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A Review on Foundries Approaching Product Life Cycle Management

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Abstract – Original Equipment Manufacturers (OEMs) are immersed in an ocean of transformation since these industries are competing themselves with general challenges such as the invariable stress to innovate, virtual supply chain management, regulatory compliance and others. To contend in this challenging atmosphere these industries are using Product Lifecycle Management (PLM) solutions. Implementation of PLM has greatly enhanced the performance of OEMs to comply for globalization and enhance profitability. Although the suppliers to these OEMs like foundries are in threshold to get utilize to PLM solutions to remain in competitive world. Implementation of PLM has become inevitable for foundries to sustain and grow. This review article fundamentally portrays the benefits procured and improvements seen by some foundries after implementation of PLM, it also discuss about the chances of implementing the PLM in small scale and medium scale foundries.

Keywords—OEMs, PLM, Foundries, Implementation, Benefits, Sustain.

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I. INTRODUCTION

Product Lifecycle Management (PLM) is a business incorporated approach that, with the help of information and communication technology (ITC), realizes an integrated, collaborative and cooperative management of the product's information, along with the dissimilar phases of its lifecycle [1]. Figure 1 show Product Life Cycle phases.

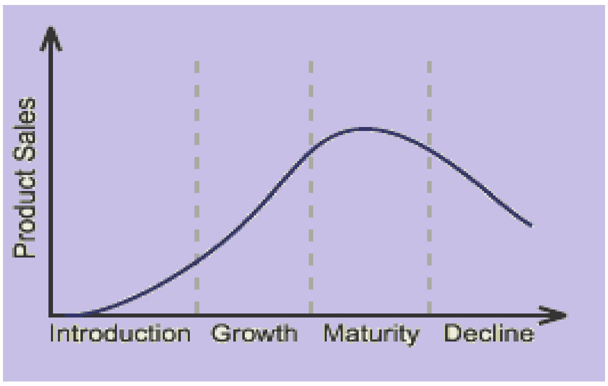

Fig. 1. Product life cycle phases

Looking at the PLM market, it can be divided into three different divisions: (i) Vendors of Authoring tools, (ii) of collaborative Product Definition management (cPDm) software and (iii) of Enterprise Applications. The first one includes vendors of software Computer Aided Design (e.g. PTC, UGS, Dassault, and Autodesk). The second includes vendors of cPDm software (e.g. IBMlDassault, UGS, Agile, Matrix One, and SofTech). The last segment contains vendors of Enterprise Applications, software suites that include Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Material Resource Planning (MRP), Supply Chain Management (SCM) and other (e.g. SAP, Oracle) [2] . Figure 2 show the business software incorporated with PLM.

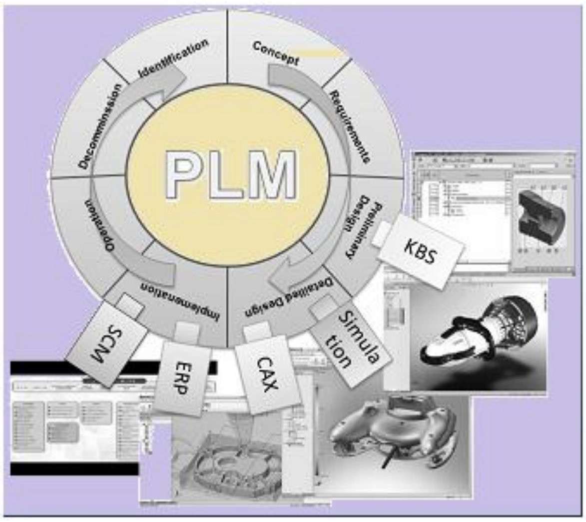

Fig. 2. Business software incorporated with PLM

However, even if collaborative software technologies are quite mature in their technological contents, their functions are still not so well known, accepted and used in the industrial segment.In Small and Medium scale(SMEs) foundries context, the production lines are not redefined with the creation of a new product. SMEs have to produce new products with the existing work centres, which is not thecae for the firms from automobile or aeronautical sectors where a new production line can be create for the creation of a new product. It is quite the same for technologies used and the organization that do not change with the arrival of a new product. The services are not taken into account by mechanical SMEs, maybe because they are not yet in charge of the maintenance and end of life of their product or because they have to manage the definition of their product before manage their maintenance or their end of life [3].This paper reviews at the implementation of PLM in foundries and lists the merits of implementation and finds the gap for implementation of PLM in small and medium scale foundries for improvement [4].

