PDM: THE ESSENTIAL TECHNOLOGY FOR CONCURRENT ENGINEERING

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Abstract
Concurrent engineering was heralded as the new panacea for manufacturing in the 1990s. Concurrent Engineering provides a systematic approach to integrated concurrent design of product and related processes including manufacturing and support. This approach intended to cause product developers to consider all element of the product lifecycle from conception through disposal including quality, cost, schedule and other requirements.

The complexity of implementing the process through an organization has proved to be a major obstacle in achieving anticipated results: implementing it is a painful process in which a complete top to bottom understanding of an organization’s processes is needed. There are few organizations which understand their own dynamics. For concurrent engineering to be successful, cross-functional design teams, along with their associated data, must be brought together.

PDM assists in implementing a concurrent engineering strategy successfully because a PDM system provides the mechanism to capture and enforce the specific product development process consistently according to the way in which a company does business. Global companies which have already invested in PDM technology include: Xerox, Texas Instruments, Groupe Schneider, Honeywell, and General Electric.

Keywords: CONCURRENT ENGINEERING, PDM, PDM FUNCTIONS, PDM BENEFITS

Introduction
According to CIMdata, through to the end of the decade, product data management (PDM) software will be one of the fastest-growing segments of the software marketplace. The market for PDM software and services presently exceeds $225 million per year. Given its current compounded annual growth rate of 40 percent, PDM will be a billion-dollar industry within five years.
Consider the statement: "A product is the sum of its life cycle processes, and not its manufactured parts" [1]. Then, "a PDM system is used within an enterprise to: organize, access, and control data related to its products, and to manage the life cycle as those products" [2].

If these statements are held to be true, then it becomes clear that concurrent engineering will only ever play a minor part in the success of an organization, unless it can relate to that organization as a whole.

"...From the business perspective throughout the 1980s and 1990s manufacturers in almost every market segment have faced an increasingly competitive, global marketplace..."

Every new product design sets in motion a torrent of tasks required for designing, manufacturing, marketing and servicing of a product. Manufacturing the physical parts of a product is only a small fraction of these life-cycle tasks.

Understanding the total complexity of these tasks and simplifying those which can give customers, and manufacturers, the greatest benefit can give a winning advantage, and will facilitate true concurrent engineering-enterprise-wide.

As already mentioned, the factors fueling the PDM marketplace are both business and technologically rooted. From the business perspective, throughout the 1980s and 1990s manufacturers in almost every market segment -- especially the automotive, aerospace, consumer products and electronics industries -- have faced an increasingly competitive, global marketplace that forces them to streamline and accelerate their product development operations. To remain competitive, these manufacturers must continue to shorten product development cycles while increasing product quality and decreasing overall product cost.

The computer industry responded to these business needs with a technological solution: low-cost, task-specific computer and software tools. These tools automated many of the individual processes involved in the design and manufacture of new products, allowing them to be executed with greater speed and precision.

The problems caused by the lack of understanding of an organization's own processes have been compounded by the popularity and widespread use of these tools. The unforeseen downside was an unmanageable proliferation of computer systems and the accompanying explosion of engineering data. This resulted in:

- Overwhelmingly complex computing environments for many manufacturers. Because of the plethora of incompatible data, integrating and maintaining applications become a formidable task.
- Users possessing either unlimited or very limited access to data anywhere in their network. Because data access and security measures remained largely an all-or-nothing proposition, manufacturers were forced to choose between two bad options: giving users access to incomplete or obsolete data, or keeping them from getting at the information they need to do their jobs productively.
- Users outpacing the speed at which their management could direct the engineering process. Because of the power of modern workstations and CAE/CAD/CAM applications, individual users can perform design tasks quickly in many cases, too quickly for project managers to post change notifications, project notes, or other information that would eliminate wasted or redundant efforts.

Thus, rather than helping companies step-up their product development cycle by facilitating
concurrent engineering, the proliferation of computers and software has actually created a new problem: keeping users in sync with each other in spite of the flood of online data.

**PDM boosts engineering productivity**

Studies have found that most engineers are able to spend only 20 percent of their time -- only one day per workweek, on average -- actually designing products. On the other hand, they spend nearly twice as much time, approximately 35 percent, looking for and verifying data regarding design revisions, performance calculations and drawings.

Over time, the failure to manage data effectively can have a devastating effect on a company's competitiveness, so it becomes crucial to minimize lost engineering productivity. If engineers are spending 80 percent of their time not developing new products, it follows logically that products are brought to market later than is possible. These products may not offer the full range of features, because of the time that would be required to develop and refine them. And they may cost more to produce, because the time required to explore alternative materials, packaging schemes and assembly processes would have resulted in additional delays.

