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Dear Sukumar Subahan,

We have received your final edits confirmed by you and also received author agreement you faxed to us. Now we are glad to let you know that, the article is accepted for publication. You have done excellent analysis various PLM challenges. The article will be published in July 2006 edition of Technology Evaluation journal in "PLM" subsection. Also parallely, it will be run on Wednesday, July 5, and Thursday, July 6 in our website. You can always access your article from web in the following url.

http://www.technologyevaluationcenters.com/Research/ResearchHighlights/PLM/2006/07/research_notes/MI_PL_XSS_07_06_06_1.asp

As per your request please find the off prints of your article attached.

Article author offprint - **TEC** Sub Section : **PLM**
Docket No:**MI_PL_XSS_XGS_XBS_05_09_06_ed[1][2]**



Yours sincerely,

David Clark



An Overview of Product Lifecycle Management Implementation Challenges

by Mr. Sukumar Subahan Tondaladinne, Dr. Shobhalatha Gurram, and Dr. Satyanarayana Bachala

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Abstract: Product lifecycle management (PLM) implementation brings its own set of challenges, whether considering vendor selection, employee perception management, or actual implementation. However, based on experience and study, it is possible to describe the best practices for overcoming these challenges.

Keywords: product lifecycle management, PLM, PLM implementation, vision document, employee support, software evaluation, implementation management, process mapping, legacy systems, legacy data migration, software implementation methodology

1 Introduction

According to CIMdata (www.cimdata.com/PLM/plm.html), *product lifecycle management* (PLM) can be defined as “a strategic business approach that applies a consistent set of business solutions in support of the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise from concept to end of life—integrating people, processes, business systems, and information.”

Part One of the series *An Overview of Product Lifecycle Management Implementation Challenges*.

Wikipedia defines PLM as follows:

“Product Lifecycle Management describes the process of managing the entire lifecycle of a product from the concept and design phase, product analysis (finite element analysis) through production planning, visualization and marketing to the end of life of a product.”

Thus, we conclude that PLM systems support the management of a portfolio of products, processes, and services, from initial concept, through design, launch, production, and use, to final disposal.

1.1 The Need for PLM

As CIMdata’s president Ed Miller correctly emphasizes, “PLM supports innovation-oriented initiatives such as integrated product development, design collaboration, intellectual supply chain management, and global resource utilization.” PLM applications hold the promise of seamlessly flowing all of the information produced throughout all phases of a product’s life cycle to everyone in an organization, along with key suppliers and customers.

For example, an automotive company can reduce the time it takes to introduce new models in a number of ways. Product engineers can dramatically shorten the cycle of implementing and approving engineering changes across an extended and globally dispersed design chain (covering suppliers, customers, and senior manufacturing and senior design engineers) which can access all data through a web-based PLM system. Procurement divisions can work more effectively with suppliers to reuse parts. Thus, the product can be manufactured faster, paving the way for capturing the market earlier than the competition.

2. Implementation Challenges

When we move from one system to another system, it is to improve the process, and save money and time. However, it is imperative that we overcome certain challenges whenever we do this. We can broadly categorize the PLM implementation challenges as follows:

1. Preparation of the vision document
2. Gathering employee support for change
3. Software evaluation and selection
4. Implementation management
5. Mapping of current process to the features of the selected software system
6. Identifying customizations and prioritization

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7. Legacy data loading into the newly built PLM system
8. Technical training on PLM software for maintenance
9. Hands-on user training on usage of new system.
10. Kickoff of new PLM system

2.1 Preparation of the Vision Document

Any major change in the way an organization work needs to be guided with a vision. The *chief information officers* (CIOs) who drive the implementation of systems such as PLM should have a clear vision and roadmap of what is to be done, and what they want to achieve with it.

The CIO's initial role with PLM is that of change agent, through working with engineering to sell the business case to senior management. From there, they need to oversee a cross-functional PLM project team charged with mapping and defining common business processes. With the engineering and operations groups as co-sponsors, they need to launch a campaign to sell the benefits of PLM to the company's different constituencies. Once an agreement is reached, this needs to be documented, and it will drive the entire implementation.

