System Creation for Company-wide Cross-Sectional Use of Information for Cost Planning during

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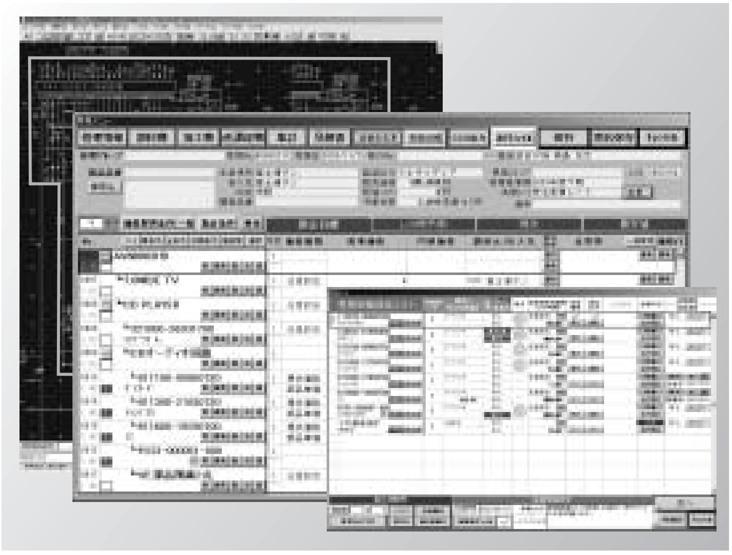


Abstract

In order to continue to profit and grow in today's rapidly changing world, a company must engage not only in the planning of individual products but in business planning, or the creation of profit-generating business models.

The cost planning division, which is responsible for the profit of a business, should constantly monitor the market superiority of the company's products and concentrate on strategically advanced product planning as well as globally optimal procurement activities in cooperation with the procurement division.

For this reason it is important, from an earlier stage of product development, to share and utilize up-to-date information on product costs throughout the company and in real time. It is also important to speed up feedback related to the results of cost reduction activities in comparison to targets, and to take quick action for abnormalities.

To meet this challenge, the company is creating a system, from the aspect of an information system, that is based on the concept of "company-wide, cross-sectional use of information from the conceptual design stage".

As part of this effort, this report will introduce a "data model for vague part structure" for the conceptual design stage, when not all of the structure has been determined for a product whose technology is established. The report will also introduce an "architecture that takes the results of studies of part unit costs, including those from overseas subsidiaries, and incorporates them into planning decisions pertaining to product unit costs".

1 Introduction

In the automobile industry, there is fierce competition aimed at tackling environmental problems, improving safety, pursuing convenience and comfort, and otherwise developing cutting-edge fields. Global cost competition is also extremely intense. And with the shortening of product life cycles, continuous drop in selling prices, and rising influence of foreign manufacturers, it has become increasingly difficult to secure a profit.

In this situation, our company, as a member of the automobile parts industry, is facing the challenge of enhancing its presence as a global player. To ensure that our business activities are accepted throughout the world, persistent efforts aimed at maintaining and strengthening our international cost competitiveness are essential. The implementation of conventional cost reduction measures, such as making after-the-fact improvements for mounting costs, will make survival hopeless. In the future there will be an urgent need to improve the cost planning activities of the past, implement "forward-looking product planning" and "optimal global procurement activities," and create a system that is a step above the current one. Moreover, for strengthened competitiveness, improved "speed" and "drastic improvements in efficiency" are needed so that required tasks can be completed within limited time periods.

Given this background our company is creating a system based on the concept "company-wide, cross-sectional use of information during the conceptual design stage" from the aspect of an information system. This report will introduce what has been achieved up to now as well as plans for the future.

2 Issues related to cost planning activities

2.1 Cost planning process

Our company's basic cost planning activity process is as described hereinafter (Figure 1).

