertaken by sales, purchasing, design, engineering and manufacturing teams regardless where they work in a global value chain [2]. In summary, PLM offers an platform to connect people, data, solutions and ideas from within and outside the organization in a single visible and intuitive environment and ultimately shorten the product development time and faster time to market.

Innovation and new product development are essential for most companies to sustain future revenue growth [3]. Batenburg et. al reported, the important drivers of PLM are the need for shorter product lifecycles, urge for more complex products in terms of components and functionality, trends of globalization and outsourcing and consequently complex supply chains, the need for customization of products due to more demanding customers, and increasing regulations such as safety, environmental and product reliability regulations [4]. To ensure that PLM creates the most value and delivers the most significant return on investment, companies should move from a systems installation mind-set to a transformational program approach [5]. There are both internal and external drivers the requirements for PLM systems [2]. The internal reasons include the need to improve the efficiency of innovation process and to speed up the innovation as well as improve or enable network collaboration in achieving product innovation for components manufacturing company moving towards modular product design to own their design IP. Anneli et. el [6] reveal the external needs for increasing use of PLM systems are the trend of globalization and competition which often lead to distributed cooperative product development, in order to save costs or gain access to resources, competencies and markets. Nagarajan indicated that PLM expediting product innovation and PLM helps to manage the product innovation process in many ways [7]. It enables companies to directly map product requirements to features and to obtain control over product data. It also helps them to preserve their product knowledge assets, and allows companies to enter into the new paradigm of modular product development. PLM will accelerate the modular product development e.g. design one, configure many.

B. Challenges in implementing PLM

Many companies struggle with adopting and implementing PLM as reported by Wongnum et.al [8]. A major reason is that PLM affects a wide range of processes within and outside the company and it requires everyone's involvement in the collaboration. This makes PLM a complex organizational change effort as indicated by Sackett and Bryan [9]. The PLM strategy development process is not terribly complicated. The single largest barrier is the inherently cross-functional nature of a broadly scoped vision. Kenly mentioned PLM success factors indicated building alignment across multiple organizations involves communication, collaboration, cooperation and compromise [5]. Company may not able to come out with strategy and roadmap if they are unclear what is the current state and their PLM maturity level. This is part of the reason, prior to the PLM evaluation and implementation, it is important to understand the current state of the PLM readiness in the organization.

The PLM readiness of an organization can be accessed via data, process and people, culture and IT infrastructure. To prepare for the PLM implementation, it is challenging and important tasks for an organization to do data cleaning and consolidating, process standardization and aligning the industry best practices methodology. The famous PLM framework introduced by Batenberg, Helms and Versendaal is most commonly discussed in PLM industry [10]. They indicated the successful deployment of PLM should encounter two aspects as follows:

1) PLM maturity refers to the evolutionary and cumulative nature of the deployment process. The organization has to go through different stages of growth before PLM is implemented at all levels and connects all managerial aspects.

2) Business/IT alignment refers to the investment domains related to PLM should be balanced. For instance, the IT-part of PLM should be in line with the business domain and vice versa. In other words, PLM software functions can only be optimally leveraged if the organizational readiness for PLM is mature.

III. Research Methodology

A. Case study company

The company for case study, **CoMfg01** is a Malaysia locally based automotive component manufacturing company. Their products mainly supply to both OEM and replacement market. Their business activities involving product design, supplying customer design data for aftermarket, technical consultancy and regulation to meet customer compliances. Their product is very customer demanding and customizable to make according to customer specific requirements. CoMfg01 has been operating in Malaysia for decades and they have well established manufacturing plant in Malaysia and other ASEAN countries. Based on the interview with the key users, their key challenges are (1) they are having tremendous legacy data

which in the form of hardcopy. (2) The design know-how and manufacturing requirement will highly rely on an individual engineer. (3) They are still practicing in 2D data, although it is faster to deliver the data in 2D however it takes a longer time to make the drawing modifications when there is engineering change order. Due to 2D did not keep the relationship on the component properties, changes have to be done manually from one to another. (4) They would like to expand the business to overseas market and they need to have their own product design. The company is looking into PLM system to help them to overcome the above challenges. A strategic PLM road map is the key to achieve successful PLM implementation. In order to define a right strategic roadmap, PLM maturity assessment was carried out to assist them to identify the key driving factors and gaps needed to fill up before the implementation.

B. PLM maturity assessment

In this paper, we are evaluating the PLM readiness in 3 main aspects that are most commonly discussed by researchers [4,6,11]. There are (1) data readiness, (2) process readiness and (3) people, culture and infrastructure readiness. The research was carried out using qualitative and quantitative methods. The data captured was segmented and categorized into 3 main aspects mentioned above. The scoring method is described in table 1 as per below.

TABLE I. PLM ASSESSMENT SCORING METHOD

Scoring	Description
1	Not Ready. Less than 20% of data, process, infra are found available. People acceptance are low and reluctant. Change culture is not ready with no visible management vision.
2	Not Ready. 20% to 40% of data, process, infra are found available. People acceptance are low and reluctant. Change culture is not ready with no visible management vision.
3	Ready and need preparation. 40% to 60% of data, process, infra are found available. People acceptance need encouragement. Change culture need to cultivate to align with the management vision.
4	Ready and need preparation. More than 60% of data, process, infra are found available. People acceptance need encouragement. Change culture need to cultivate to align with the management vision.
5	Very Ready. More than 80% of data, process, infra are ready and available . People acceptance are high and committed. Right culture has embedded with management clear vision and supporting.