II. IMPLEMENTATION OF PLM IN FOUNDRIES

A. Case 1

A foundry involved in production of aluminum gravity die castings. Its castings are used in automobiles and consumer products, instrumentation, and electrical and pneumatic tools. The company also has a rubber moulding division. The products include bellows, gaskets, oil seals and anti-vibration pads, to name a few. With a high volume of tools being developed each year [5]. The foundry originally outsourced its design work. There were a number of drawbacks to this, including a lack of data security (caused by sharing proprietary information with third parties), the inability to design a part and tooling concurrently and design errors that disrupted the manufacturing process. In addition, the company had no way to simulate manufacturing operations. Mistakes were discovered on the shop With the goal of bringing design work back in house, and ultimately improving design accuracy and productivity, foundry began its evaluation of computer-aided design/ computer-aided manufacturing (CAD/CAM) solutions, honing its final assessment to a combination Solid Edge® software and CAM Express software that is implementation of Product life cycle management system. The evaluation team found the functionality of Solid Edge with CAM Express to be better in a number of ways. “Only Solid Edge has synchronous technology, which allows designers to swiftly check over existing geometry, for faster design changes In addition, Solid Edge offers outstanding drafting capabilities, as well as seamless interoperability between CAD and CAM.” With those advantages, along with the availability of training, the foundry was confident in its choice of Solid Edge. After the implementation the foundry possesses ability to envisage the designs which has enhanced greatly [6] [7]. Product drawings received from customers are converted into 3D geometry in Solid Edge. The Solid Edge models are used for process planning and cost estimation. In addition, Solid Edge component geometry is used for tool design in CAM Express, which helps in completing the design-to-manufacturing cycle seamlessly. . Figure 3 show the solid model of the die used for casting. Therefore it had reduced errors in manufacturing Product development turnaround has significantly improved as well. Using Solid Edge and CAM Express, we have reduced our design cycle by 30 percent, with the greater accuracy provided by modelling in 3D, as well as the direct use of the CAD geometry in the CAM program, fewer errors are found on the shop floor. Specifically, due to the accuracy of Solid Edge drawings, foundry reduced scrap and rework by 10 percent.

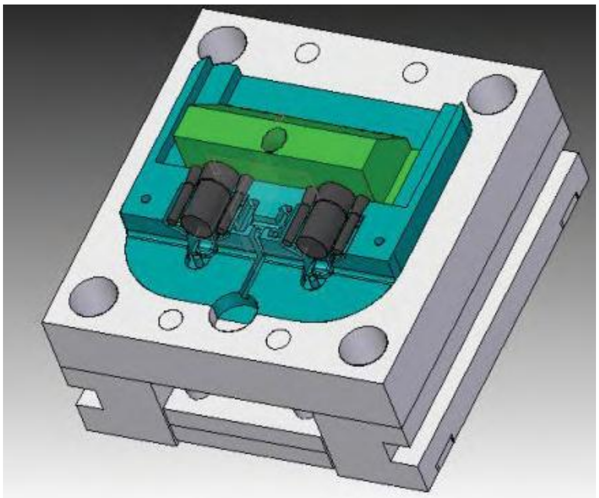

Fig. 3. Solid model of Die

Overall, the implementation of PLM has given foundry the ability to respond more swiftly to its customers and a sooner time to- market.