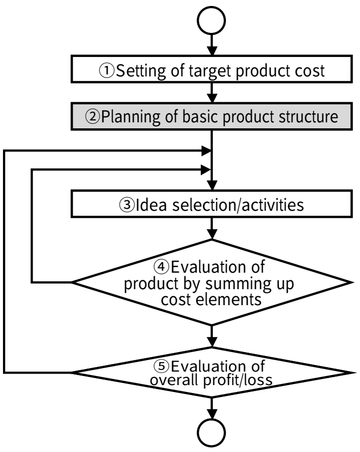


Fig.1 Cost planning activities

The basic product structure that influences cost is determined during the conceptual design stage. For this reason the activity starting from step ② is extremely important. Also, because it is a company-wide activity, which include those of overseas affiliates, it is important to summarize and feed back the evaluation results of ④ and ⑤ after the activities of ③ are completed. In this way, the results of the activities in ③ will be reflected in real time, making it possible to monitor current values in relation to company-wide targets at all times, which is vital to company interests.

In this regard the issues described hereinafter had emerged in connection with our company's cost planning activities.

2.2 Start of cost planning activities

The adoption of major new electronic parts and high-priced parts is examined during the conceptual design stage. The corresponding structural information for each product officially makes its way to the departments concerned starting from the primary prototype stage when the in-house drawings are issued.

Generally, improvements to the design specifications will have less and less effect on the cost as the conceptual design stage moves toward production. Thus, opportunities to reduce costs have been lost when cost planning activities were delayed. And though partial cost studies could be conducted without a parts list (the in-house drawings), the accuracy of the evaluations described in ④ and ⑤ above did not improve, leaving the company to reexamine its cost planning activities.

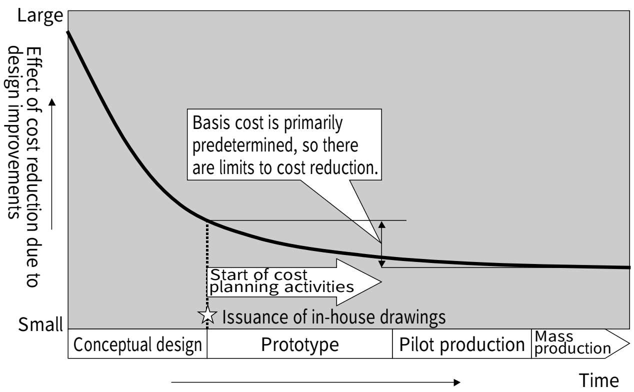


Fig.2 Development schedule and cost establishment

2.3 Company-wide information sharing/dissemination means

Materials containing activity target information, material costs, processing costs, and other survey results were created by the cost planning division using spreadsheet software and disseminated to the concerned divisions through means such as groupware and e-mail. These materials, however, were created in division units and the computation formats also varied. Consequently, information transmission was limited to viewing only, there was no improvement in the information transmission speed that was required for sharing information throughout the company, and there were delays in the feedback of up-to-date information and in surveys on the overall effect.

2.4 Labor required by cost estimating

At the present time, the most time-consuming part of cost estimating is that of gathering information on the prices of parts. This situation has been a problem because it prevents personnel from devoting sufficient time to the planning work that they would prefer to do. In the future as overseas local procurement expands and commercial distribution/product types become more complex, this tendency will grow even more. Also, if we look at impact studies that simulate individual costs and study them from product cost to overall profit or loss, it is clear that the computation algorithm became more complex.

Thus, with conventional methods, an exorbitant amount of labor was used for gathering and calculating, and a drastic improvement in efficiency could not be expected.

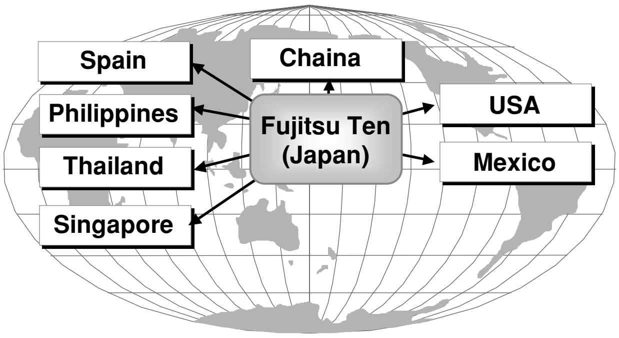


Fig.3 Design, production and procurement bases of our company

2.5 Challenge of cost planning

If we summarize the foregoing discussion, the challenge facing cost planning was to examine the cost of part units across the entire company from the conceptual design stage before issuance of the parts list (the in-house drawings), while simultaneously creating a situation in which appropriate action was taken and the effect of product unit cost and profit/loss was synchronized with design progress and could be monitored in real time.

