

Enterprise Resource Planning Systems: Introduction of Nippon Steel's System Integration Approaches

Masahide MORI ⁽¹⁾
Yuetsu OGAWA ⁽¹⁾

Minoru MAEDA ⁽¹⁾
Takeo KAKU ⁽¹⁾

Abstract:

In this paper, the recent trend of needs for the systematization of corporation business data with the manufacturing corporations as the central figure is described on the basis of our experience of the solution business in which we have practically participated, and further outlined are the market of the integrated business operation package to be the core of a definite solution and the trend of package products developed by corporations. Then, described are our actual results of concrete system integrations and consultation services performed by Industrial System Solutions Div.-1 of Nippon Steel Corp., where the elementary technologies to be put up as security and the actual circumstances of integrating enterprise resource planning (ERP) systems including a form of executing a project are explained in detail. Lastly, problems to be solved which the present ERP systems have are considered and the future trend of the ERP system is observed and discussed from both sides of existing conditions of the elementary technologies and development of business situation.

1. Introduction

As a new form of corporation business data system, ERP (Enterprise Resource Planning) systems have been in the spotlight in recent years. ERP is a concept of pursuing "systematic and integrated applications of a series of management resources related to corporation activities." The ERP systems are a means of realizing this concept for installing the integrated business operation packages in the core place, and they were developed by European and American companies such as SAPR/3 and Oracle Applications (see 2.3 section for details). The systems were initially introduced in the European and American business fields where they were first developed. In Japan, they have been rapidly employed in corporations reflecting changes in philosophy to investment for systematic approach, owing to aggressive products development and reinforcement of support systems by developing companies.

Major activities to which ERP systems are applied are fundamental regions essential in each corporation's business activities including Financial Control, Sales and Distribution, Purchasing, and Production Planning. This means that the ERP system is supplied as a nearly complete product under integral design concept for a series of standard business models^{*1} (system function and data model^{*2}) related to each business activity (see **Fig. 1**). The Industrial System Solutions Div.-1 of Nippon Steel Corp. promotes the system construction business and consultation services, to be the core of central business, applying both integrated business operation packages of Oracle Applications by U.S. Oracle Corp.

^{*1} Business model: Generic term of data (data model) related to business applying the system and a series of business procedures (procedure model).

^{*2} Data model: Data assembly (e.g. order receiving information, ordering information) and connection of each data item dealt with in the business applying the system.

⁽¹⁾ Electronics & Information Systems Div.

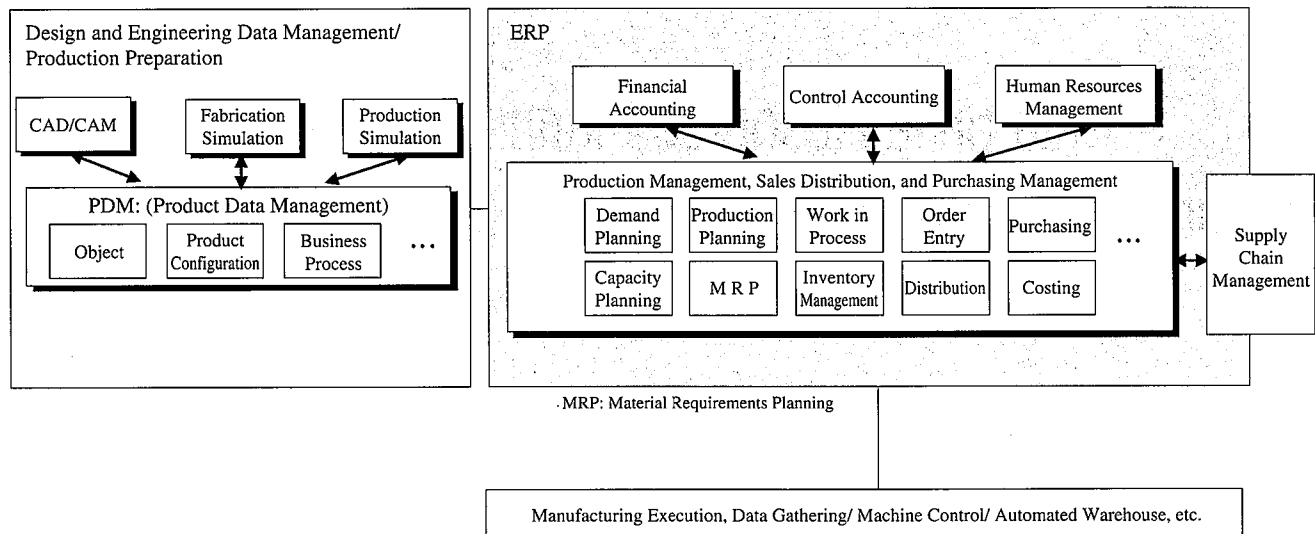


Fig. 1 Entire ERP Function Relation Diagram

and eMIS/2000³ of U.S. ESI Corp.

In this paper, we describe the recent trend of needs for systematization of corporation business data with the manufacturing corporations as the central figure on the basis of our experience of the solution business in which we have practically participated. Further, we outline the market for the integrated business operation package as the core of a definite solution and the trend of package products developed by developing corporations. Then, we describe primarily our results with concrete system integrations and consultation services performed by Nippon Steel Corp. We explain in detail the elementary technologies to be put up as security and the actual circumstances of integrating enterprises resource planning systems including a form of executing a project. Finally, problems in the present ERP systems to be solved are consolidated and the future trend of the ERP system is observed and discussed, both from the aspect of existing conditions of the elementary technologies and the development of business situations.