B. Case 2

A foundry which manufactures impeller casting was chosen was considered. However, these demands were extremely erratic depending on the market circumstances. Hence, the foundry firm was in immense complexity to meet the resources in order achieve the client demands. Outsourcing the effort due to the shortage of workforce and machines was not a shrewd decision as per their organization [8]. Also, there were issues with scarcity of equipment since inventory control was not a vigorous exercise in the foundry. As a tactical decision, this foundry was interested to adopt PLM and check the benefit of using PLM tools. A few PLM approach implemented were (i) instant to market (ii) mechanization (iii) paramount process and (v) minimization of making cost. To march towards this preparation of activities, a few vigorous practices and digital manufacturing concepts were introduced to the foundry. Further, to recognize the immediate advantages, a qualitative evaluation was completed on various activities in foundry in which manufacturing of impeller casting was done with and without the intervention of PLM tools [24] [25]. The healthy practices introduced in the foundry include timely communication among users through commercial PLM tool, in-house computer aided design, structural analysis casting process simulation, interaction with the customer for the finalization of product and delivery schedule, evaluation of man-hours and its appraisal, online monitoring of resources and accounting. User logins were created in Teamcenter to carry out these tasks and to intermingle with users and customers. The model in STL format was then pre-processed using a program to adjust the size, location and orientation of the model within the Rapid Prototyping machine. Figure 4 show the pattern made from digital manufacturing.

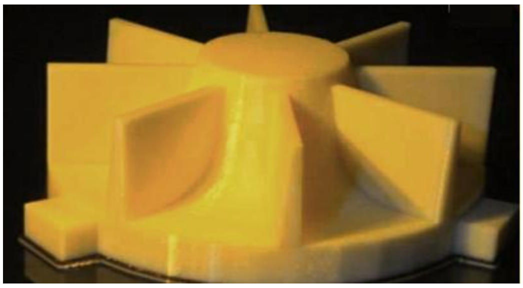

Fig. 4. Pattern made from Rapid prototyping.

Tool path generation, support material generation, assigning of material (made up of a polymer) building, were other pre-processing steps done in programming. The time taken to build the parts and the amount of building material and the support material required for the parts was obtained from software that was quick comparatively with older method and the pattern was possess high quality of finish. From this pattern the foundry saw a greater enhancement in the quality of casting and timely delivery was possible to client by implementing PLM.

C. Case 3

High-volume zinc die casting manufacturer has automated part of its plant by installing an ABB IRB 140 Foundry Plus 6-axis robot to tend a real-time control zinc die casting machine. The operators were facing a harsh environment and their health was spoiled. The company thought of the PLM. Automation is a part of PLM. Figure 5 shows the Robot used in the foundry.

Fig. 5. Robot used in Zinc foundry.

The installation of robot was carried out by robot integration expert. The foundry found that robot cycle is short and relatively simple, with little scope for adding extra downstream tasks. The IRB 140 Foundry Plus robot picks up the casting assembly from the die casting machine using specially designed pneumatic grippers, and transfers it to a part-separation station. A pneumatic press then separates individual castings from the runner, and the robot directs the runner to a chute for reprocessing, before returning to the starting position for the next cycle [9] [10]. The Foundry investment on Robot can be completely justified, with the automated cell increasing manufacturing efficiency and reducing costs. Benefits include: total reliability in a harsh environment; release of skilled manpower; maximized space; improved quality and accuracy of castings; and a complete “closed loop” for zinc. The efficiency of foundry operation is achieved by eliminating variables, wherever possible The Company is a relatively small foundry therefore it was imperative to be highly competitive and also be highly efficient. Therefore the foundry installed a Robot for its operations which resulted in a most significant effect [11]. It was very compact and highly efficient; scrap is reprocessed immediately – rather than allowed to build up in bulky skips – and an arduous, boring and labour-intensive task has been fully automated, allowing staff to use their skills on much more challenging and fulfilling operations [12].