3 Essential issues related to information systems

3.1 Functions expected of system

In order to meet the challenge of cost planning, an information system is expected to fulfill the three functions described below.

①Company-wide sharing/use at conceptual design stage
During the vague conceptual design stage, it must be able to evaluate the effect that a common design and other concepts have on cost and profit/loss.

②Real-time dissemination and use of cost information from throughout the world
It must be able to instantaneously link the effects of local procurement activities around the world to cost planning decisions.

③Modeling and quantification of product functions
It must be able to develop cost planning activities (functional element forecasting and cost trend development) that anticipate things such as future technology trends and customer demands.

3.2 Present state of system

3.2.1 Present state of applications

Our company did not possess a cost planning application that had the desired functions, nor did any commercially available package software have a solution that could solve the issues facing our company. Reasons for this situation include the following three possibilities:

①Design results that were needed for cost studies generally consisted of parts lists. There were no precedents of alternative results at the conceptual design stage or data models that expressed vagueness.*1

②There was no established architecture through which part-unit cost studies could be conducted individually, information shared between the design and procurement divisions, and information assembled and evaluated in product units.*2

③There were no instances of application coordination that instantaneously linked the design division and head office procurement division to the local procurement base. Each division presented and saved cost information using an independent method. Consequently, an optimal company-wide information utilization system was not developed.

Design results that indicate the product structure are essential for information sharing at the conceptual design stage; however, the existing parts lists did not fulfill that role.

This is most likely because the primary purpose of the parts list was to help make arrangements for parts rather than to examine prices. And even though it was intended for work that did not allow vagueness, namely parts logistics, the parts list was used to transmit information during the vague conceptual design phase. Thus, a contradiction existed.

3.2.2 Present state of information system structure

Cost planning activities require that databases and applications of cost information from the procurement division and design information from the product design division be coordinated throughout the company and across sectional lines. Our company's information system structure, however, consisted of islands of information separated by the following divisions:

①Administrative core system/engineering system
②Head office system/overseas operational base systems
③Company-wide system/systems for each department.

These divisions, which were likely the result of organizational growth, network infrastructure, and/or rapid popularization of personal computers, have inhibited company-wide, cross-sectional use of information.

3.3 Technical issues related to system architecture

To materialize the functions expected of the information system, the following two technical issues must be resolved:

①Establish information technology such as architecture and data models, the application issues mentioned earlier, and establish new ways to work using them.

②Establish an interface that links the information islands in order to achieve company-wide, cross-sectional information sharing between design, procurement, and overseas affiliates.

*1 Data model:
Abstract model of real-world events that has been developed from the aspect of a database

*2 Architecture:
Hardware, operating system, network, application software, and other basic design components and design concepts

This report will focus on ① and explain key points in the technical development of a "data model for a vague part structure" and an "architecture that incorporates part-unit activity results (cost studies), including those of overseas affiliates, into product-unit cost planning decisions," both of which particularly require the establishment of technology.

And though ② is not an issue that is directly related to cost planning, it is a common issue that should be recognized from aspects such as infrastructure and system standardization in order to implement business activities that are globally accepted. Therefore, in this report its discussion is limited to factor analysis and solution direction-giving.

4 Key points of technical development

4.1 Data model for expressing vague information

With regard to part information, the term "vagueness" in the conceptual design stage refers to the following two items:

A: Nonassignment of a number to a new part when adoption is being considered

B: Undetermination of part structure since design is in progress

During the conceptual design stage, in-house numbered parts and unnumbered parts are mixed together. The assignment of numbers advances with design progress, and the expressions change moment by moment.

Vagueness can cause some specific problems. For example, if the major circuits, printed circuit board configuration, and key parts have been determined in the conceptual design stage, it becomes necessary to estimate the cost based on the results of past product estimates. In such cases the cost estimates are generally made to a certain degree on a cumulative basis, based on similar parts lists from the past.

With this method, however, accuracy cannot be expected with new parts for which there is no similar parts list, and it is difficult to say that such cost planning simultaneously advances with actual design progress. Thus, a data model was conceived that made it possible to express part information based on aforementioned items A and B.

4.1.1 Expression model for part itself

Regarding the part ID (Identification*3), which is the basis of the data model, an internal ID was assigned by computer during the conceptual design stage instead of using the part number from the parts list. In that situation, however, a row of numbers emerges, causing a deficiency in convenience and identification. For that reason a decision was made to enable part names to be arbitrarily assigned when numbers for the "main circuit board," "power IC," and other parts have not been determined.