2. Informational Approach in Manufacturing Corporations and ERP System

2.1 Business environmental change for manufacturing corporations and problems to be solved

Authors feel acutely at the daily system solution business, with clients mainly in the manufacturing corporations, the fact that each corporation is situated an important turning point from the viewpoint of informational restructuring. This can be understood as an event caused by changes in the business environment of each corporation.

Specifically, the point is how early a company should deliver its own competitive products to the market and how quickly to supply them in response to various daily changes in demands. This requirement is needed more urgently than ever. If precise response to these requirements is not available, it is absolutely impossible to realize reduction of opportunity loss in business promotion and minimum investment costs including those for materials and in-

ventory, and then finally to construct a strong benefit foundation as the market leader dominating its competitors.

From the viewpoint of systematization of corporation business data, problems each corporation should tackle in responding to these changes in business environment can be summarized by the following four points.

(1) Global business promotion and restructuring of production management system corresponding to re-organization and integration of production bases including overseas activities.

(2) Direct control system of Materials Procurement - Production - Sales and Distribution and computerized support system for the supply chain management taking a view of entire products supply activities.

(3) Promotion of corporation-wide business innovation (so called Business Process Reengineering) including above (1) and (2) and resultant review for work responsibility outside and inside the organization toward reconstruction.

(4) Effective use of recent IT (Information Technology) related to development of original products and services.

In addition to these four points, renewal of data assets that are subject to the year 2000 problems in existing systems has been revealed as a common need of corporations. Incidentally, we have observed too many examples to enumerate in some specific projects with which the authors have recently dealt. There are examples in pharmaceutical manufacturers aiming at the global supply chain, integrating worldwide production and sale bases; examples in chemical manufacturers promoting logistic system reconstruction, integrating production factories, distribution bases, and sales; examples in electronic device manufacturers tackling system construction, realizing proper production assignment and production management at domestic and overseas production points mainly in Southeast Asia.

2.2 Basic viewpoint at ERP system construction to solve problems

It is common to projects mentioned above that each customer aims at clearly constructing the ERP system by applying the integrated business operation package from the beginning. Indeed, at the initial stage, it is probable that a package cannot be applied because the

³ eMIS/2000 is the registered trade mark of U.S. ESI/TECHNOLOGIES, INC.

business process selected by a customer as an innovation target does not agree with business models of the package. The authors understand, however, that, in order to deal with the above mentioned challenges and obtain a stronger position in markets, the customer corporations should adopt a clearcut attitude on applying the business package and have aggressive stance to apply it if only a partial set of the business package is available.

In addition, from the system construction viewpoint, the customer corporations should be free from pursuing the conventional rationalization and efficient business activities, while it is strongly required that they should follow the speed of business innovation progressing at the global scale, and modify them own business process quickly to reflect changes in the situation. In this case, the end user-oriented functional construction seen in the conventional hand-made system may be cut off depending on situations. This requires the system construction to consider the final target of investment for the information management and roles to play in entire business activities.

In other words, this means that there is a background established for discussing the corporation business data system at the management strategy level. It is the ERP system applying the integrated business package that positions it at the core of a practical realization method. In the next section, this ERP system is described featuring its market structures and major products.

2.3 Market trend and major products of ERP system

As mentioned above, the market of the ERP system has been formed and spread in Western countries, particularly the United States. This system involves many problems such as the conventional package application culture, global operation, outsourcing of information system resources (IT and human resource), approach to UNIX⁴-base distributed environment, year 2000 problems, etc. Under these situations, the market is steadily growing at a high rate of over 40% a year. Triggered by success stories in Western markets, the ERP system and integrated business package have been rapidly popularized in Japan, overcoming traditional customs respecting self-supplied systems. For the purpose of management,

the necessity to respect self-supplied systems has been called into question today.

As a result, the domestic market has steadily grown to reach more than 20 billion yen (license + consultant fees) the estimated for 1997 (see Fig. 2).

For the rapidly growing market, each vendor mainly in Western markets has actively evolved product development and market participation. According to the survey conducted in 1997 by a consultant of AMR (Advanced Manufacturing Research) Corp. in the United States, the present market leader is a German SAP Corp. having a 34% world share followed by U.S. Oracle Corp.⁵ with 10% and JD Edwards Corp with 7%.

In Japan, in the early 1990s, a few vendors such as SSA Corp. carried on business through corporations in Japan. Since then, however, major corporations which conduct worldwide business have established corporations in Japan one after another or have moved into Japan's market through their agencies here. ORACLE Corp., which had already established a firm foundation in the database field, positions this Japanese market as the most important business region for aggressive investment of management resources. Table 1 shows typical products of each corporation and their characteristics. Products specifically used for the supply chain and others

