Outlook for PLM for Management Reform in Manufacturing Industries

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OVERVIEW: As the environment surrounding the manufacturing industry in Japan gets harsher, businesses are not only required to quickly recognize saleable products and shorten development periods in an attempt to put products onto the market rapidly but also to provide profit forecasting covering all businesses (from sales to after-sales services) and to ensure manufacturer accountability in regards to environmental regulations, etc. To meet these needs, it is necessary to introduce "PLM" (product lifecycle management) to ensure thorough product information management across all process stages — from planning and development up to sales, maintenance, and disposal. In this way, applying PLM can optimize profits across the whole product lifecycle, ensure safety and security, and continuously improve CS (customer satisfaction). As a manufacturer ourselves, Hitachi is establishing its own PLM, and utilizing the know-how gained in order to provide "PLM solutions."

INTRODUCTION

IN the business environment surrounding manufacturing industry, every passing year gets tougher. On one hand, customer needs are diversifying and product lifecycles are continuing to shorten; on the other hand, the coming of globally competing societies is intensifying demands for product quality and price cutting. Moreover, communities of nations — starting with the EU (European Union) — are beefing up their environmental regulations and

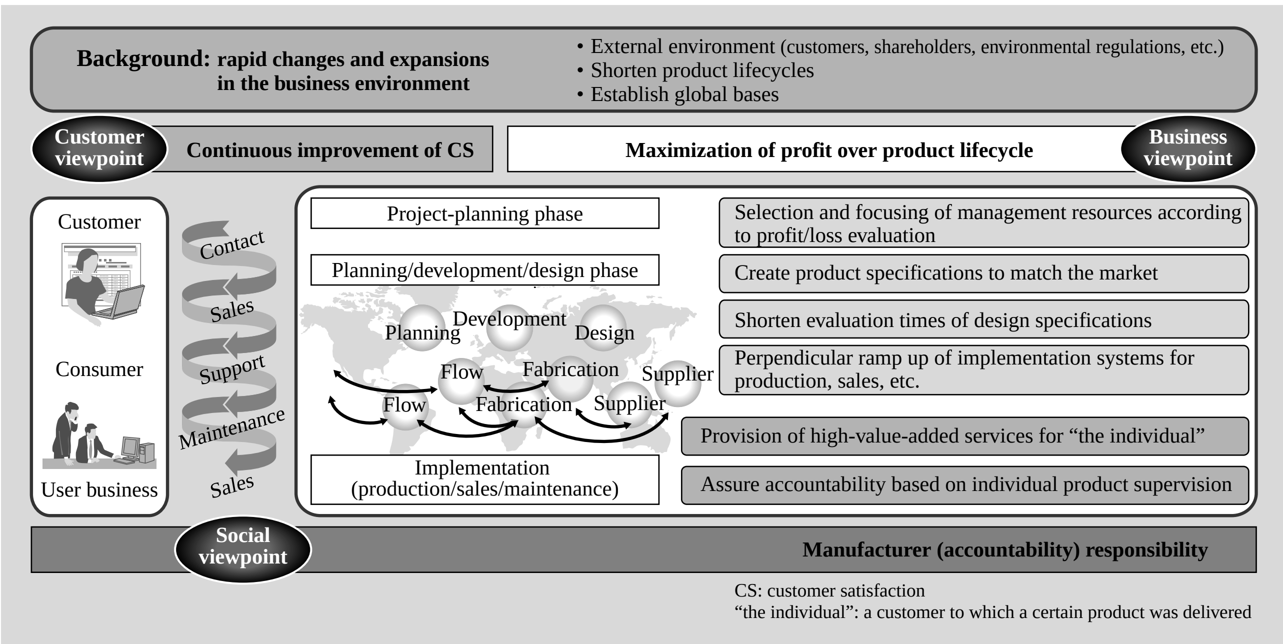

Fig. 1—Implementation Challenges and Requirements Concerning PLM for Realizing Management Reform in Manufacturing Industry.
In regards to manufacturing industry, to realize management reform and deal with environmental changes, "PLM" — which balances the viewpoints of customers and society with that of management — is being sought after.

demanding "environmental compliance" in accordance with them.

Under these circumstances, the necessity for restructuring of management techniques such as SCM (supply chain management) and CRM (customer relationship management) is being advocated and actually introduced into many organizations. In particular, over the last few years, the expectation in regards to PLM (product lifecycle management) has been growing rapidly.