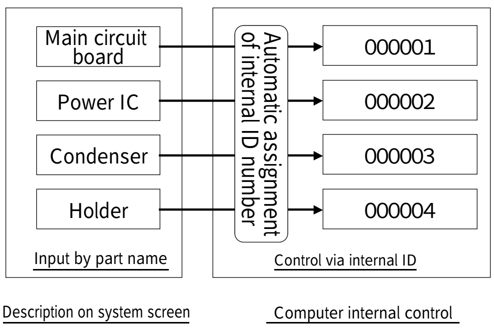


Fig.4 Internal IDs of parts

Next, when arbitrarily assigned part names are shifting to in-house part numbers according to the progress of the design, the following name-classification identification numbers were assigned to identify situations in which part names and in-house part numbers are mixed: 0 = arbitrary name, 1 = temporary part number, and 2 = in-house part name. The reason for setting up temporary part numbers as a classification in this instance is that there were many restrictions on in-house number assignment conditions for standard electronic parts, including confirmation of part qualification test results and completion of part attribute information input. Moreover, the use of temporary part numbers was thought to be appropriate for information sharing until official adoption had been approved.

Thus, at first it was possible to use vague expressions with internal IDs and arbitrary names during design, while using temporary part numbers when requests for part estimates were sent to the procurement division. Then after official adoption, the part IDs were changed from internal IDs to in-house part numbers. In this way it was possible to share information during the conceptual design stage and shift smoothly to the conventional system.

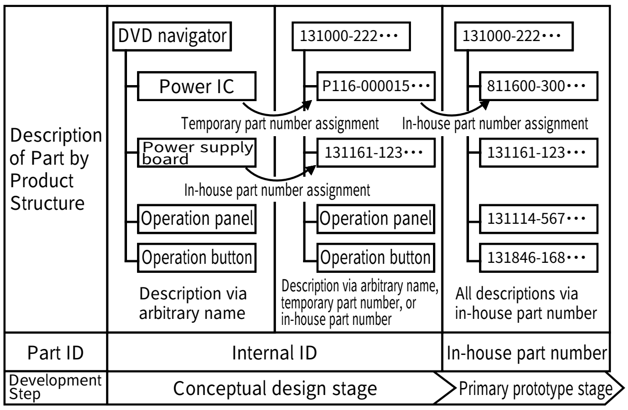


Fig.5 Name classifications of parts

4.1.2 Expression model for product structure

Product structure during the vague stage is difficult to express with a simple list format known as "single-stage regular development*4," a standard format for a parts list.

*3 Identification:
A number or symbol that uniquely indicates the existence of data in a database, such as an employee code that indicates an employee. Because of the need to indicate items uniquely, a number or symbol that can guarantee uniqueness is often used instead of a name.

*4 Single-stage regular development:
An expression that indicates a structure. It is expressed in a single-stage parent-child relationship. The expression for a three-generational relationship, for instance, is referred to as multistage, while an expression that views the parent from the child is referred to as reverse development. A parts list is managed by means of single-stage regular development when data is created or revised. During utilization, however, multistage expressions and reverse development may also be applied.

Taking as an example a car navigation system, our company's principal product, it is difficult to imagine the entire product using single-item parts lists since, for product parts lists, there are 15-16 of the aforementioned "single-stage regular development formats."

Also, during the conceptual design stage, when one wishes to express the functions of a part group such as a "power supply unit circuit," the structure may not be limited to the parts that actually exist, as in a parts list. For this reason a multistage form was adopted for the part structure.

承認済 Approved 部品表 PARTS LIST

ECO No. EN 000039206

品名 PART NAME	品番 PART NUMBER	ASP	数量 QTY	DR	部品番号 SYMBOL NUMBER	NEW
TUNER S.	121312-34608700	S	0001 /0001			N
PANEL	121832-47800700	P	0001 /0001			N
KNOB	121843-1820A700	P	0001 /0001			N
CAP	121865-00300700	P	0006 /0001			N
DISPLAY UNIT	121921-16600700	P	0001 /0001			N
DISPLAY UNIT	121921-1680A700	P	0001 /0001			N
MICRO PROCESSOR	121923-65400880	P	0001 /0001			N
CUSTOM-MADE- IC	121926-00600880	P	0001 /0001			
REMOTE CONT A.	143000-17700700	A	0001 /0001			N
CD DECK A.	321000-35608700	A	0001 /0001			N

Fig.6 Issued parts list

With multistage it is easy to use group expressions for parts in functional units. For this reason, the number 3 (= functional group name) was added for the aforementioned name classification's identification number, which simplified management-related classifying. Also, the result from this structure expression was given the name "product structure."

