General Design Information Management System: PLEMIA

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PLEMIA is a tool that realizes a management solution concept for Fujitsu's product lifecycle management (PLM). A PLM solution is a general strategic solution to build a next-generation development design and fabrication environment from the planning stage of a product to its design, development, manufacturing spot, sale, support, disposal and recycling. PLEMIA collectively manages product-related information of the whole lifecycle of a product by using information and communications technology (ICT). It is a strong tool realizing a flexible manufacturing system which can adapt to changes in the market environment via support from the upstream areas of the design process. PLEMIA makes it possible to have design support from a product's concept phase via engineering data management, product configuration management via a bill of materials (BOM) system, and efficient process management. In addition, introducing PLEMIA brings the following merits: safe team design, a general BOM system, and visibility of the processes conducted by designers and managers, effective use of information assets through diversified search functions and document data that can be shared in the process flow. This paper describes PLEMIA's development policy and a plan to enhance it.

1. Introduction

The manufacturing industry of Japan needs measures to address the intensifying global competition, reduced product lifecycles, various regulations and resource/environmental issues. With such market environment in the background, enhancement of product development ability and cost competitiveness and prompt marketing of saleable products are an absolute must for enterprises. To solve these issues, business reform from upstream processes including research and development, design, production preparation and production engineering, to which information and communications technology (ICT) has not been much applied, is becoming essential. Product lifecycle management (PLM) was proposed more than 10 years ago and many enterprises attempted to introduce it, but it has not been very successful. As a result of surveys and interviews that Fujitsu conducted on enterprises that introduced PLM, the following problems were identified.[1)]

1) Incompatibility with reconciliation-based processes peculiar to Japan
2) Strong opposition from the shop floor hindering utilization of the system
3) Heaviness of the data preventing utilization
4) Inclination to return to familiar environment
5) Uncertainty in linkage with outside

The PLM solutions proposed by Fujitsu are based on the concepts of succession of virtues of Japanese manufacturing with the focus on the site of development, common understanding of the accumulated wisdom, provision of global standard-compliant products and services from the customer's viewpoint, and evolution of the

shop floor by integrating people, processes and ICT. Specifically, the following approaches are taken to solve the problems mentioned above.

1) Accommodation of reconciliation-based processes peculiar to Japan
2) Selection of human resources best suited for business reform and appropriate consulting for business improvement
3) Achievement of agile environment by evolution of computers and infrastructure
4) Provision of consulting and PLM utilization services at the time of introduction as support for migration to PLM environment
5) Use of manufacturing interface integration to provide the capability of conversion to the cooperator's environment while the company's own familiar environment is maintained

Based on the experience of solving these problems and troubles of customers, Fujitsu has developed PLEMIA, a general design information management system incorporating the solutions wanted by the shop floor and useful to management.

This paper descries PLEMIA's basic structure, operations it can realize, merits of its introduction, global application, support for cloud and an enhancement plan.

2. Basic structure

PLEMIA is a PLM system developed based on the concepts of the Fujitsu PLM solutions[2)] and has the basic structure shown below.

1) Engineering data management

Manages mechanical and electrical engineering data and offers the following services.

- Similar shape retrieval
- Drawing management
- Integrated management of 2D drawings and 3D models
- Multi-CAD support
- Access control, security management and exclusive control
- Assembly tree explosion and implosion
- Final data storage and history management
- Provision of functions including call and registration as CAD commands

2) Product configuration management by bill of materials (BOM)

Various types of product information such as CAD data, design process, documents, know-how, problem/complaint information and environmental information can be managed in an integrated manner. The BOM information is made use of to realize general management of product information including consideration and reliable change of the product specifications, understanding of the product costs, management of deliverables and ensuring of product configuration traceability. The features include:

- Package system allowing easy operation and maintenance
- Information management by respective purpose using the multi-view function
- Pursuit of ease of introduction and operation as a Web system
- Realization of system introduction suited to the customer's business requirements and business category (for mass production/ custom production)
- High-speed response at the top level of the industry
- Achievement of the function/operation environment with the focus on "user-friendliness" for the shop floor

3. Operations that can be realized

This section presents operations that can be delivered by the basic structure of PLEMIA.

1) Design support from the concept phase by engineering data management
- Support for team design including distributed environment

Realizes a design environment that allows the designer to constantly view the latest information about assembly and component data that may have an impact on the user. It also

clarifies the owner (with exclusive rights), which allows the design intent to be shared in the team.

- History management in the respective phases of design

Offers simplified history management for designers in line with the workflow. The same name can be used for history management over the process of maturation of design data and wasted person-hours can be eliminated.

- Various functions that achieve operation efficiency improvement and speed-up

Provides tools used by designers on a daily basis including advance verification of the CAD structures, detail search, usage search and simplified workflow function.