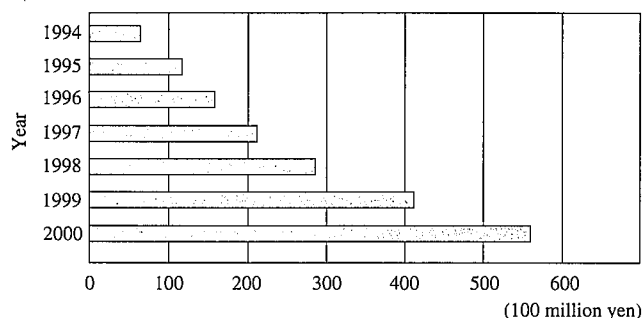


Fig. 2 Prediction of Japan's market scale on ERP package

Table 1 ERP package products of major companies

| Name of products | Developing corporation (domestic sales corporation) | Specific items |
|---------------------|---|--|
| Oracle Applications | Oracle Corp. : U.S (Japan Oracle) | <ul style="list-style-type: none"> • To fully apply Oracle RDBMS and D/2000 functions • To develop add-on function efficiently by standard open I/F • To supply solution classified by business field and effectively combine external vendor packages • To actively take into the business standard, the latest IT such as Web and CORBA • To deliver standard engineering procedure "AIM" for the system construction |
| eMIS/2000 | ESI Corp. : U.S.(Nippon Steel Corp.) | <ul style="list-style-type: none"> • Package corresponding to CASE by DOA approach • Easy to customize corresponding to business requirements applying data model • To apply Oracle RDBMS, D/2000 function |
| R/3 | SAP Corp. : Germany (SAP Japan) | <ul style="list-style-type: none"> • To analyze and integrate business processes of about 4,500 companies in the world • To insist upon BPR and best practice construction by supplied package |
| BPCS | SSA Corp. : U.S. (SSA Japan) | <ul style="list-style-type: none"> • To expand implementation share as the conventional AS/400 loaded business package • To direct application of distributed object technology |
| One World | JD Edwards Corp. : U.S. (Japan JD Edwards) | <ul style="list-style-type: none"> • To promote integration and C/S-ization of business package for AS/400 like BPCS |
| BAAN IV | Baan Corp. : Netherlands (Baan Japan) | <ul style="list-style-type: none"> • To combine various function modules to correspond to systematization of individual business requirement |
| PROTEAN | MARCAM : U.S. (NEC) | <ul style="list-style-type: none"> • Integrated business package for process industry |

⁴ UNIX is a trademark exclusively owned by X/Open Company Limited in the United States and other countries.

⁵ ORACLE is a trademark of U.S. ORACLE Corporation.

will be explained in Chapter 5. Nippon Steel Corp. promotes definite business activities reflecting characteristics of Oracle Applications and eMIS/2000.

Thus, these ERP related products will have a significant affect on the future SI (System Integration) business forms and what the customer information systems become.

3. Practice of ERP System Construction

Nippon Steel Corp. has conducted the ERP solution business for six years starting from its license contract with 4GLEMIS⁶ (previous version of eMIS/2000) in 1990, to the addition of Oracle Applications in autumn 1995. Introduced were a total of more than 40 sites including middle and major corporations, ranging from automobile, electronics, electric machinery, machinery, food products, chemicals, pharmaceuticals, and clothing fields.

A series of introduction experiences show that many users introduce the ERP system expecting quick effects on the entire corporation rather easily. However, there are some differences observed between the business model assumed in the integrated business package and the user's requirements. Much more effort is required, in contrast to initial expectations, than that required in the traditional scratch based system. This is mainly caused by low comprehension among users for the system construction approach. At present, only the ERP concept is likely to exceed its real situation. Therefore, the authors conclude that it is necessary to promote in consideration of gaps with the actual ERP system.

This chapter first introduces performance at major customers of Nippon Steel Corp. and typical examples, then describes requirements for the integrated business package and key points for promoting the ERP system construction.

3.1 Example of construction of ERP system

3.1.1 Major performances

Nippon Steel Corp. is carrying on the SI oriented business to consistently promote the system from designing, manufacturing, implementation, and start up operation, and in particular, it is tackling a wide range of business areas from package implementation consulting, customization and add-on development, to maintenance at construction of main business system using 4GLEMIS and Oracle Applications.

Table 2 shows principal deliveries of main business system by Nippon Steel Corp.

In addition to examples of 4GLEMIS and Oracle Applications, included in this table are results of introducing such cases as to construct associated with commercial accounting and personnel management packages specialized in the specified fields and implemented for many customer, and to switch to scratch base development⁷ due to problems related to individual business models during introduction, and also examples in food and beverage industries where few dominant packages are applied. Recently, many customers are asking consultants (owner's consultants for SI business to corporations which have installed the system) to construct systems by other famous integrated business operation packages, expecting application effect of a series of construction skills.

⁶ 4GLEMIS is a trademark of U.S. ESI/TECHNOLOGIES, INC. Other names of corporations and products shown in this paper are brands or trade marks of the respective corporations.

⁷ Scratch base development: Conventional system construction method to develop necessary software by defining data and function from the beginning to realize business requirements. It is also called hand-made development.

Table 2 Main implementation

| Industry | Name of corporation | System contents |
|----------------------------------|---------------------|--|
| Automobile | A corp. | Production and process control at factory T |
| | A corp. | Production and process control at factory F |
| | B corp. | Estimation and adjustment system |
| Electronics, electric, machinery | C corp. | Production, sales, and accounting system |
| | D corp. | Sales management system |
| | D corp. | Production management system |
| | E corp. | Production management system |
| | F corp. | Production management system |
| | G corp. | Production management system |
| | G corp. | Sales management system |
| | H corp. | Production management system (printer factory) |
| | I corp. | Corporate system |
| | J corp. | Corporate system |
| | K corp. | Corporate system |
| Food and beverage | L corp. | Financial accounting system |
| | M corp. | Sales and manufacturing integration system |
| | N corp. | Sales and manufacturing integration system |
| | O corp. | Sales, distribution, and accounting system |
| Chemical | P corp. | Production, sales, and accounting system |
| | Q corp. | Production management system |
| | R corp. | Sales and distribution system |
| | S corp. | Production management system |
| | T corp. | Production management system |
| Pharmaceutical | U corp. | Sales and distribution system |
| | V corp. | Production management system |
| | V corp. | Global supply chain system |
| Clothes | W corp. | Production management system |

3.1.2 Examples in electronics parts manufacturers

A typical example of the ERP system construction based on 4GLEMIS, which is the most common installation, is introduced below.