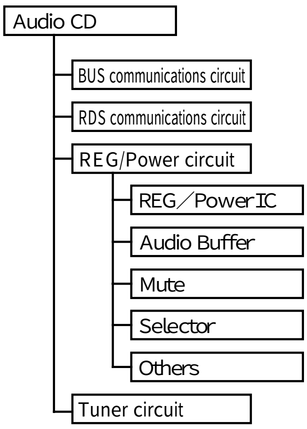


Fig.7 Product structure

4.2 Data model and architecture for cost information

There are a number of cases in which information that made use of parts lists has been utilized after production. For instance, in the area of environmental regulations, there have been cases in which the content of hazardous substances in parts was individually investigated, and the gross weight in product units was calculated. Thus, a cumulative database was built in part units and combined in a parts list, and then used for evaluation in product units.

Recent actions taken for the conceptual design stage are shown below:

①Efforts to centralize control of individual part cost information that was scattered around the world, including that of overseas affiliates' systems, by creating a company-wide, cumulative database.

②Establishment of an architecture that draws centrally controlled part cost information into product units, using the aforementioned product structure.

4.2.1 Construction of global cost database

When examining parts during cost planning, it is essential to organize part cost information that includes not only the home office in Japan but the overseas affiliates.

Such part cost information includes the decided price, target price, estimated price, future price, and other price information that varies according to the purpose and target period even when the part is the same.

Factors that influence price information include the purchasing section,supplier, assumed purchased lot, exchange rate, and mold cost. The mold cost includes a particularly large number of factors that affect part costs, such as common mold, purchase/unit-cost premiums, and depreciated lots.

A globally integrated database was built to create a data model of these factors and for centrally managing them on a global scale. It is expected to be used in the future as an analysis database for cost planning as well as for achieving optimal best global procurement.

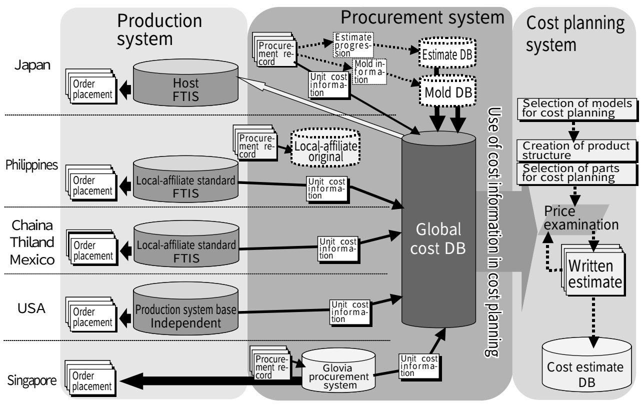


Fig.8 Global integrated database

4.2.2 Product estimation architecture

During cost planning, the evaluation aspect of product estimating requires that a single product be evaluated from different perspectives and includes the following estimates:

a. Current estimate

b. Target cost estimate

c. Expected estimate at "line-off" time (start of shipment).

Also, depending on the location of a prospective production site, the exchange rate and buyer that should be selected, for instance, may vary (Figure 9).

A decision was made to perform the objective-based estimates in a thru c simultaneously and multidimensionally by setting them as estimation conditions.

For example, when a prospective production site is specified as a buyer's first choice, the exchange rate is automatically determined, a procurement route that raises the local procurement rate is selected, and individual part prices are incorporated into price estimates when products come off the line.

At this time, the price of the part is extracted from the information that is in the globally integrated database, based on the procurement route that is selected. Thus, even if part prices are registered in the database, a price will not be extracted if there are different procurement routes. Also, because the price is extracted from the second prospective procurement route. Alternatively, it may be necessary to develop a new procurement route that uses the original prospective production base as the optimal buyer.