Thus, the output at this stage is a PLM implementation vision document clearly describing the key milestones, implementation methodology, various phases, and checkpoints. Finally, it explains the benefits that are expected in the short and the long run. Apart from this, it should indicate when to expect *return on investment* (ROI).

2.2 Gathering Employee Support for Change

Once a vision document is made, it is clear that it has won over the senior management. But the success of any implementation lies completely with the people who actually use the system.

i) Psychological aversion to change

Any change in the existing system provokes a psychological reaction in the mind of many people: the system they have is good, so why change it? They scream, saying that they have been working with it since so many years; why do they need to change and learn something new? This resistance to change is unavoidable. But as technology grows, it is vital to change current processes, machines, and software to save time and money.

The human tendency by and large is to oppose change. This because of the fears and concerns of people regarding the new system's potential usefulness and impact on their day-to-day life.

ii) Overcoming aversion—managing people

It is crucial to sell the change, otherwise employee morale will be affected. The following ideas point to a few things that can be done to achieve this. The best way to do this is to organize team meetings on the need for change, and ask the employees to come up with solutions. This might involve organizing brainstorming sessions and discussions to explore the possibility of achieving benefits without investing in change. If it is not possible, employees themselves may feel the need for a new system. Any solution that evolves will surely benefit the organization. Then they will cooperate in evaluating current and new systems: they will be ready to change, and will be enthusiastic to learn how to improve their way of doing things.

Those who do have previous expertise in implementation of PLM systems can conduct sessions on how their daily routine work can be done efficiently, and can discuss how it can help them personally (as well as the whole organization). It should be clarified that there will not be any threat to job security; rather, improved performance of systems will provide a boost to management to introduce new products—and thus finally raise employment levels by streamlining current processes.

2.3 Software Evaluation and Selection

This is a competitive world, and there are hundreds of PLM software vendors. One needs to evaluate them in order to choose the right one for the organization. We took part in PLM implementations in the automotive, hi-tech, and food industries. We have gathered the inputs of these experiences, and upon studying the various means of software selection pertaining to PLM, we summarize the following process for vendor selection.



i) PLM system document preparation

An enterprise has to prepare a document on how they envision their PLM system: this is their company's "PLM system document."

First of all, let all the stakeholders of the proposed PLM system imagine (with the ideas that evolved in change management sessions, as described above) how they envision a system that would help them work efficiently. All inputs gathered here need to be documented.

Let us give a couple of examples. Some engineers might come up with the idea of accessing designs from home, an internet café, or even for that matter from another country. From this concept, we might get the idea of a PLM system being web-based. Some people might come up with the idea that PLM systems should provide an option to see what will be the cost if new components are added by removing old components, and vice versa. What this means is that the PLM system may need to provide a "what-if" kind of cost analysis. Thus, upon brainstorming, the most important features (agreed by majority) need to be gathered, and documented in the name of the PLM system document. This completes the document, and is an expert committee's baseline for evaluating various software vendors.

ii) Software evaluation

The software product evaluation methods suggested by Ireland's **Centre for Software Engineering** (<http://www.cse.dcu.ie>) can be efficiently used. They are based on international standards such as ISO/IEC 9126 and the proposed ISO/IEC 14598 (see <http://www.cse.dcu.ie/essiscope/sm4/14598-5.html>) for evaluating a software system. Our evaluation approach is based on this baseline, and is discussed below.

The industry practice is to form a committee or group of people who have good experience on using PLM software, functional experts in the area of implementation, technical experts, and experts from the respective design, manufacturing, production, and procurement departments.

Once a committee is formed, it needs to contact software vendors by all available means, such as inviting tenders, contacting vendors' marketing departments, and so on. This will ensure the attention of various vendors. Once this committee starts receiving responses, then it should share its vision and PLM system document with those vendors, and specify budgetary limits.

This reduces much of the pain in trying to make a short list among the many vendors who do not have what an enterprise is looking for: only those vendors with offerings matching the expectations (at least nearly) will approach. Finally, there will be limited set of vendors which can offer a solution as per needs.

Once there is a list of short-listed vendors, meetings with the vendor marketing departments should take place. However, an organization should not be satisfied with the typical demos. Instead, they need to insist on being shown the features in practical contexts, with at least small quantities of legacy data. At this stage, information regarding the integrations that vendor software supports needs to be obtained. This is to ensure that systems currently in use (like *enterprise resource planning* [ERP] or *computer-assisted design* [CAD] systems) can be integrated with the new PLM System.