Generally speaking, PLM is a method for management restructuring or reform. That is, it is a way of managing product information in each operational process in a cross-sectional manner throughout all steps of the product lifecycle (planning, development, production, sales, maintenance, disposal, and recycling) in order to improve development investment efficiency exponentially and shorten lead-times of products to market (i.e. TTM: time to market).

The rest of this report presents an overview and the future outlook regarding PLM activities at Hitachi Group.

HITACHI'S THINKING CONCERNING PLM

Aims and Requirements of PLM

Shortening TTM is an important theme in regards to the business environment. However, it cannot be said that PLM only involves restructuring methods for design processes and their accompanying tools. In regard to establishing PLM, as suggested by the word "lifecycle," there are three essential requirements that must be met from the following viewpoints (see Fig. 2):

(1) Maximize profits by means of overlooking the whole "business lifecycle" at all times — including after-sales activities such as additional services and maintenance services.

(2) Improve brand value by positively responding during the period up to disposal and recycling of individually shipped products to laws related to the "individual lifecycle" and to the concerns of society.

(3) Improve market share and increase share of products among individual customers by continuously providing products and services with a high degree of satisfaction — taking into account the time line of individual customers (i.e. lifecycle of the purchase).

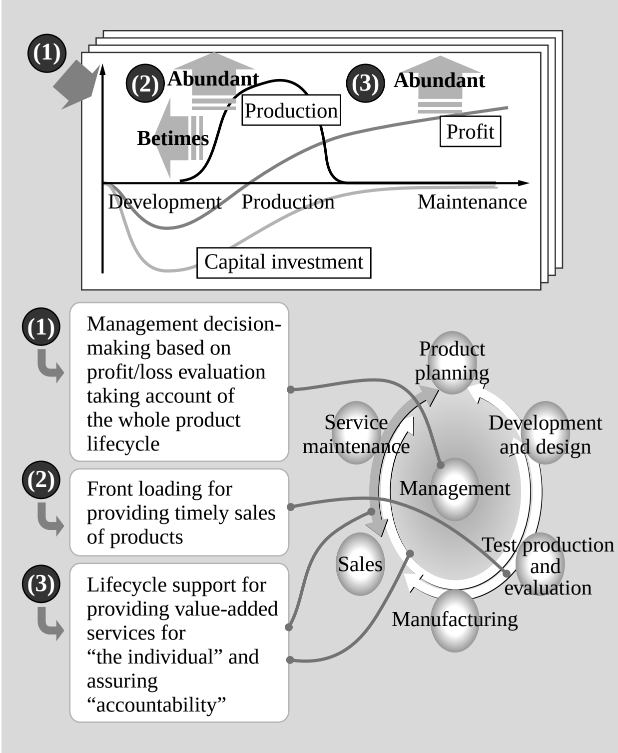

Fig. 2—Aims of PLM.
By means of precise capital investment, speed up production and sales, improve the profit range to include after-shipping services, and establish business models for improving accountability and CS.

Characteristics of Hitachi's PLM Solutions

To meet the requirements listed above, Hitachi is proposing PLM solutions composed of the technologies listed below:

(1) Front-loading technology

As well as getting new products to market quickly by evaluating and tackling diverse problems occurring in the development process in the earliest stage possible, this technology cuts costs across a wide range. This not only includes CAE (computer-aided engineering) technology but also business application technology for improving product quality and shortening times in each phase — from product planning, to actual production and launching.

(2) Lifecycle-support technology

Concerning products after shipping, this is individual information management technology and application technology that makes it possible to provide high-value-added services and assure accountability.

(3) Support technology for decision-making in management of development systems

As regards selection and concentration of management resources, it is necessary to efficiently select from a multiple of on-going new-product development projects. And it is also important to assess the "end-of-life" of current products. To handle these