(1) Background of systematization and role of Nippon Steel Corp.

Corporation A, an electronics parts manufacturer, makes an all out effort for production activity in Asia deciding the policy of "Reinforcement of Overseas Development" along with overseas operation of the customers of Corporation A, who are manufacturers of peripheral equipment for personal computers. The corporation has been forced to change quickly its product models in response to customer's specification modifications due to shortened life cycle caused by frequent model changes in personal computers. Corporation A tried to construct a new global system for unified management of order receiving, production and shipping information by linking domestic and overseas factories to establish the product supply system at factories most suitable to meet such customer requirements as delivery date, modification of specifications and cost reduction. But this approach has the following problems.

- Business and management systems are not unified between departments and factories.
- Actual costs classified by products are not grasped by indexes common to the total corporation.
- System is individually introduced not to be unified.
- Personnel engaging in system planning and promoting from the total corporation viewpoint are difficult to line up.

Under these circumstances, Nippon Steel Corp., as an SI and package

vender, has promoted the system construction from design, production, introduction and start up of operation and maintenance.

(2) Outline of system

The system was constructed to select 4GLEMIS, which is easy to customize by 4GL language, and it is joined by other packages suitable for the business situations of corporation A such as accounting, personnel affairs, and salaries. Fig. 3 and 4 show the configuration of software and hardware of this system. Specific targets specified for system construction are as follows.

- To give "top priority" to actual cost estimation, after a total management system is constructed.
- To comprehend actual conditions in domestic and overseas factories at the head office on an on-line basis.
- To establish procedures to analyze differences between standard and actual costs.
- To consider cost effectiveness for overseas operation and maintenance.

(3) Standardized approach by business model

SEs familiar with the data model and business model of the package were dispatched to factories from the beginning of the basic design stage to instruct factory field personnel for standardization related to business and code system and to help them master data after grasping actual business conditions. This allows minimizing of the work volume of customization and add-ons to smooth implementation of data transition and system start up. Standard-

ization and integrated items conducted from the total corporation viewpoint are shown below.

1) Business standardization

- To realize unified operation of order receiving, production, purchasing and shipping instruction by the system.
- To shift instruction of manufacturing and purchasing from the conventional hand work to MRP.
- To clarify and unify the fabrication procedures

2) To arrange and integrate code systems including overseas factories at the total corporation level.

- To unify lot numbers and division codes which were distributed in each manufacturing division.
- To prepare new material lot numbers.
- To abolish work in process numbers used for work history control by hand work.
- To unify warehouse codes and inventory transactions.

3) Master construction

- To unify instruction key items for order receiving, production, purchasing and shipping.
- To clarify, newly specify, and standardize manufacturing sequential process.
- To specify and standardize items related to process information (cycle time, lead time, etc.)
- To clearly arrange bills of materials not unified in the past for divisions and persons using ambiguous parts configurations.