' . . . PDM can be considered accurately as the critical component in helping manufacturers improve product quality and reliability, accelerate time-to-market, and reduce product development costs . . . ''

For concurrent engineering to be successful, cross-functional design teams, along with their associated data, must be brought together. The software should, however, be much more than a repository of information PDM assists in implementing a concurrent engineering strategy successfully because a PDM system provides the mechanism to capture and enforce the specific product development process consistently according to the way the individual company does business. A PDM system strives to overcome the problems which are typically associated with that philosophy, because it keeps information required for decision making current and accessible - PDM can be considered accurately as the critical component in helping manufacturers improve product quality and reliability, accelerate time-to-market, and reduce product development costs.

**Product Data Management :**

A product data management (PDM) system is a software framework that enables manufacturers to manage and control engineering information, specifically, data surrounding new product designs and engineering processes.

From the product perspective, it can help to organize design revisions, track versions of an evolving design concept, retrieve archived data and other product-specific information. From a process perspective, a PDM system can orchestrate procedural events such as design reviews, approvals, product releases and so on.

By organizing, tracking and controlling access to product information as it is created, a PDM system facilitates a team-oriented approach to product development, because it manages data as it is reviewed, modified, approved and archived. Because it helps to accelerate the process in which products are designed and approved, a PDM system can directly help to compress the time required to bring new products to market.

A PDM system works at every level and across all divisions within a company - even in facilities located around the globe. It integrates data from different types of hardware and software applications to enable members of a multi-person design team to locate and access project data quickly. It also permits project leaders to oversee data better throughout the entire design effort, to
ensure that team members are working on the most current version of the design, making only permissible modifications to the design, and not given access to designs that are outdated, unapproved, or "frozen" for review.

'... Users can easily define their own way of addressing data, configurations, audit trails, and computer interfaces through the centralized data repository...'

Throughout the design process, the PDM system stores product and associated design information related to drawings, mechanical solid models, PCB layouts, assembly instructions, product relationships and process plans in a relational database. A graphical user interface gives each person the ability to access and review the engineering information. Users can easily define their own way of addressing data, configurations, audit trails and computer interfaces through the centralized data repository.

A PDM system provides the project team or work group with a flexible data management tool for meeting the engineer's requirements for productivity and quality. At the same time, management of the entire design effort is improved by providing an advanced query capability for accessing data via common attributes and increasing data security.

By overseeing application-level tasks -- such as checking and tracking design revisions, authorizations, and drawings -- a PDM system provides procedural control over the design methodology by facilitating approvals and notifying team members of a project's status. As a result, it provides the improved internal coordination required to allow companies to implement concurrent engineering and compress the overall product development cycle.

### PDM Functions:
Initially, PDM System were developed to manage and control the volume of data created by CAD/CAM/CAE software. The type of information that is managed by such systems include: Spreadsheet, 2D drawing, solid models, documents, Bill of Material (BOM), images, design geometry, Project plans, parts files, NC machine tools programs, analysis results, correspondence and reports. They enabled fast information search and retrieval. In the next generation of PDM systems, translation and viewing tools were added, which enabled data communication between heterogeneous systems and relieved the user from recreating the data from scratch for each application. In the third phase, workflow management capabilities were included, which allowed product version management during its development process. Finally, PDM functionalities were extended beyond the engineering department that facilitated synchronization of product development activities and enabled concurrent product development. Such a system provides number of functions as mentioned below.

- **Product Structure Management**: Maintaining the part list, bill of material and part definition.
- **Document Management**: Storage and retrieval of files containing product information.
- **Communication Management**: Information transfer and event notification.
- **Data Transport**: Tracking data locations and moving data from one location or application to another.
- **Workflow and Process Management**: Specifies process definition or who approves what and when.
- **Part Management**: Provides information on standard components and facilitates re-use of design.
- **Release Management**: Provides security and control, establish data relationship.
**Program management** provides work breakdown structures and allows coordination between product-related processes, resource scheduling, and project tracking.

**Different Software’s Used In PDM System**

**Wind chill**

WIND CHILL is very much efficient software, which has combination of modeling software PROE and is based on language JAVA. This software is currently used in product Development Company such as PTC for managing the engineering data.

**Team centre**

TEAM CENTRE is PDM software. Here in TEAM CENTRE we can have combination of any modeling software and software language JAVA. This software is also been used in many of the product development company for management of engineering data.

**Enovia**

ENOVIA is PDM software used with modeling software CATIA and is based on language JAVA. This software is also used to manage the engineering data in design field. This software can also be used with WINDCHILL for exchange of data.

**BENEFITS OF PDM**

**Reduced Time-to-Market**

This is the major benefit of a PDM system. Three factors serve to place limits on the speed with which you can bring a product to market. One is the time it takes to perform tasks, such as engineering design, and tooling. Another is the time wasted between tasks, as when a released design sits in a production engineer’s tray waiting its turn to be dealt with. And the third is time lost in rework.

A PDM system can do much to reduce all these time limitations.

- It can speed up tasks by making data instantly available as it is needed.
- It supports concurrent task management.
- It allows authorized team members access to all relevant data, all the time, with the assurance that it is always the latest version.