PART II

Product Lifecycle Management Challenges: From Solution Evaluation to Kickoff

by Sukumar Subahan Tondaladinne, Dr. Shobhalatha Gurram, and Dr. Satyanarayana Bachala

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Abstract: In future, companies will be forced to release products practically every other day, due to fierce global competition, and the significance of product lifecycle management (PLM) implementation will thus increase. We provide some guidelines for a rigorous PLM implementation.

Keywords: product lifecycle management, PLM, PLM implementation, vision document, employee support, software evaluation, implementation management, process mapping, legacy systems, legacy data migration, software implementation methodology

1 Introduction

In the first part ([LINK TO Part One](#)) of this series, we explored some of the difficulties inherent in selecting a *product lifecycle management* (PLM) system, including the usual psychological resistance to change, as well as ways of managing and preparing for this change. One of the strongest weapons in the arsenal of change management turned out to be the PLM system document, which outlines the company's vision for the PLM system. We turn now to the specifics of the actual implementation, including software selection (via scorecarding), implementation management, and kickoff of the new system.

Part Two of the series *An Overview of Product Lifecycle Management Implementation Challenges*.

At the point where an enterprise has completed the list of PLM features it's looking for (in the form of a PLM system document), a scorecard can be prepared for prospective vendors. This can be managed by defining a weight for each of the features. Based on this (and the features supported by each vendor software), generate a scorecard. This will give a score-based view of each vendor's capability. This data can then be analyzed using bar graphs, pie charts, 2-D graphs, and so forth. Even a simple comparison of total scores in the form a score card table will also help to decide who is better. Table 1.1 shows a typical score card.

PLM Evaluation - Score Card						
Scoring (S) criteria 0- Not available 1- Available with heavy customization 2- Available with medium customization 3- Available with limited customization or configuration 4- Out of the box						
S. No.	Feature	Weight (W)	Vendor 1 (W*S)	Vendor 2 (W*S)	Vendor 3 (W*S)	Vendor 4 (W*S)
1	Web login via internet or intranet	10	40	40	40	30
2	Task delivery to user's inbox	8	16	0	0	32
3	Auto-escalation regarding critical tasks	7	21	14	28	21
4	Bi-directional sync with CAD tools and project management tools	8	24	32	8	16
5	Product Configurations User-based configuration (user can create configuration only for his view) Global configuration (to be shared across organization) with cost calculation	10	20	20	40	30
6	Creates multi-level and complex BOM easily. Imports BOM from Excel, csv, and text files along with calculation of total BOM cost at each level	8	24	16	32	16



7	Collaboration with vendors and suppliers: limited data access to assemblies concerned with joint ventures and suppliers	8	24	8	16	24
8	Easy report generation in Excel, PDF, and other formats	10	10	20	40	30
			179	150	204	199

Table 1.1

Before making a decision on buying software, a clear understanding is needed of the kind of infrastructure required to implement the PLM software. For example, how many server machines will be required? How many client machines? What should the LAN speed be? Is there any need to buy third-party software? All these issues have to be considered, and the budget estimate should include this infrastructure cost as well. Now, a final decision should be taken, keeping budget in mind.

The scorecard shows eight features an organization is looking for, and the scores of various vendors with respect to a predefined weight. Vendor 3 may be a better choice on the face of it. But on careful observation, we see that Vendor 4 provides consistent medium or less customization (or out-of-the-box) solution, whereas Vendor 3—even though they scored high—cannot satisfy feature 2. Additionally, some features need heavy to medium customization. Thus, we come to the conclusion that Vendor 4 is a better option.

However if cost comes into the picture, further refinements in the decision may be possible. As per this scorecard, Vendor 1 also offers a decent solution. Suppose that Vendor 4 offers the software at a cost of \$100,000 (USD), while Vendor 1 offers the software for \$60,000 (USD). The choice is fairly evident, even though Vendor 4 may offer a better product. Also, there is need to look at post-implementation and post-buy support, as some vendors show interest only until their solution is bought. To avoid this, do a reference check of the vendor's previous clients about their experience with this vendor's software.