D. Case 4

A PLM cloud-based platform is a next-generation alternative to traditional product lifecycle management that makes the benefits of PLM accessible anytime, anywhere, to companies of all sizes was implemented in foundry. A cloud-based software-as-a-service transforms PLM offered an affordable, easy-to-use, and simple-to-deploy solution that makes the benefits of PLM business applications available to anyone, anytime, anywhere for foundry men [13].The software has streamlined the creation, information, people, and processes to help to become more competitive and grow the business with significantly less cost and risk [14] [15]. The benefits that foundry obtained by cloud based software were as follows

- Greater visibility to critical information
- More efficient business processes
- Improved supplier collaboration
- Faster time to market
- Improved compliance to standards

Successful companies focus on core competencies to produce truly valuable products and services, but even the best continue to suffer unique challenges. This software helped foundry to overcome obstacles and remove bottlenecks that lead to inefficient operations. It offered the same, simplified experience whether on a desktop in office or on a mobile device while on the go. Person was able to maintain the same capabilities on a mobile device tool [16] [17] [18]. With this software, PLM extends capabilities to mobile devices that enable professionals to readily collect and share project information and conveniently engage in rich and informative interaction with clients. Continuing the 'no programming' approach, it enabled them to modify PLM elements such as item details, process workflows. To automate programmable, multi-step tasks that are unique and critical to an organization, the use of it includes browser-based scripting and a debugging engine that accepts standard, open-sourced JavaScript. In addition, a full set of application programming interfaces (APIs) was available to assist with integrations to other systems or with advanced handling of information. Activities managed within software encompass the entire product lifecycle, so it's natural to share the data stored in PLM with other enterprise systems used in an organization. Autodesk PLM 360 (a PLM software) Connect technology that enables migration, integration, and consolidation of information. Migration capabilities support one-time movement of data into or out of Autodesk PLM 360. Integration capabilities make synchronous data sharing possible for processes that run in Autodesk PLM 360 and other systems. Consolidation capabilities gather data originating in other systems so it appears as though it's stored directly in Autodesk PLM 360 [19] [20] [21]. Built in integration templates of software gave the clients a start on integration among popular Customer Relationship Management and Enterprise Resource Planning systems. As in the configuration process, a full set of application programming interfaces (APIs) is made available to assist with more advanced integrations. The efficiency and economies of scale underlying cloud technology made possible to offer Autodesk PLM 360 at roughly 1/10th the cost of traditional PLM systems, while achieving substantially the same benefits. Customers subscribe to individual seats of Autodesk PLM 360 on an annual basis, making it easy to forecast and adjust usage and expenses. Autodesk PLM 360 offered seats for both Participant and Professional users. Professionals used and created an unlimited number of PLM applications, including: Program and Project Management, New Product Introduction, Change Management, Item Masters and Bills of Material, Quality Processes, Supplier Management, Request for Quote, and other applications tailored by clients themselves to meet their specific business needs. Participants were are able to read and review data and documents, run reports to better understand the context of information, and perform workflow activities or make comments on submitted work as part of the approval process[22] [23].