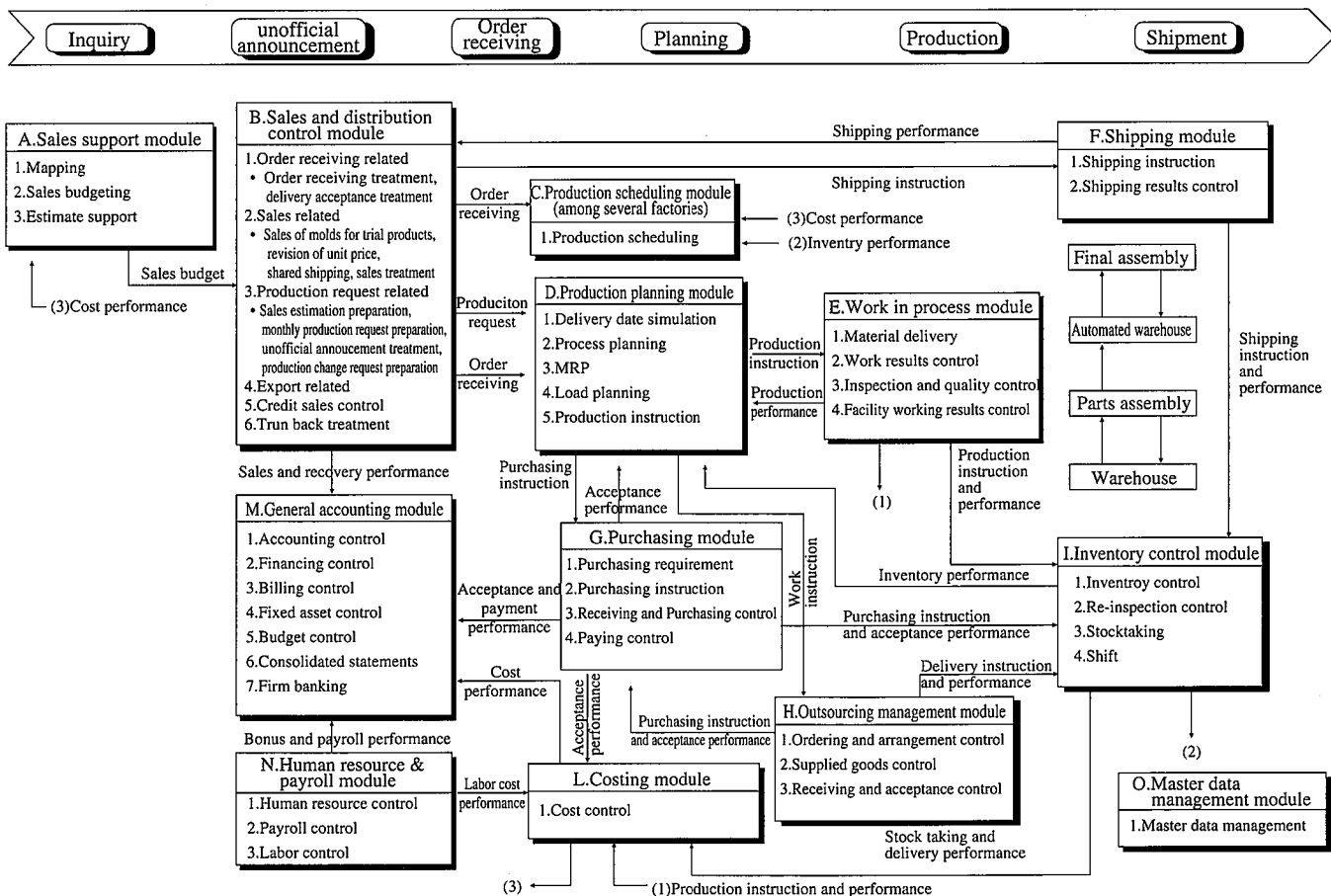


Fig. 3 Configuration of software function (for corporation A)

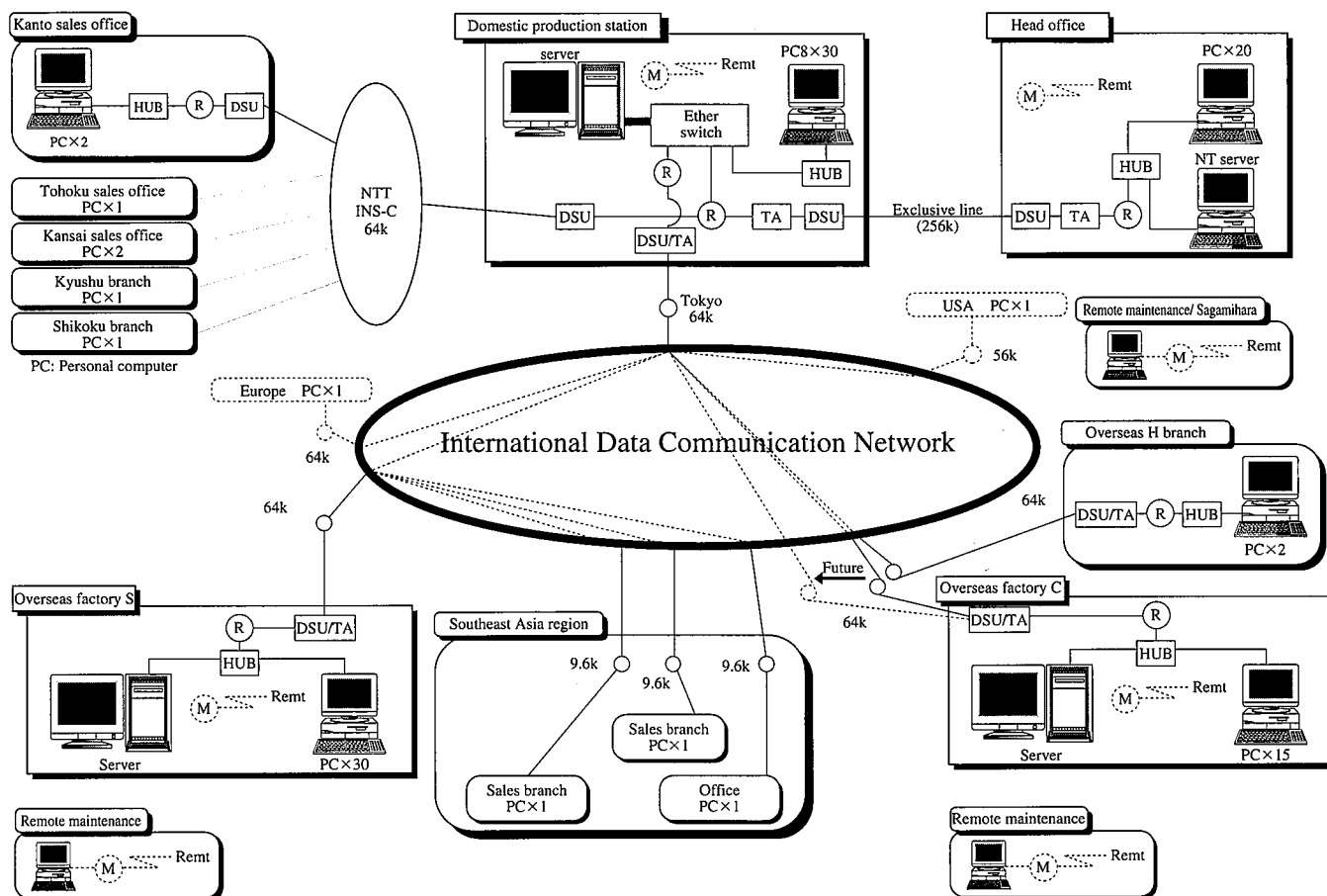


Fig. 4 Hardware configuration (for corporation A)