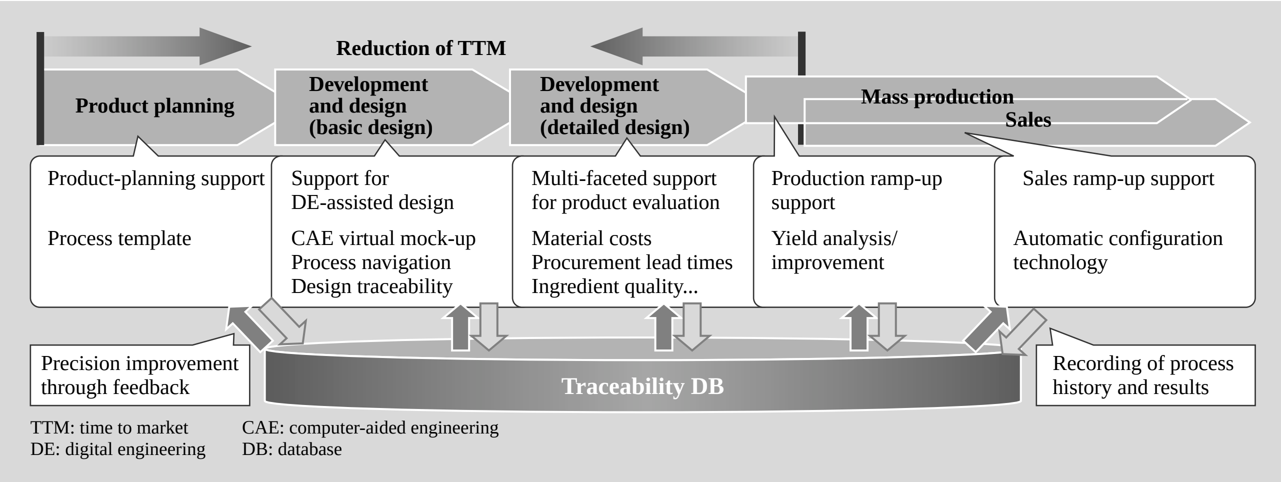

Fig. 3—Overview of Front-loading Technology for Attaining Shorter TTM.
As regards the process flow for product planning, development, etc., on top of thorough specification investigation based on feedback of results, a mechanism for launching production and sales perpendicularly is necessary.

needs, accurate and rapid profit-information management technology is essential.

The key characteristic of the PLM system developed at Hitachi is the fact that it is based on complete individual information management. Covering the parts composition of finished products as a matter of course — PLM enables unified management of product information from design and procurement to manufacturing, shipping and maintenance histories. As well as providing the above-mentioned high-value-added lifecycle support [refer to (2) above], PCM feeds back the performance records and the results of their analysis to the various models given by front-loading technology [refer to (1) above]. This feedback procedure results in even more accurate and finer processing. Moreover, by establishing profit models for product lifecycles, the reliability of the decision-making process [refer to (3) above] can be improved.

FRONT LOADING

To continuously provide services and products that assure CS, at the same time as matching the right product specification to customers' needs and avoiding re-working from the development process up to production and product launch, it is essential to constantly raise product quality. As regards analysis examples of nonconforming parts of products produced at Hitachi, over past years, it has been reported that at the product design time, if field information can be utilized effectively, 50% of nonconformities could be prevented.

In the case of front loading, feedback is received at all times, a mechanism for improving service quality must be built in (see Fig. 3).

Support Technologies for Product Planning

Generally, because product planning includes a rich variety of personal and atypical processes, errors and oversights are detected after processing. At Hitachi, this process is divided into four steps:
(1) refined search for target customers,
(2) "VOC" (voice of customer) analysis,
(3) development of higher quality functions, and
(4) optimization of defined base options of product.

These steps provide a process template in which each step is defined concretely and evaluated quantitatively. Moreover, this mechanism amasses and analyzes individual product information (which depends on assumed functions and performance that reflect the VOC) and "needs information" of individual customers ("the individual"); it then feeds the results back in to the above planning process.

Support Technologies for DE-assisted Design

In the design phase of development — when functions and performance are determined — by applying DE (digital engineering), as represented by CAE, business operations can be conducted smoothly. At Hitachi, this procedure fuses together three techniques: virtual mock-ups by CAE, process navigation by standardizing the design process, and design traceability. These three techniques form a support system that realizes high-quality designs and smooth execution of processes spanning investigation, evaluation and diagnosis.

During the design process, "traceability" means that medium-term product histories (including record changes, design-review results, and reference information) are recorded and the design basis is specified. In this way, the correctness of the design process and criteria and analysis know-how can be assured.

Multi-viewpoint Evaluation Technology for Design Schemes

Utilizing CAE, etc., after completing the design of a product's functions, performance, and structure, the designer performs all sorts of evaluations on production methods, operating environments, etc. This process suffers from several problems. For example, after the design is completed, the materials department might inform the designer that they cannot meet the parts-procurement order, and the quality assurance department might order certain parts to be exchanged because they do not meet environmental regulations. Such problems bring about the need for re-working and increase development delays and costs.