III. RESULTS AND DISCUSSIONS

An foundry with PLM application can expect benefits such as, deal with increasing product complexity and customisation innovate more quickly, improve quality and lower costs provide better service to customers work in virtual teams and provide 24x7 global support exploit intellectual assets more effectively insulate itself against the effects of frequent structural changes ranging from full mergers to temporary partnerships The business benefits of PLM are clear, but many companies struggle to implement PLM and to achieve the highest possible return on their investment. Projects are often held back by: a failure to create an enterprise wide product data blueprint which provides a focus to draw the various elements of PLM together too much focus on providing tools to create data rather than access data which is all the majority of users need to benefit from PLM overemphasis on standardisation and the search for a single solution, which leaves no-one satisfied and is inflexible in the face of mergers or trends such as co-development with suppliers. An enterprise-wide PLM solution can help foundries respond to a range of challenges which are placing increasing strain on their capacity to meet customers' needs. PLM can help deal with increasing product complexity and customisation, by managing core product architectures and giving easy access to standard designs, and by providing strong support for configuration management. PLM can help handle pressure within the supply chain to innovate more quickly, improve quality and lower costs, by: allowing re-use of existing designs and encouraging excellence in design procedures to ensure products are designed "first time right"; supporting more effective collaboration between different parts of the business, allowing better planning in supply chain or permitting design, manufacturing or support functions to be relocated or outsourced without affecting performance; enabling strategic sourcing and opportunities to gain economies of scale through consolidation; and removing dead time in processes such as costing products or conducting engineering reviews. PLM can help foundries respond to demands from customers for better service, by making all product data and supporting documentation available electronically for manufacturing and order fulfilment as well as to customers. PLM also allows foundries to react more quickly to sales enquiries and work in a more collaborative fashion with customers to develop custom products. PLM can address the challenges of globalisation such as the move to virtual teams and increasing demand for 24x7 supports through the use of online collaboration tools and workflow to control processes and by providing simple web based access for local support teams or even customers themselves - into global knowledge bases. PLM can foundries to exploit intellectual assets more effectively, by making it easy to re-use previous designs, helping you to avoid "re-inventing the wheel" and making it easier to provide product line extensions. PLM can help insulate foundries against the effects of frequent structural changes ranging from mergers, acquisitions and divestments through to temporary partnerships and collaboration with contract manufacturers and suppliers by allowing you to share critical information in a controlled and secure fashion and by giving you the tools to work effectively in virtual teams. Industry-wide figures suggest that companies employing PLM can expect to see revenues grow by 5% to10%, while net profits can increase anywhere between 10% and 100 per cent.

IV. CONCLUSION

After comprehensive study PLM implementation one can understand the benefits easily. From this review it can be concluded that there is much need implementation for foundries of small and medium scale especially in the domain of design, manufacture and in managing the product data for improvement and survival in globalization Foundries being doubtful can say that the high investment cost, scarcity of trained labours, fixing time, inadequate training and support, unwillingness towards involvement and the monetary risks involved are a few grounds that makes not agree to the PLM . Nevertheless, it is suggested that the foundries which worth products, especially those fit in to Original Equipment Manufacturers, should employ PLM, so that they can build up new and novel goods in a very short time by meeting the demands from clients and hence harvest immense merits over globalization.

REFERENCES

G. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, 1955.

Ming X.G, Yan J.Q, Wang X.H, Li S.N, Lu W. F, Peng Q.J and Ma Y. S "Collaborative process planning and manufacturing in product lifecycle management, Computers in Industry," vol. 59, pp. 154-166, 2008.

Julien Le Duigou, Alain Bernard, Nicolas Perry and Jean-Charles Delplace "Application of PLM processes to respond to mechanical SMEs needs "Journal of PLM, pp 21-30, April 2010.

CIM data Inc, Product Lifecycle Management "Empowering the future of business," 2003.

Kermanpur, Sh. Mahmoudi, and A. Hajipour, "Numerical Simulation of Metal Flow and Solidification in the Multi-Cavity Casting Moulds of Automotive Components" Journal of materials processing technology, vol. 206, pp. 62–68, 2008.

Stark, J. Product Lifecycle Management: Paradigm for 21st century Product Realisation, Springer Ed, 2004.

Julien Le Duigou, , Alain Bernard, Nicolas Perry and Jean- Charles Delplace, A Constraints Driven Product Lifecycle Management Framework, Proceedings of the 19th CIRP design conference-competitive design, Cranfield University, pp.109–114, March 2009.

R.Patil, S. Mohan Kumar and E. Abhilash "Tools and Strategies for Product Life Cycle Management – A Case Study in Foundry" International Journal of Advancements in Research & Technology, vol.1, Issue3, August 2012.

D.Dutta, "Sustaining product innovation through PLM" International Seminar on Product Lifecycle Management, 2005.