Thus, by taking into consideration all the propositions above, it becomes easier to select a suitable vendor.

2 Implementation Management

Once a vendor is selected, the company should consider how to manage the entire implementation. The following gives some idea of how to manage this important issue.

i) Scope of work and establishing a steering committee

Sign a *scope of work* (SOW) document with the vendor which describes all the items that are to be covered during implementation of the PLM System. Provide the PLM system document, and all other information to the finalized vendor. Involve senior members of the organization in preparing the SOW document. Define the scope with mutual understanding.

Establish a steering committee with consultants from the vendor company and senior members of the organization (as well as with stakeholders of the new PLM system). Formulate strategy for implementation, and chalk out a milestone-driven plan. The SOW document needs to clearly indicate milestones which signify some remarkable achievement, and which will also stand as payment gates (meaning that payments to the vendor should be linked with these milestones). The steering committee should meet at regular intervals to resolve any issues, and its decisions should be final.

ii) Infrastructure and installations

Once the SOW is prepared, the implementation will be kicked off. The steering committee contains a certain set of people who will lead various teams which will fulfill certain responsibilities. The various functionalities are the infrastructure group, the implementation group, and the quality group.



The infrastructure group will team up with various sections of the enterprise to procure the required infrastructure (such as the server machine, client machine, and file servers), and to identify and procure resources which can work on the implementation internally. If need be, they initiate the recruitment with the responsible *human resources* (HR) department, and form various teams.

The implementation group will be led by senior functional and technical managers who will drive the implementation by arranging the training required for the resources identified by the infrastructure group. It will also form a project plan for implementation.

The quality group will contain a highly experienced quality head, with a team which is well-versed in ensuring the software quality of new systems. They will assist the development through timely testing and by implementing the industry-accepted procedures to deliver quality systems.

2.1 Mapping of Current Processes to Software Features

Once the new system is installed, the next step is to perform a gap analysis and prepare a mapping document.

i) Gap analysis and mapping document preparation

Any software will have good features. After all, that's what impressed in the first place and led to the decision to buy it. But keep in mind that it is impossible to get everything out of the box. There should be rigorous study to understand the new system, its benefits, and the implementation procedure.

Since a PLM system document is already available, there is clear description of what is expected of the new system and what the current process is. Map the solutions available in the new system to the requirements. There should be mapping against each feature, and explicitly stated when a feature is non-available. If a feature is available through a different process, this also need to explained. This will raise questions of whether this different process is best practice in the industry, and also of the organizational benefits should this new process be followed.

However, if a requirement is so important to the organization that it cannot be ignored, it should be explained why compromise is viable, and the effort required to implement the compromise needs to be assessed, if possible.

2.2 Identifying Customizations and Assigning Priority

Once the mapping document is prepared, it will pave the way for identifying what features are not available in the system, and it will also illustrate the level of complexity involved in meeting these requirements. This mapping document will be presented to the steering committee. This committee will discuss and arrive at the list of customizations, ranked by priority.

i) Identifying customizations

The steering committee will have the mapping document validated through the input of the respective teams. These teams should explain the necessity of requirements if they are not available, and the possibility of changing any process as per the design provided in the new PLM system, to avoid customization. It is always better to avoid customizing new systems too much because it leads to loopholes, and the cohesiveness of the system will be reduced. There can also be related problems when there is an upgrade, or if the vendor releases new versions with enhanced features. Thus, only the most required features lacking in the new PLM system will be identified for customization.

ii) Assigning priority

Careful evaluation will limit customization. However, before a decision is taken about customizing for some feature, its importance and criticality need to be evaluated. Some features, though important, may not be required immediately. An enterprise should identify the immediate requirements that might be show-stoppers for a new PLM system implementation. Those requirements which are less important can be implemented at a later stage. It is always better to give ranking to these customizations, and to assign an end date for implementation for each of these items.

2.3 Technical Training on PLM Software

Once the process of implementing the new software system is in place, it is always better to obtain technical training for the resources within the organization, to avoid over-reliance on the vendor. Usually, this will be part of the purchase agreement. This will improve the organization's capability to solve many small issues that might arise after implementation.

i) Selection of the team

The selection of the team is an important first step. One needs to see what kind of core software the vendor is using in the PLM system (such as Java, .Net, C++, and so on). Organizational resources experienced in that technology should be selected. This will ensure that learning happens faster. Once they start learning about the new system, they need to have some practical exposure, and should be involved in the customizations identified.

ii) Scheduling the training

It is always good to plan things well in advance. Once a team is identified, obtain the consent of each selected member, and then free the trainees from all other assignments in order to minimize distractions.