Therefore, a function was added to emit a warning when the prices of parts making up a product cannot be extracted and when the conditions are not compatible even though the prices are extracted.

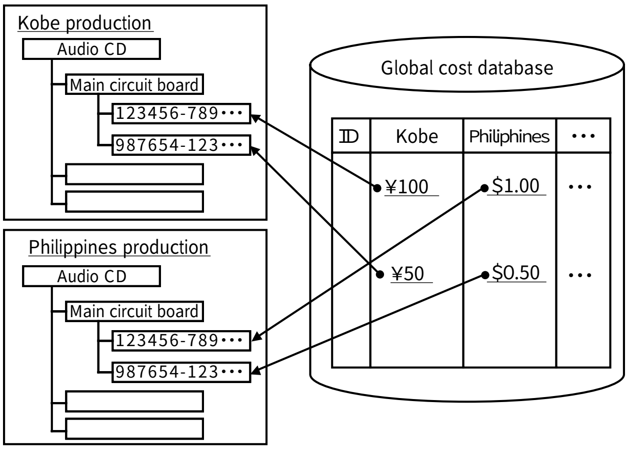


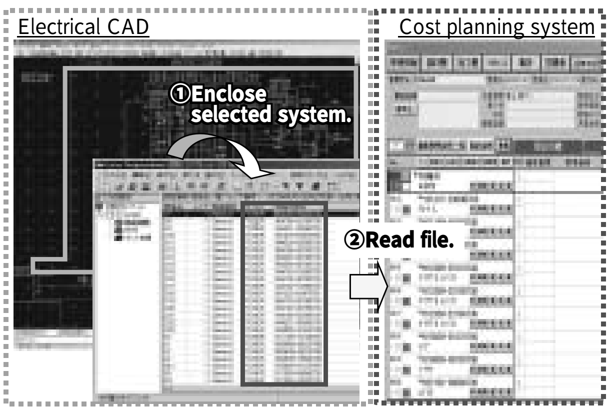
Fig.9 Product estimate architecture

4.3 Other support improvements

4.3.1. Cost studies for circuit diagrams

Design results during the vague conceptual design stage include the aforementioned product structure as well as circuit diagrams that were examined using CAD for circuit diagrams. Ultimately, the product structure can be the original information that is used to issue formal drawings as parts lists. Since it is desirable to take the results of examinations using the circuit diagrams and use them in cost planning, a data link function was developed to instantaneously develop circuits into product structures and perform cost trial calculations.

As a result of examination with circuit diagram CAD, it became possible to perform individual cost calculations for examined circuits by specifying a designated circuit range, outputting data into the part information, and loading it to the desired position of the product structure. And similarly, it became possible to cut part information from an issued parts list and incorporate it into a product structure, and, conversely, to easily create a parts list from a product structure.



Reading Parts for Each System Enclosed on CAD into the Cost Planning System.

Fig.10 Linkage image to circuit diagram

4.3.2. Request for part estimate

New-part cost studies should begin at the time the designer selects the candidate for adoption.

A part estimate request procedure (Figure 11) was created as a mechanism for successively communicating the status of product structure development to the procurement division and for promptly sharing and using new-part price information throughout the company. A support function was also developed to put it into practice.

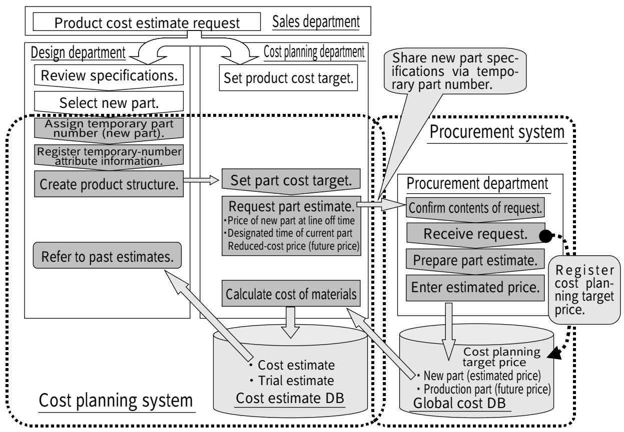


Fig.11 Work flow of part estimate request

①Temporary part number assignment function

With standard electronic parts of purchased goods, an evaluation is conducted to confirm the quality of the parts before the items of specification information (specifications and drawings) are registered in-house. For this reason it