2) Realization of product configuration management by BOM

The following gives an outline of product configuration management (**Figure 1**).

- Centralization of components and structures by general BOM

Builds an environment that allows production structure and process information to be easily created based on the design structure information.

- Ease of utilization of information owned by respective sections

Allows information owned by respective sections to be freely used in design change request and design change implementation.

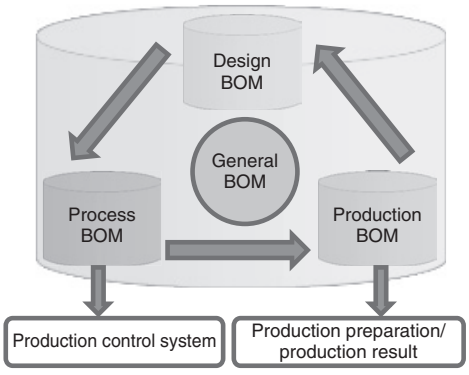

Figure 1
Realization of product configuration management by BOM.

- Strengthened traceability of component information

Improves the traceability of component information by associating between different component numbering systems of the respective sections as in design component numbers, production component numbers and process codes.

3) Improvement of production preparation efficiency by digital mock-up (DMU)

The purposes of improving production preparation efficiency include parallelization of design and production preparation and improvement of the design quality by collaboration.

4) Realization of environmentally-conscious design

Reduces person-hours by automated report creation and makes it possible to identify the content and extent of the impact of substances.

5) Improvement of process management efficiency

Figure 2 shows an overview of process management. The following outlines project management.

- Improvement of project management efficiency

Share and reuse project-related information.

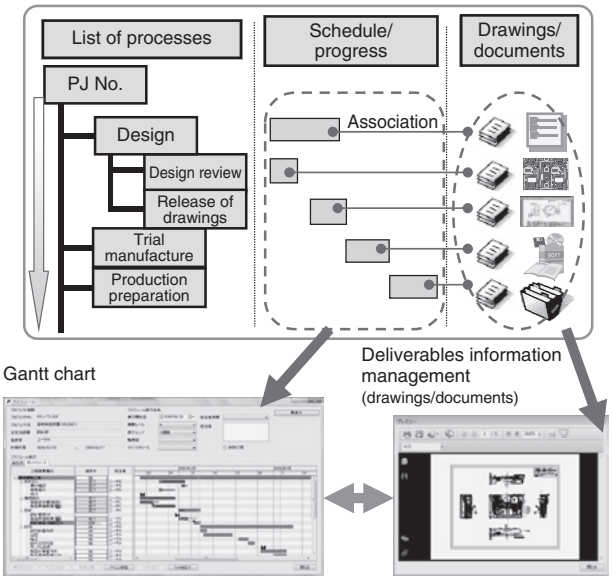

Figure 2
Improvement of process management efficiency.

- Clarification of action items

Give detailed operation navigation and assistance with information communication.

- Support for the growing process

Accumulate and utilize knowledge with the focus on process.

4. Merits of introduction

This section presents the merits of introducing PLEMIA.

1) High-speed response

A response five to 10 times faster than that of the conventional product data management (PDM) has been achieved. Response speed is important when the system is used in business. Concerning structure explosion (or implosion), which is often used in BOM operation, explosion/implosion can be achieved in a few seconds even with a structure including about 10 000 items.

2) Safe team design

Safe team design can be easily implemented by access control. Product design may involve various requirements such as a case in which design data must be viewable to others in divided (team) design but editing or deletion is not permitted or where even the existence of data must be hidden from other teams in the prototyping phase. The data access control of PLEMIA allows access permissions to be defined for the respective user groups and data folders, which assures safe design collaboration.

3) Support for various CAD systems

Various CAD systems including those of other companies are supported. In the sites of Japanese manufacturing, where top-down standardization of CAD systems is difficult, different sections use different CAD systems according to the part of a product. Accordingly, manufacturing data management requires a system that allows standardization of multi-CAD data for management. PLEMIA is capable of managing various types of CAD data including SolidMX, which is Fujitsu's 3D CAD, SolidEdge and SolidWorks. It can also manage 2D drawings and related documents together, which allows data management that matches Japanese manufacturing.

4) Visualization of processes

Management can be strengthened by visualizing the progress of projects. PLEMIA offers a system of managing and sharing different types of information relating to product development such as the schedule progress, work progress and resource loading state based on the process flow. Designers can work while checking the schedule and progress of the projects they are in charge of and managers can gain an accurate understanding of the current states of those multiple projects. In this way, "visualization of processes" for both designers and managers is facilitated to allow any delay or problem to be detected at an early stage and promptly dealt with.