In response to these problems, Hitachi has come up with technology for comprehensively evaluating the BOM (bill of materials) of design proposals from various viewpoints. By using this technology, the designer can analyze the evaluation results and design proposals in collaboration with the departments concerned, and then make any necessary design improvements before potential problems or non-conformities arise.

Some examples of the evaluations possible with this technology are listed below:

(1) Standardized evaluation that takes into account cost of parts, etc.

(2) Environmental impact assessment of all the chemical compounds contained in finished products, etc.

(3) Procurability evaluation that takes into account the cost of surplus inventory of parts, etc.

(4) Producability evaluation that takes into account the assemblability of parts, etc.

Support Technology for Production Ramp-up

To ramp-up production of new products according to plan, it is necessary to coordinate the design and production technologies. Particularly in the case of so-called "process products" such as semiconductors, LCDs (liquid crystal displays), and magnetic disc drives, how to assure yields at the initial stage of mass production is directly linked to profitability. At Hitachi, we have established a mechanism that even covers our design and manufacturing facilities spread at great distance in a "WW (world wide)" environment. This mechanism enables problems occurring at WW sites to be precisely fed back into the product design so that prompt action can be taken and yields can be ramped up. In this way, yield-analysis technology based on in-company performance is provided.

Automatic Order-planning Technology

As regards ordered products, specification information — which takes into account development results — is released by the sales process in a usable "master" format and sales then starts for the first time. Consequently, one important factor in establishing this master is shortening the TTM. At Hitachi, unifying "specification configuration management," which uses a "sales configurator" for offering guidance in selecting specifications for proposals, with the design BOM allows sales to be ramped up.

Since the parts configuration is developed from the exact specification data selected by the configurator, the origin of the individual parts in a finished product — the so-called "traceability" — is known.

LIFECYCLE-SUPPORT TECHNOLOGY

In response to the social and regulatory concerns in regards to environmental compliance and to the need to sustain and enhance brand names, on top of improving product quality, businesses are being expected to provide accountability.

In reality, this means that an information infrastructure that assures accountability concerning individual manufactured products must first be established. Applying this infrastructure across the whole product lifecycle will enable us to provide optimum maintenance and services to every customer (see Fig. 4).

Provision of Customer Safety and Security

As environmental awareness increases and regulations are tightened, it has become necessary for manufacturers to ensure "accountability" concerning customers and public bodies. This accountability includes the commitment to demonstrate that their products do not contain harmful chemicals as well as the provision of the necessary information on adequate processes for disposal of products at the end of their lifecycles.

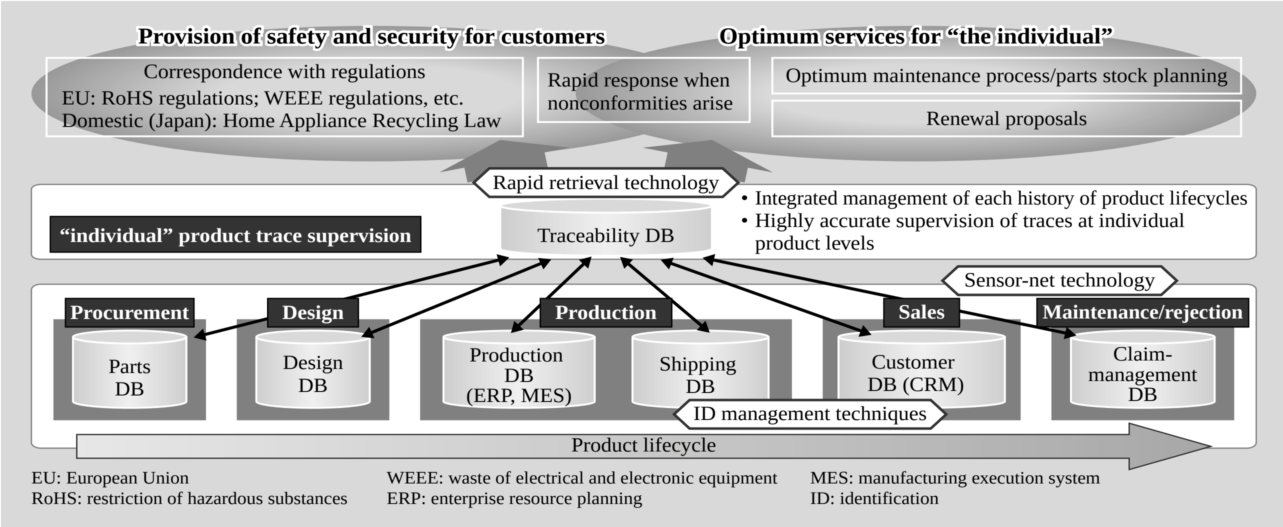

Fig. 4—Overview of Lifecycle Support Based on Traceability Management.
Product history from design and production up to sales and maintenance is managed en bloc as a single history. Based on an information infrastructure that provides traceability at "the individual-customer" level, accountability and optimum services for each customer are provided.