Le Duigou, J., Bernard, A., Perry, and Delplace, J.C., "Inductive approach for the specification of a generic PLM system in an extended enterprise context", 5th international conference on Digital Enterprise Technology, October 2008.

T. Seino, Y. Ikeda, M. Kinoshita, T. Suzuki and K. Atsumi, "The impact of digital manufacturing on technology management," Proc. Portland International Conference on Management of Engineering and Technology, vol. 1, pp. 31–32, 2001.

John Stark, Product Life Cycle Management; 21st Centaury Paradigm for Product Realization, Springer Verlag, London, 2005.

H. R. Siller, A. Estruch, C. Vila, J. V. Abellan and F. Romero, "Modelling workflow activities for collaborative process planning with product life cycle management tools," Journal of

Intelligent Manufacturing , vol. 19, pp. 689–700, 2008.

Agnieszka Radziwona, Arne Bilberga, Marcel Bogersa, and Erik SkovMadsenb "The Smart Factory: Exploring Adaptive and Flexible Manufacturing Solutions," 24th DAAAM International Symposium on Intelligent Manufacturing and Automation, 2013.

T. Hata, "Modeling the Effects of Maintenance on Product Life Cycle Management", Proc. Fourth International Symposium on Environmentally Conscious Design and Inverse Manufacturing, pp. 726–729, December 2005.

Shuhua Yue, Guoxiang Wang, Fei Yin, Yixin Wang and Jiang bo Yang, "Modelling of Investment Casting Process" Journal of Materials Processing Technology, vol. 135, pp. 291–300, 2003.

Madjid Fathi, Alexander Holland, Michael Abramovici and Manuel Neubach, "Advanced Condition Monitoring Services in Product Life-cycle Management," Proc. IEEE International Conference on Information Reuse and Integration, pp. 245–250, August 2007.

X.G. Ming, J.Q. Yan, X.H. Wang, S.N. Li, W.F. Lu, Q.J. Peng and Y.S.Ma, "Collaborative process planning and manufacturing in product lifecycle management," Computers in Industry, vol. 59, pp. 154–166, 2008.

H. R. Siller, A. Estruch, C. Vila, J. V. Abellan and F. Romero, "Modeling workflow activities for collaborative process planning with product lifecycle management tools," Journal of Intelligent Manufacturing , vol. 19, pp. 689–700, 2008.

S.G. Lee, Y.S.Maa, G.L.Thimm, and J. Verstraeten, "Product lifecycle management in aviation maintenance, repair and overhaul," Computers in Industry, vol. 59, pp. 296–303, 2008.

El Kediri, S., Parnell, P., Delatorre, and Boras, "A Current situation of PLM systems in SME/SMI: Survey's results and analysis." Proceedings of 6th International Conference on Product Lifecycle Management.2009.

Madrid Fathi, Alexander Holland, Michael Abramovici and Manuel Neubach, "Advanced Condition Monitoring Services in Product Life cycle Management," Proc. IEEE International Conference on Information Reuse and Integration, pp. 245–250, August 2007.

T. R. Vijayaram, S. Sulaiman, A.M.S. Hamouda, and M.H.M. Ahmad, "Numerical Simulation of Casting Solidification in Permanent Metallic Moulds" Journal of Materials Processing Technology, vol.178, pp. 29–33, 2006.

J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp. 68–73.

M. Young, the Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

Michael Grieves, Product life Cycle Management, Tata McGraw-Hill, New Delhi, 2006.

Veronica Serrano and Thomas Fischer, "Collaborative innovation in ubiquitous systems," Journal of Intelligent Manufacturing, vol. 18, pp. 599–615, 2007.

S.G. Lee, Y.S.Maa, G.L. Thimm, and J. Verstraeten, "Product lifecycle management in aviation maintenance, repair and overhaul," Computers in Industry, vol. 59, pp. 296–303, 2008.

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