5) Realization of general BOM system

Mechanical, electrical and other types of BOMs can be managed in an integrated manner. BOMs may be of a variety of types according to the part and application such as mechanical or electrical components and design or manufacturing. PLEMIA realizes a general BOM that integrates these BOMs in a unified management system.

6) Diverse search functions

The diversified search functions allow scattered information assets to be effectively used. In addition to searching by management attribute, PLEMIA is equipped with various search systems such as full-text search, which uses as a key an arbitrary character string included in documents, 2D drawings or 3D models, and similarity search, which retrieves similar drawings or images based on "feature values" extracted from shapes and color distributions of 2D drawings or images. This allows crossover searching of existing information assets built up in an enterprise regardless of the location or format, which can be used for subsequent manufacturing.

7) Realization of environmentally-conscious design

PLEMIA supports various regulations including the directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive) and directive on end-of-life vehicles (ELV Directive). To help corporations in their activities for environmental compatibility such as green purchasing, PLEMIA provides associations with BOMs for managing information about the materials and content of chemical or hazardous substances of components. This improves the efficiency of surveys on the company's own products and suppliers regarding the state of compliance to and measures for various environmental regulations including the RoHS and ELV Directives.

8) Sharing of various types of knowledge

Documents, know-how and past problems (including problem information and challenges) can be shared in the process flow. PLEMIA allows information to be shared by associating input and output of each process and offering procedures and know-how relating to the work based on the process flow. This gives designers a clear understanding of what should be done, when, and by what procedure, which prevents them from forgetting to carry out a task. By sharing know-how and past problems in each process, designers' self-resolving ability can be improved and processes optimized.

9) Configuration management for respective destinations

Configuration information for respective destinations can be compared and edited in a list. For Japanese manufacturing, in which many products with different specifications and configurations are made for different places of product application and production along with global expansion, efficient management and creation of destination data is important. A matrix BOM gives an at-a-glance view for comparison of BOMs for arbitrary destinations and allows editing.

10) Collaboration across different sections

Company-wide information can be shared via the portal. Access to various types of information handled in manufacturing can be controlled by means of the portal, which allows the necessary information to be correctly shared with the people who need it. This, for example, makes it possible to reflect the customer and business negotiation information at the front end in product development at the back end for smoother information communication between the upstream and downstream processes. In this way, information sharing and construction of collaboration environment across different sections can be achieved.

5. Global application of PLEMIA

As globalization is accelerating at present, global application of PLM is essential. Assembly design across global bases using PLEMIA is illustrated in **Figure 3**. PLEMIA can construct an assembly structure in a way that encompasses multiple bases including overseas ones to support cooperative design across global bases.

Along with globalization, security measures are gaining importance. PLEMIA is provided with the following security measures as standard features.

1) Secure distribution

Distributes secret information such as product design information in a secure environment. Also possible to check whether or not such information has been received by the intended recipient.

2) Prevention of inside information leaks

Permits access only to the specified application. Allows data to be copied and moved only in the security area.

6. Support for cloud

Migration to cloud is an important means of having advanced development design without increasing burdens on customers. One point

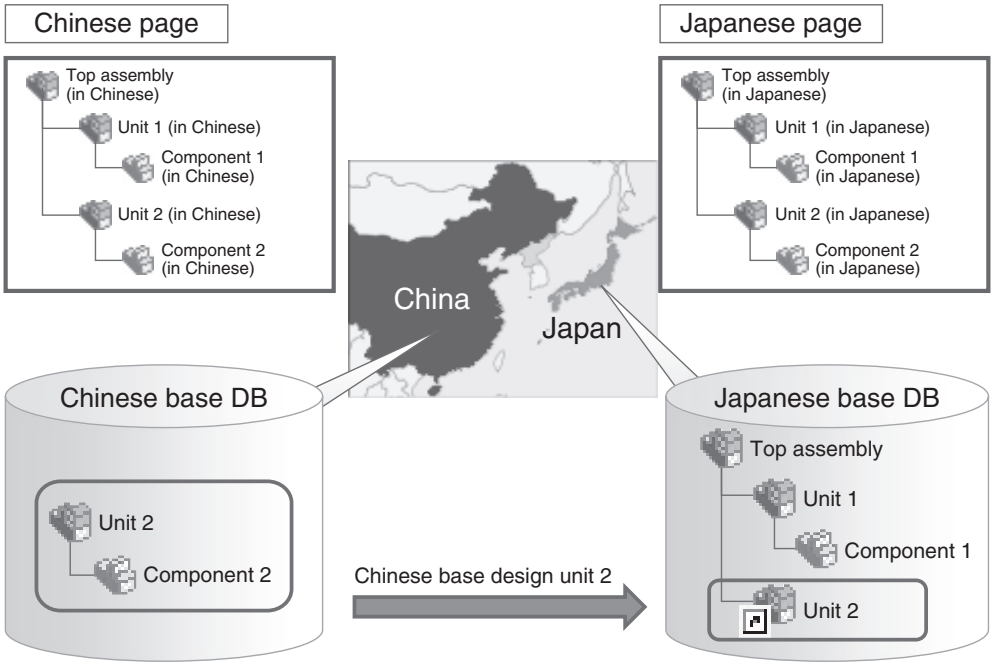

Figure 3
Assembly design across global bases.