2.4 Milestone-based Development

As per the SOW, the development should be milestone-based. At the end of each milestone achievement, a summary report need to be submitted to give information regarding key issues that may have come up, along with solutions to them. It should also identify potential risks that might hamper the implementation, so that a mitigation plan can be prepared. This will give the steering committee enough time to find ways to mitigate the risk. At the end of each milestone, the feedback of all the resources related to that milestone needs to be obtained, and analysis has to be performed about the expected results and the degree to which they are satisfactory. If some milestone has not yielded the results it was supposed to deliver, it should be not "closed" until proper steps are taken to ensure that the output of each milestone implementation is satisfactory.

2.5 Final Implementation

Once all the milestones are reached, the system is fully developed. The following phases will have to be followed to obtain full-fledged implementation.

i) Testing and adherence to quality

The quality phase consists of thorough system testing, acceptance testing, and stress testing. As modern PLM systems are web-based and used by multiple clients, the guidelines available in our article "Guidelines for Performance Testing of Multi-client Systems" can be followed. These guidelines explain how to ensure that the performance of new systems will be satisfactory, and enable the final rollout to go without any major issues.

ii) User training

Once the system is found to meet quality standards, then the new PLM system can be considered ready to replace the old system. This is the stage when users need to be trained. Some real data for any one product can be used for training on the final PLM software system. As PLM systems guide all the processes of product development, from design to market, this kind of data will be useful for training various users in different departments. The training process should include audio-visual tools, and every user needs to stay focused, and train in a systematic and proper way.

At the end of each day, there should be a question-and-answer session, and all the users are encouraged to raise any questions that they do not understand. They need to be allowed to create data of their own, and to work on various modules which are related to their work. It is best to frame some kind of tests which will identify the level of user understanding about the new system. This will raise the confidence level of users.

iii) Legacy data migration

Once users are trained, the stage is reached for transferring the legacy data from the old system to the new. There needs to be a "no-improvement period" for the old system (a no-improvement period is the time

during which no new data creation or data modification is allowed). The data migration should use techniques like programming and simulation to facilitate smooth and fast data migration.

Once the data migration is complete, the new system is ready for launch.

iv) Kickoff

When all the data is available in the new PLM system and users are well-trained, the retirement of the old system can be announced, thus opening the new PLM system for users.

Initially, there might be erroneous entries or transactions, and there should be some sort of support available for undoing the transactions. Critical processes need to be carefully watched to see that erroneous entries do not cause any major damage.

Users who are performing well using the new systems need to be rewarded. The major benefits of the new PLM system need to be posted on an intranet or bulletin board in order to raise morale and motivate staff to use PLM system.

Conclusion

In this series we have identified various challenges that may come up during PLM implementation, and tried to provide possible ways of overcoming these challenges. We discussed how to motivate employees with respect to the new PLM system, how PLM software can be selected by making a PLM system document, how to use team meetings, brain-storming sessions, and the like, and how to use a scorecard for each vendor. Once the vendor is selected, the infrastructure and other initial procedures can be handled. We have discussed the preparation of a SOW, which clearly states the milestones for payment and provides a strategy of implementation.

During the implementation phase, we discussed various issues about how to map existing processes to the PLM software features, and how to arrive at a list of customizations and their prioritization. Then we discussed how a team can be selected, and the importance of training resources on the new PLM software. Further to this, we discussed how the data can be migrated from legacy systems to the new PLM system.

We do believe that this will help CIOs, design, manufacturing, and production engineers, and all those who play a crucial role in PLM system implementation.

In future, companies will be forced to release products practically every other day, due to fierce global competition, and the significance of PLM implementation will thus increase, along with demand. PLM implementation will need to be more rigorous, and methodologies such as *rapid application development* (RAD) and *extreme programming* (XP) might be followed to achieve this.

This concludes the series *An Overview of Product Lifecycle Management Implementation Challenges*.

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