- To employ standard cost management system by standardizing the work process and unifying bills of materials.
 - 4) Fully worked out plan on SI promotion
- In addition to the above, ingenious points obtained during promotion are shown below.
- The same integrated business package was employed including overseas key stations for advanced introduction and development in Japan. Then the package was translated and distributed to overseas for schedule shortening, data coordination, and for unification of handling and operation, and maintenance.
 - A communications network system was used focusing on balancing its cost reduction after operation, security, and real time availability as well as selection of supplying corporation and functional assignment design between key stations.
 - In order to support operation and maintenance at every key station, Nippon Steel associated corporations having site bases are selected.
 - Three-phase promotion was employed for development and introduction ; establishment of consistent data flow for order receiving to shipping (First Step); corporation-wide cost evaluation by connecting with accounting system and with overseas key stations (Second Step); reinforcement of management support and production planning functions(Third step).

3.2 Requirements for selection of integrated business package

The integrated business package is composed of various sub-

systems covering a wide range of business areas such as production, purchasing, inventory, sales, accounting, and personnel affairs. Most packages have been generalized to apply to any business configurations (industrial sectors and business conditions).

However, the present package of products has been developed based on the production management or was manufactured on the accounting business with various application scopes and characteristics for industrial sectors and business conditions. In particular, the production management is likely affected by production configurations including assembly type and process type, and presumptive production or order production. Therefore, it is essential to select the integrated business package having requirements suitable for introduction purpose, business scale, industrial sectors and business conditions.

On the basis of the authors' experience with package construction, major requirements for the integrated business package are shown below.

- (1) Integrated control functions for total corporation business level.
- (2) Integrated database to secure data consistency.
- (3) Data model and process model* have been published and many SEs and consultants familiar with the system are available.
- (4) Global correspondence for multi-languages, multi-currencies,

* Process model: Generic term for a series of procedures related to business applying the system. A data assembly used in business operation is called a data model, while the term process model is used as a general term for functions realized by application software.

and taxation system in each country.

- (5) Introduction procedures of the package are well prepared and systematized.
- (6) Interfaces and tools for customization and add-on are well prepared with sufficient support available.
- (7) Operates on an open platform foundation.
- (8) Linkage to EDI (Electronic Data Interchange), POS, group ware, and the Internet.

3.3 Points at ERP system construction

No matter how excellent an integrated operation package is selected, the package is a tool after all. This means that the most important point for constructing the system is how effectively the system's ability and merits can be utilized. The most significant items for constructing an ERP system on the customer side are described below.

- (1) Clarification of top executive's policy for system introduction from management viewpoint

The purpose of introducing the system has been clarified as a natural requirement even in the conventional information systems. The ERP system plays an important role as an approach for realizing the management strategy, so that the purpose of its introduction is more important than in the conventional system, having an influence on the management performance.

- (2) Participation of key persons who can lead the project from the total corporation viewpoint

The ERP system is originally constructed as a prerequisite for optimization approach from the total corporation viewpoint, which requires key persons to coordinate with counterblow from the field and stake between divisions at business standardization and integration of the code system. Authors' experiences show that the key person from the management section is effective for concluding the project in a short period.

- (3) Understanding and cooperation from the field

The ERP system, when introduced, tends to reduce the weight of functions well by considering customer-oriented functions, reducing rejection from fields familiar with the conventional methods. Without understanding and cooperation from the field, the system can not be operated. Understanding and cooperation from the field is indispensable. Effective approach includes explanation of introduction purpose, participation of end users to prototyping⁹, and instruction by consultants familiar with the package.

- (4) Selection of SI vendor with high construction skills and support capability

Construction of the ERP system needs design and manufacturing of customized add-ons, data transition, training, and maintenance in addition to the package introduction consultation, and this results in a big project that joins many persons. Therefore, it is desirable to select SI vendors who can deal with businesses ranging from introductory consultation to maintenance and have consistent support capability at each promotion stage with much experience in system construction.

As mentioned above, we explained the problems and important points to keep in mind in construction of the ERP system practically. In subsequent chapters, technical issues and methods necessary for solving them at introduction related to the integrated business package as a core of system construction are consolidated and described to consider future approaches to the ERP system.

⁹ Prototyping: Software developing method in which a trial product (prototype) was first made for customers' test operation for functions and operability to reflect the formal system construction.

4. Problems and Response on Introduction of Integrated Business Package

In recent years, the integrated business package has been introduced in Japan and its successful results have been reported for shortening of the work period, reduction of development costs, and BRP. In contrast, some problems involved in the system are reported. They include general problems related to introduction of the package such as existence of an opinion leader in the project members, and significance of the top executives' leadership. This paper describes some problems related to introduction of the integrated business package.

4.1 Concept of package introduction

Upon introducing the integrated business package, tentative introduction/imaginary operation has been carried out by only a study team called CRP (Conference Room Pilot) for gap analysis as an initial judging method on whether to apply it or not. However, this method needs much time to judge the possibility of introduction, and in the worst case, introduction of the system is likely to be abandoned in the detail function design phase at a later stage.

This is partly caused from the basic concept for the package application. When the package was first introduced in Japan, it was blindly believed that the versatile business model of the integrated business package is Best Practice and that fitting each business to the integrated business package is BPR. As a result, much time was consumed. Another reason is lack of understanding of the package by Japan's vendors or agencies and lack of support SEs. So far, the packages were developed in Western markets to potentially contain a black box in it.