Furthermore, in the event that nonconformities occur after shipping, rapid response, including product recall (i.e. free replacement or repairs), is vital. Whether the nonconformity originates in the design or manufacturing processes or whether it originates in the individual service conditions is assessed. In the former case, it is possible that the same problem could occur in other delivered goods, so those goods must be identified.

In this way, to actively provide customers with "safety and security," technology that can retain and utilize a huge amount of individual information concerning the parts composition and the manufacturing and maintenance histories of individually delivered products is needed.

Provision of Optimum Products and Services for Individual Customers

(1) Optimum maintenance and parts planning

In order that customers always get to use their individual products under the best conditions, inspection, tuning, and replacements must be performed at optimum times. For example, by means of remote monitoring by sensors 24 hours a day/365 days a year, signs of trouble and unusual operating conditions can be identified and treated, maintenance plans for each product can be worked out, replacement schedules and emergency responses can be anticipated, and the necessary parts can be fixed in just proportion. As a result, optimum maintenance services that meet the SLA (service level agreement) can be provided at low cost.

(2) Renewal-approach technology

In response to utilization conditions of each customer, this approach can improve delivered products, renew existing products, or suggest separate but related products.

In this manner, providing optimum products and services to individual customers makes it possible to continuously preserve the relationships with them.

Management Technology for Information on Individual Products

To realize the "lifecycle support" described earlier, in regards to individual manufactured products, as well as taking in procurement and fabrication as a matter of course, it is desirable to keep up on product histories after shipping. In response to this need, businesses are demanding individual-information management technology that can provide coordinated management of design information, procurement information, processing information, and BOM data at respective levels of product type, production lot, and product number and provide traceability that also takes in maintenance histories and operation conditions.

Hitachi is providing a unique individual-information management infrastructure by combining several technologies such as ID management technology (namely, Hitachi's "μ-chip") for identifying individual part components, "sensor net" for

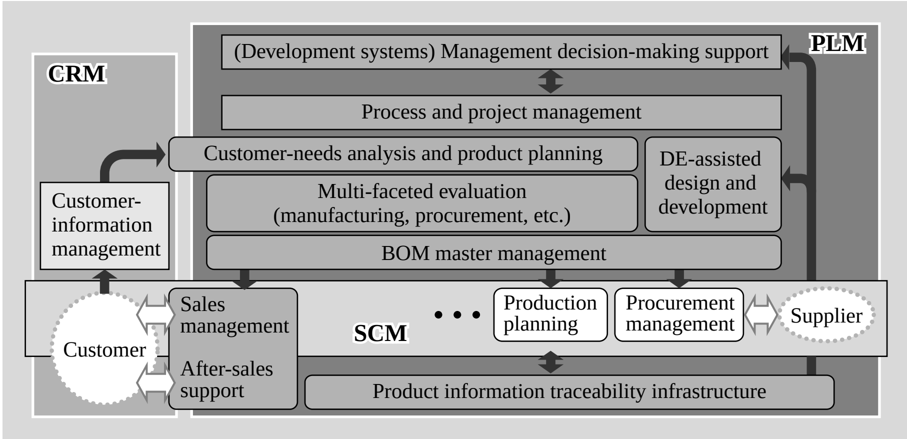

Fig. 5—Configuration of PLM Business System.
As for PLM business, mutually combining CRM and SCM increases their effectiveness.