IV. RESULTS AND DATA ANALYSIS

The details of the results for PLM maturity assessment are indicated in the followings:-

A. Data Readiness

Since CoMfg01 is still working in a 2D design driven environment. The result showed CoMfg01 has low rating in Product Data Management (PDM), Bill of Material (BOM) management in term of Engineering BOM (EBOM) to Manufacturing (MBOM) and configuration management is mainly due to the fact of their design data is still in 2D format. 2D files do not provide the connectivity of design properties and product relationship. With the limitation in 2D design, they cannot build the master library and consequently to derive their product variant and configuration from the library. There are lot of manual work and time consuming in updating the document when changes are made. Document traceability become harder since the 2D data do not allow synchronization from one to another.

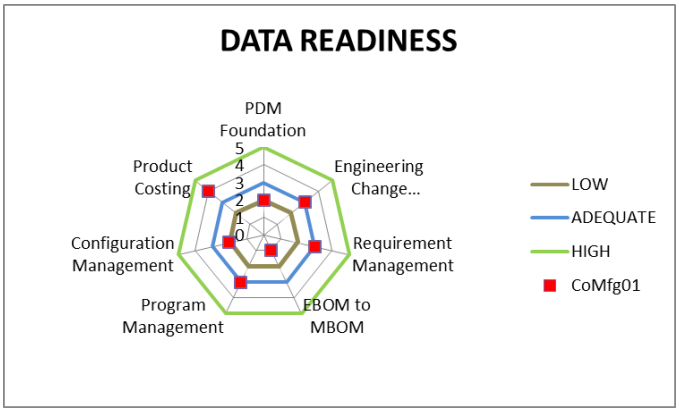

Fig. 1. Data readiness

B. Process readiness

CoMfg01 scored low in engineering bill of materials (EBOM) and manufacturing bill of materials (MBOM) management because they are still working in manual way in creating EBOM due to their current design environment in 2D. In term of new part creation process and product configuration process the rating is low because they do not have the visibility in reviewing and tracking the past project and data.

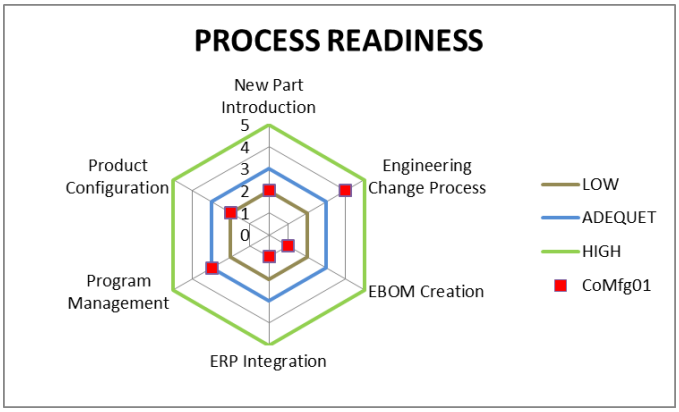

Fig. 2. Process readiness

C. People, Culture & IT Infrastructure Readiness

CoMfg01 scores high in company vision because the top management sees the needs and value the adoption of PLM. The top management drives the PLM initiative and putting budget allocation for it. They already have good IT infrastructure in place. However, PLM is literally new to the user and their understanding and acceptance are still low. They may need to develop more resources and impart knowledge to them prior to successfully adopting PLM to support their transformation.

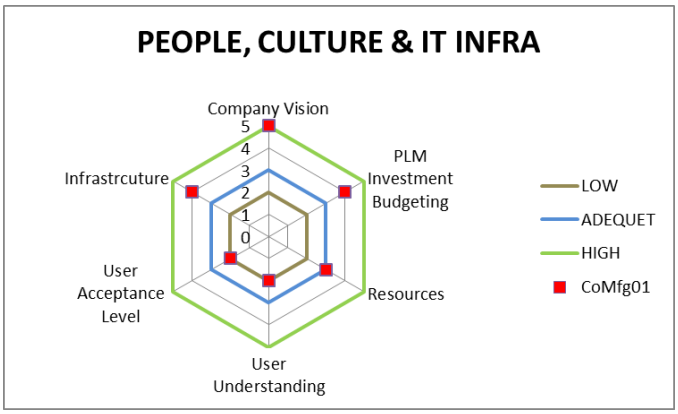

Fig. 3. People, culture & IT infrastructure readiness

V. DISCUSSION

The outcome of this research gives an overview of the current state of the PLM readines in the case study company prior to the PLM implementation. PLM implmentation consist of wide range of scope to be covered to address the needs across the functional departments througout the enterprise. The results have indicated each of the modules are inter-connected in order to measure the readiness of PLM maturity. It is important to identify through accessing the data readiness, process readiness and the people, culture and infrastructure readiness. The PLM assessment can serve as a guideline to the case study company to identify the gaps and then define the right strategy before the actual PLM implementation.

In this paper, the PLM implemetation methodology such as part classification, part numbering, BOM management, CAD maangement, engineering change proces and workflow control are not covered. There is room for further research work to be carreid out and discussed. This can be done by benchmarking to the industry best practices in the similar category.

VI. CONCLUSION

Manufacturer who requires doing product innovation realizing moving towards to have a PLM system in place is mandatory. This paper showed the areas to be covered in the PLM maturity assessment prior to PLM adoption. A right PLM strategy plan can be defined after understanding of data readiness, process readiness and people, culture and infrastructure readiness. Based on the outcome of the PLM maturity assessment, it is suggested that CoMfg01 requires time to (1) convert the hardcopy of the legacy data to softcopy for PLM migration. (2) Start to upgrade from 2D design to 3D product and establish product-to-document relationship for better product data management. (3) Adopting PLM best practices for effective process and change control. (4) Conduct PLM training and workshop to promote PLM to raise the awareness among the employees. PLM maturity assessment can lead to defining the right implementation roadmap for the PLM adoption.

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