Under these circumstances, each corporation made the best use of the package's merits based on understanding the package function of finding optimum processes to each corporation and of responding by customization and add-ons for unreasonable parts, which is intended to reduce the stress of introduction. This approach is very important because the system refers to standard business model of the package to consider employee's skill to the own business as well as the product's characteristics for reasonable business process construction.

The following four points can increase customizing possibility in specific studies.

- (1) Disclosure of repository¹⁰ and design data
- (2) Upstream process support such as business process design
- (3) Environment for Fourth Generation Language corresponding (4GL) tool¹¹ to develop add-ons to the package's data
- (4) Massive standard interface to replace external database

Nippon Steel Corp. plans to further employ Oracle Applications and eMIS/2000 for individual products strategy.

Concretely, the repository is disclosed for a new version of Oracle Applications 10.7, which fulfills add-on developing function by Oracle's standard 4GL Developer/2000 (for (1) and (3)). "Open Interface" has been prepared to increase the target tables and enhance the system function (for (4)).

The previous version of eMIS/2000, 4GLEMIS is 4GL based

¹⁰ Repository: Database including system construction data and program information. It is usually used in the same meaning as "data dictionary" to control data attribution (data related to data definition specification and address).

¹¹ Fourth Generation Language corresponding (4GL) tool: Development support tool using Fourth Generation Language for software development

products^{*12} corresponding to (3) mainly for customization and is further modified to correspond to CASE^{*13} for enhancement of (1) and (2) by supplying repository objects on CASE. In the future, we will take various batching interfaces along with modules modified for Japan as described below.

4.2 Functional problems

The business models assumed in the past in Western packages are not always suitable for Japan's own business customs and legal system. These models are diversified mainly for discrete industrial manufacturers, so that they are difficult to introduce effectively the system to CPG (Consumer Packaged Goods) with high order volume such as food and beverage and maintenance services, and production related businesses such as manufacturing industries with design at the order.

Oracle Applications was modified to Japan's characteristics from version 10.7 and various module groups will be supplied corresponding to individual businesses as a vertical solution. Specific target business will cover CPG, project type manufacturing industries, maintenance service businesses, and pharmaceutical inspection approval.

Meanwhile, eMIS/2000 due to high customizability, has been introduced without full modifications, leaving original functions to develop functions necessary in individual projects. However, it will add Japan's inherent functions to expand constituency and to develop the secondary agencies in Japan.

5. Future Approach to ERP System

Finally, we outline the direction of the ERP system and describe the future approach of Nippon Steel Corp.

5.1 Web application correspondence

At present, C/S (Client Server system) is well known as a platform of open mission critical systems. In the future the Internet will be popularized as a social infrastructure for basic framework of computerized information systems. Therefore, the ERP system should be available for WEB, in particular urgently for Intranet for transaction processing applications and for Extranets connecting several Intranets.

Each integrated business package will correspond to these trends: (1) eMIS/2000 will be available for Web at the next version of ORACLE's Designer/2000 of the development base, (2) Oracle Applications will announce to deliver Oracle Applications for the Web of Oracle Web Employees (purchasing request, expense report, production planning, asset management, inventory management, etc.), Oracle Web Customers (order sheet preparation, payment data, order receiving management, service management, etc.) and Oracle Web Suppliers (basic contract inquiry, inventory inquiry, requisition and payment data inquiry, delivery schedule inquiry, production schedule inquiry, etc.)

The middle software to correspond to full-scale transaction processing will be studied to introduce from the mission critical Web application developing tool such as the ERP system.

5.2 Response to decision support system

The past response to the ERP system was for the transaction system focusing on the fixed order processing of the basic processing such as ordering and order receiving. In contrast, from the viewpoint of development of ERP and computerized data processing, the judgment support system was strongly requested at each level including top management, control, and operation.

To respond to these requests, OLAP^{*14} products have begun to be supplied such as data warehouse (DWH) accumulating enormous data generated by corporations in analyzable form and multi-dimension DB used for effective marketing and cost analysis of accumulated data. Nippon Steel Corp. not only introduces the tools but also promotes to deliver the effective application methods and data modeling know-how. Furthermore, APS (Advanced Planning & Scheduling) which can be applied for the optimum planning function for the total supply chain of customer - delivery - production - purchasing has been noticed recently from requests to BPR and needs to establish both delivery achievement rate and inventory reduction.

The integrated business package places the basic framework on MRPII. MRPII treats sequentially parts/materials (MRP)^{*15}, factory capacity (CRP)^{*16}, distribution capacity (DRP)^{*17}. Therefore, in order to balance the capacity plan and material plan, MRP and CRP should be repeatedly processed, which is called Closed Loop MRP. APS is composed of the on-memory high speed simultaneous planning engine for the entire system and ATP (Available to promise: delivery reply function) which applies the former results. This system is operated by receiving data from the existing system or the ERP system to return the results to the original existing system after planning (see Fig. 5).

In this field, each corporation, typically Manugistics Corp. and i2 Technologies Corp., begins to supply unique packages classified by industries. Nippon Steel Corp. also will deal with this field as a key element of the ERP system.