is that, because of the massive quantities of data handled by PLM software, smoother data coordination between bases both at domestic and global levels is a challenge. To address this, we have developed Remote Virtual Environment Computing (RVEC), a high-speed display technology capable of fast compression of 3D CAD data running on a cloud for high-speed display on the client PC, which has made massive data processing possible. Fujitsu PLM solutions have realized cloud operation of all technical information including 3D data.[3] Data are exchanged between software packages via Flexible Technical Computing Platform (FTCP).

The building of a cloud environment on customers' premises, not to mention operation at Fujitsu's data centers, is possible. The Fujitsu Group's variety of tools, component databases and consulting services in relation to design are brought together into the cloud environment so that it can offer support in the form of software as a service (SaaS).

7. Enhancement plan

Based on our experience in constructing a PLM system and developing our products, we have announced the development policy of PLEMIA functions in the future as the M3 concept. **Figure 4** outlines the concept.

The following is an overview of functions of the eight frameworks that embody the M3 concept.

1) Integrated management of technical information that supports the basis of product development
- Integrated mechanical-electrical-software management
- Environmental substance management meeting the needs of the global market
- Multi-view function
- Excel editor
- Virtual product simulator/Manufacturing (VPS/MFG) management

2) Cloud infrastructure to support business continuity
- Engineering Cloud

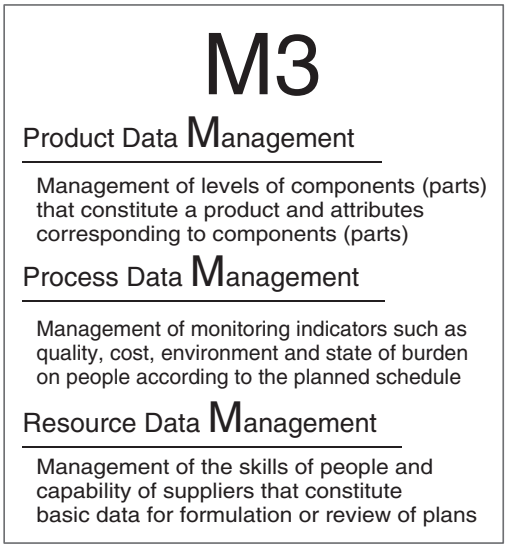

Figure 4
PLEMIA M3 concept.

3) Management for risk forecasting
- Project management
- Target costing

4) Concept design support to incorporate global needs
- Specification proposal management
- Assembly design across global bases
- 2D/3D shape search

5) Strengthening of communication for human resource development
   - Request/fault management

6) Virtual verification

7) Security filling the needs of global environment
- Secure distribution
- Prevention of inside information leaks

8) Maintenance work support for increasing customer satisfaction
- Maintenance work support

Figure 5 shows an overview of the next PLEMIA consisting of the eight frameworks above.

8. Conclusion

This paper has described PLEMIA, a general design information management system that realizes Fujitsu's PLM solution concept. For PLM solution products, the market is expected to grow because of the increasing global expansion and reduced product lifecycles.

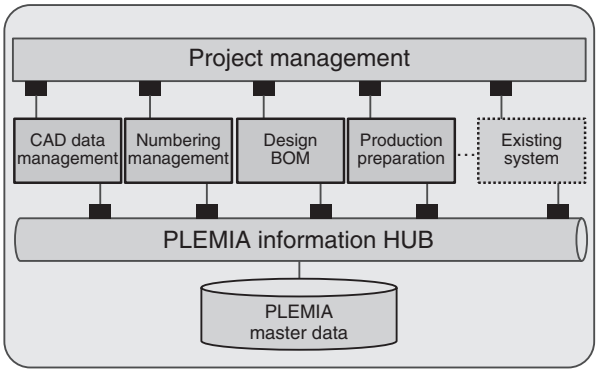

Figure 5
Overview of next PLEMIA.

In the future, we intend to develop a package that functions as a consistent core infrastructure from the upstream to the downstream and from the downstream to the upstream of product lifecycles based on the PLEMIA M3 concept.

References

1) Fujitsu: PLM Solutions. (in Japanese). *http://jp.fujitsu.com/solutions/plm/*
2) Fujitsu: PLEMIA M3—Fujitsu's PDM (Product Data Management). (in Japanese). *http://jp.fujitsu.com/solutions/plm/pdm/plemia/*
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