**Improved Design Productivity**

Product Data Management systems, when driving the appropriate tools, can significantly increase the productivity of your engineers. With a PDM system providing them with the correct tools to access this data efficiently, the design process itself can be dramatically shortened.

Another factor is that designers should spend more time actually designing. Historically a design engineer would spend as much as 25-30% of his time simply handling information; looking for it, retrieving it, waiting for copies of drawings, archiving new data. PDM removes this dead time almost entirely. The designer no longer needs to know where to look for released designs or other data; it is all there on demand.

A third major time saver is the elimination of the 'reinvented wheel' syndrome. The amount of time designers spend solving problems that have probably been solved before, is notorious. It is often considered quicker to do it again than to track down design elements that could be re-used. With a PDM system, however, the identification, re-use and modification of existing similar designs should become routine.

**Improved Design and Manufacturing Accuracy**

An important benefit of PDM systems is that everyone involved in a project is operating on the same set of data which is always up to date. If you are working on a master file you know it is the only one; if you’re viewing a reference copy, you know it is a replica of the latest master. So overlapping or inconsistent
designs are eliminated - even when people are operating concurrently. Naturally this leads to far fewer instances of design problems that only emerge at manufacturing or QA, fewer ECOs, more right-the-first-time designs and, once again, a faster path to the marketplace.

**Better use of Creative Team Skills**
Designers are often conservative in their approach to problem solving for no other reason than the time penalties for exploring alternative solutions are so high. The risks of spending excessive time on a radically new design approach which may not work would be unacceptable. PDM opens up the creative process in three important ways.

- First, it keeps track of all the documents and test results relating to a given product change, minimizing design rework and potential design mistakes.
- Second, it reduces the risk of failure by sharing the risk with others and by making the data available to the right people fast.
- Third, it encourages team problem solving by allowing individuals to bounce ideas off each other using the packet-transfer facility, knowing that all of them are looking at the same problem.

**Comfortable to Use**
Although PDM systems vary widely in their levels of user-friendliness, most set out to operate within the existing organizational structure of a product engineering operation, without major disruption. The system should, in fact, make familiar tasks much more user-oriented than before. When users wish to view information on a PDM system, the application is loaded automatically, and then the document is loaded. In a conventional working environment, users would either have to be much more skilled at accessing the information or be prepared to accept it in a much less flexible form.

**Data Integrity Safeguarded**
The single central vault concept ensures that, while data is immediately accessible to those who need it, all master documents and records of historical change remain absolutely accurate and secure.

**Better Control of Projects**
The reason that product development projects are almost invariably late is not that they are badly planned in the first place, but that they routinely go out of control. Why? Because the immense volume of data generated by the project rapidly snowballs beyond the scope of traditional project management techniques. The greater the competitive time pressures, the greater the scope for inconsistency, and likelihood of rework. PDM systems enable you to retain control of the project by ensuring that the data on which it is based is firmly controlled.

Product structure, change management, configuration control and traceability are key benefits. Control can also be enhanced by automatic data release and electronic sign-off procedures. As a result, it is impossible for a scheduled task to be ignored, buried or forgotten.

**Better Management of Engineering Change**
A PDM system must allow you to create and maintain multiple revisions and versions of any design in the database. This means that iterations on a design can be created without the worry that previous versions will be lost or accidentally erased. Every version and revision has to be 'signed' and 'dated', removing any ambiguity about current designs and providing a complete audit trail of changes.
7. Investors’ experience

Companies such as Boeing, which has recently invested in the technology to the tune of $20 million, cite that “the software (PDM) will be a key element in our plan to develop a single source for access and control of our product data. The software ... will provide us with critical linkages between our engineering and manufacturing processes and help us to reduce our cycle time further”[3]. Other global companies which have invested in the same technology - Xerox, Texas Instruments, Groupe Schneider, Honeywell, and General Electric, are now using a PDM system as part of their product development efforts. They are achieving quantum leap improvements in the following areas:

- fewer engineering changes
- Reduced development time
- Better audit trails
- Improved communications between team members
- Faster customer response
- Reduced overheads.

Clearly, as with any major new technology, there are pitfalls which need to be avoided in the process of ensuring that your organization invests in the right PDM system. Mistakes are likely to prove costly, both in terms of confidence, and financially. In looking for a PDM system, ensure that you identify a supplier who has a track record of successful implementations, know your own requirements, and be prepared to make the necessary changes in structure. There is no easy solution to implementing PDM, what is apparent however, is that organizations which have implemented the technology are convinced that the effort required in the early stages pays dividends in the long term.

8. Conclusion :

Web based Collaborative engineering has come a long way since the days of product data management within an organization. Team-member can be located anywhere in the world and can not only view the product data but also review and modify the same. The technology has proven to have significant benefits in terms of improved features coupled with reduced development lead time and costs. Several software packages are available today, and many organization, including SME’s are implementing the technology. Hence PDM solution is very essential technology for success of Concurrent Engineering Process.

9. References


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