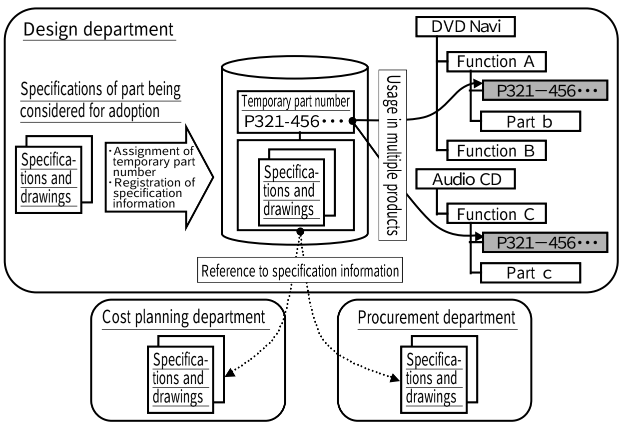


Fig.12 Sharing of information on new part specifications

takes more time to register the specification information of parts than it does for mechanical parts and other parts whose specifications are determined by the company.

The company created a function that assigns temporary part numbers for part estimate requests, as well as a function that registers information related to part specifications when temporary part numbers are assigned, and made it possible to share part specification information, including information on standard electronic parts, from the time a part becomes a candidate for adoption.

②Parts list generation function

To study the cost of parts, the procurement division needs to know the number of uses of a part. Accordingly, the client at the information dissemination origin must total the number of uses per product for each part.

For this reason the requester who will be disseminating information needs to calculate the number of uses of each part per unit of product.

But because the number of uses of parts used in the product structure is summarized for each product function, the number of uses will be scattered among the various functions when the same part is used with multiple functions.

Generating parts lists from the product structure and automatically calculating the number of uses per unit of product in part units made it possible to reduce the labor involved in request preparation and improved calculation accuracy.

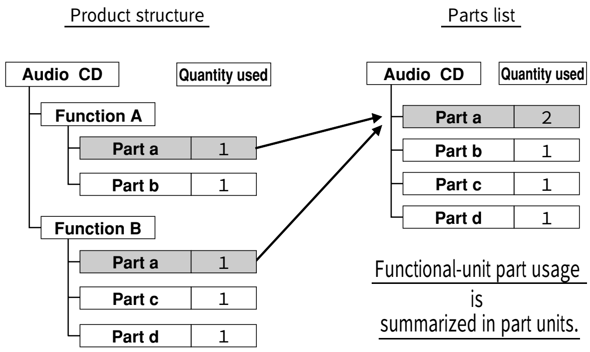


Fig.13 Collection of information in part units

③Part estimate request function

During the conceptual design stage, there are constant updates of product information that greatly affect the part cost, such as the planned number of units, place of production, and number of derived-product models.

Making it possible to take such up-to-date product information, in addition to the estimate-intended new parts list information, and disseminate it from the cost planning division to the procurement personnel at the time of an estimate request has enabled the personnel in charge of procurement to reduce the labor involved in individually gathering information and to focus on obtaining product cost targets by concentrating on activities aimed at reducing part-unit costs.

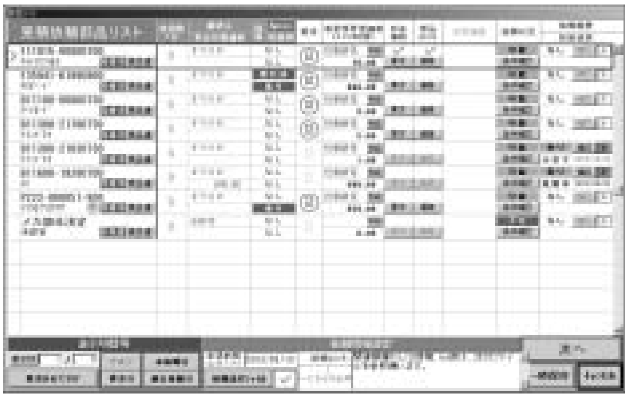


Fig.14 Part estimate request screen

④Progress confirmation function

Improving the accuracy of product cost evaluations requires the availability of up-to-date cost information on all of the parts used in the given product.

However, with general electronic parts that are used as standard parts in multiple products, the person in charge of the product does not necessarily request an estimate at the time of new adoption.