6. Conclusions

Nippon Steel Corp. has carried out system construction by introducing the integrated business operation package, mainly Oracle Applications and 4GLEMIS, since starting SI business in 1990 for construction and introduction of the ERP system using 4GLEMIS. Technical development in recent years surrounding the ERP system is remarkable and customer motivation is very active for computerized data management, which will steadily expand this market. Nippon Steel Corp. has strong intention to establish a firm position by reinforcing the business foundation in the rapidly expanding

^{*12} 4GL base: Description in this paper was modified in "4GL Language" because 4GL base is used as Fourth Generation Language (latest generation of programming language). 4GLEMIS is also written in the Fourth Generation Language.

^{*13} CASE: Acronym for Computer Aided Software Engineering, which is a general term for various methodology and support tools for increasing productivity and quality by effectively promoting software design and development works.

^{*14} OLAP: Acronym for On-Line Analytical Processing, a processing system by which end users directly access the basic system's data for improvement and analysis. Specific applications include decision making support systems, etc.

^{*15} Parts/materials (MRP): Acronym for Material Requirements Planning, generally called material requirements planning. Arrangement plan to purchase and produce assembled products, parts, and materials based on the production plan at product level for required items, at required time (delivery time), and required numbers.

^{*16} CRP: Acronym for Capacity Requirements Planning, generally called capacity requirements planning. Each item planned at MRP is scheduled and piled up for loads at each process to coordinate balance with holding capacity (facilities capacity and required personnel)

^{*17} DRP: Acronym for Distribution Requirements Planning, generally called distribution requirements planning to plan and coordinate distribution loads for parts shipping, distribution route, distributing method, and timing.

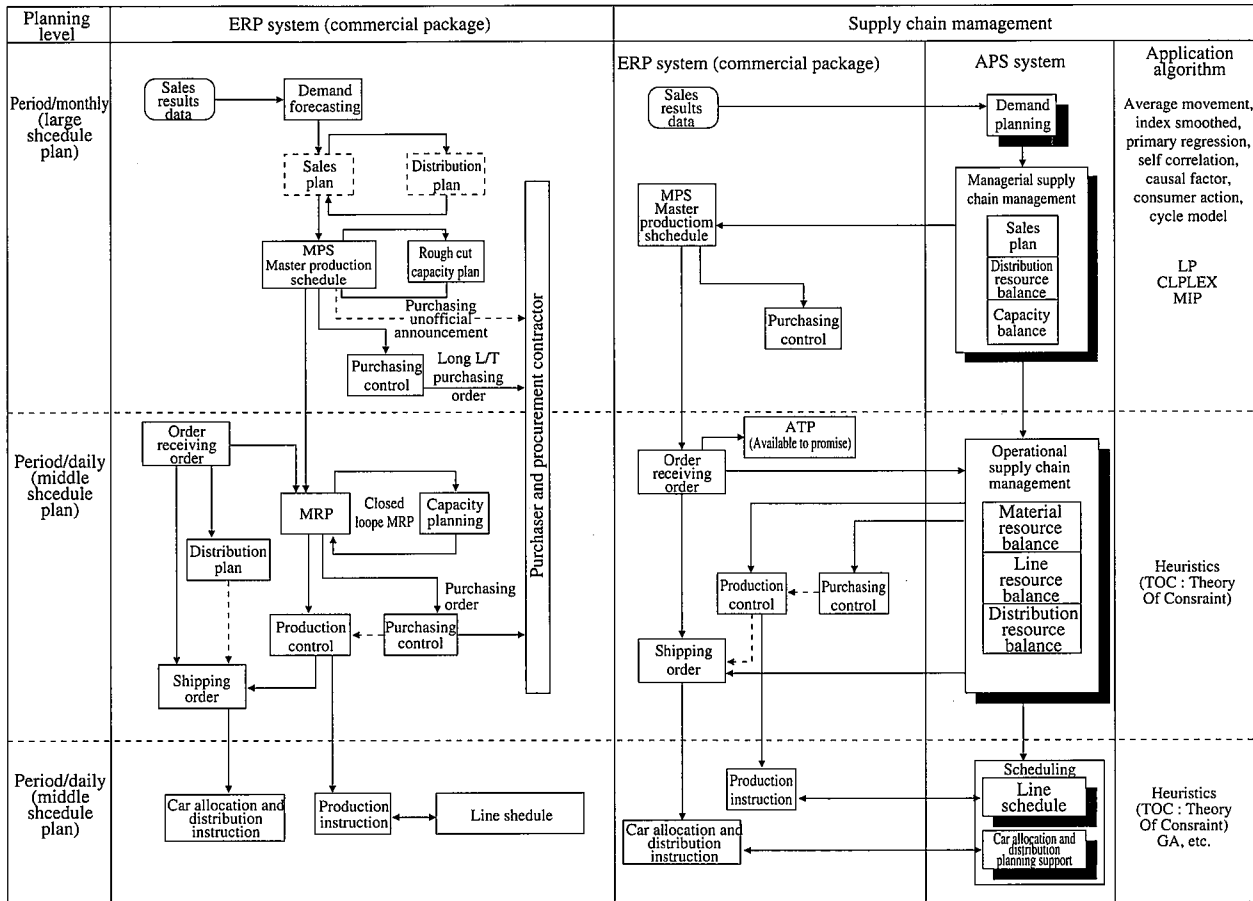


Fig. 5 Relation between ERP and APS

market. For this purpose, it is requisite to supply the integrated ERP system by assembling solutions by new judging support system such as DWH (Data Ware House) and APS on our past experiences. In addition, we will search for not only our own business packages but also a wide range of business configurations such as owner's consultation of dominant third vendor packages as well as cooperation with other system integrators to secure the system integration capacity for the full-scale ERP system.

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