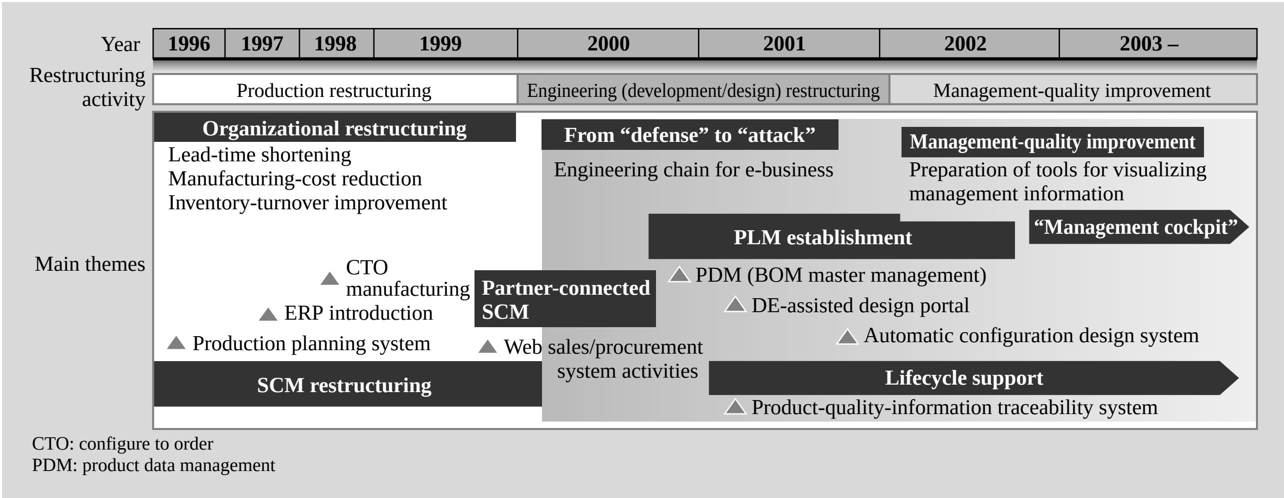

Fig. 6—Examples of Restructuring Steps Taken by Mass Production Divisions of Hitachi, Ltd.
Starting with SCM and proceeding through DE to visualization of management information, Hitachi is performing each step carefully.

monitoring the conditions of individual products, a traceability DB for managing huge amounts of individual product information, and rapid search technology in the form of an engine for establishing various applications that can utilize this amassed data.

ESTABLISHMENT STEPS AND SOLUTION DEVELOPMENT OF PLM

Way of Thinking behind Establishment Steps for PLM

An overview of the business systems that compose the above-described PLM is shown in Fig. 5. In this set-up, PLM does not exist on its own; it is combined with SCM and CRM in order to improve their overall effectiveness. However, to cover a target range across all businesses, introducing and operating these management systems at the same time can be said to be almost impossible. As an example approach to solve this problem, the framework adopted by Hitachi's IT device business is shown in Fig. 6. Given this example as a basis, the best way to improve these systems smoothly and effectively is to follow the four basic steps given below:

(1) Implement restructuring of SCM systems and DE system design, and at the same time as improving efficiency of design and production processes, collect together the performance results for each business process.

(2) Establish a mechanism (traceability DB) for connecting the performance data of each of the above-described business processes, and perform follow-up management by tracing product data forward and backward. This step provides the accountability necessary to meet environmental regulations, etc.

(3) Speed up improvements in CS by means of mutual analysis of performance results, upgrading front loading based on feedback, and enriching lifecycle support.

(4) Construct a profit-estimation model based on profit data spanning product lifecycles, and support decision-making in management of development systems (i.e. logical judgment regarding continuing or terminating projects).

Evolution of “Solution Business”

At Hitachi, to handle each of the four above-mentioned steps, we are offering the following four respective “solutions”:
(1) SCM and logistics
(2) ERP (enterprise resource planning)
(3) Design information management
(4) Digital engineering

From now onwards, utilizing the content that we have been putting into practice in our in-house businesses, we are aiming to offer “traceability solutions” for manufacturing industry — which will enable product information to be traced and managed — as well as “management cockpit solutions” for comprehensively supporting decision-making in the management of development systems.

Each solution will be offered in such a way that they also incorporate templates applied by our in-house businesses. We plan to offer these templates — “Best-practice Frameworks” — so that they consistently provide systemization that spans the introduction of design consulting up to the running of application software.

CONCLUSIONS

Hitachi’s way of thinking regarding PLM — which can respond to environmental changes surrounding manufacturing industry — and its future outlook have been explained here. Regarding management reform, by introducing PLM solutions through concrete actions such as fulfilling after-sales services, assuring accountability, and shortening development times, steady processes — which enables anticipatory actions and rapid decision-making — can be established, and business risk can be thereby reduced.

By utilizing our in-house achievements and experience acquired as an industrial manufacturer, preparing “templates,” systemizing methods and know-how in response to various businesses and operations, Hitachi is moving forward toward the provision of “fulfilling PLM solutions.”

REFERENCE

(1) CIM data website, http://www.cimdata.com.

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