The estimate progress screen enables the person in charge of cost planning to confirm the estimate status for all parts used in the given product and makes possible the acquisition of complete, up-to-date cost information.

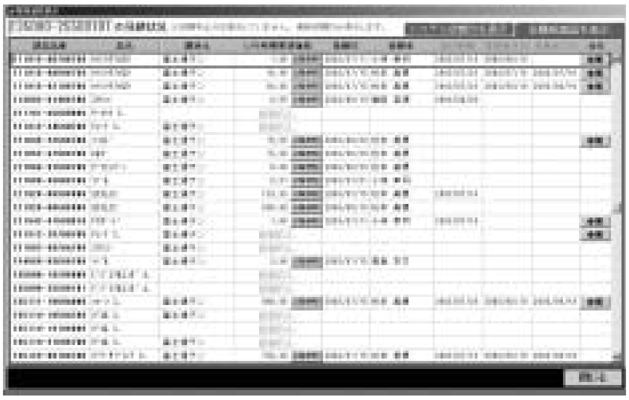


Fig.15 Estimate progress confirmation screen

5 Efforts aimed at common issues

The technical issue of information being divided into islands was mentioned previously. For such common issues, factors are analyzed and direction is given toward a solution. The primary factors are infrastructure factors and application factors.

5.1 Infrastructure factors

As for infrastructure factors, most of the internal network issues facing the operational bases have been resolved. The external networks, however, particularly the international networks, that link the bases face issues such as security barriers that are related to national conditions and threats from hackers, for instance, as well as relatively narrow bandwidths in comparison to the internal networks.

5.2 Application factors

Application factors, on the other hand, are caused by differences in databases, programming languages, and design concepts, for example. Databases vary, reflecting differences in the operating environments of general-purpose computers, personal computers, and other information systems. Generally, however, integration is being promoted in steps, as the system moves toward centralization and away from mutual use via open-type databases.

6 Future challenges

This report has introduced some of the company's key undertakings. But as these actions were going forward, new challenges began to appear.

One challenge is to eliminate vagueness and estimate the ripple effect of a partial change on the whole by quantifying all of the events of the conceptual design stage, including cost planning, which was addressed here. Another challenge is to detect abnormal values and issue an alarm. By comprehensively correlating them, we can establish a more wide-ranging impact forecasting system can be established.

For instance, the system will be able to convey changes in the number of ordered units to changes in profit/loss due to increases in material costs, perceive the effect that worsening individual product costs have on overall profit/loss, and perceive the effect that design difficulty and common designs have on design labor, thus forming the basis for personnel hiring plans from an intermediate-range perspective.

These can be used during the rapidly changing conceptual design stage and order-receiving/negotiation stage much like a radar to constantly monitor the various ripple effects and as reevaluation indicators for management. And if an advance alarm can be given, a great contribution can be made to the company's global competitiveness in this current age of uncertainty.

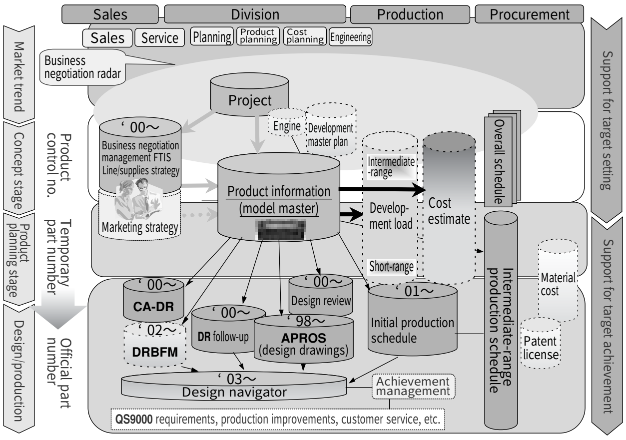


Fig.16 Frontloading at conceptual design stage

7 Conclusion

With the efforts that have been made up to now, unprecedented wide-ranging organizational involvement has been expected. Activities have made it possible to see the intrinsic weaknesses of the company's information systems, and a direction for the future has been determined. In the future we plan to develop this direction and refine our information technology and management techniques in order to develop an innovative information system. By thus maintaining and improving our international cost competitiveness and boosting our presence as a global player, we hope to achieve results that exceed the expectations of our customers.

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