Re-engineering the Sales Department

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Abstract

Successful bid preparation for complex products requires cooperation among specialists of different domains. To enable efficient cooperation between employees of different departments a computerized system capable of supporting distributed processes on possibly different hardware platforms is necessary. This paper presents a concept for cooperative bid preparation as well as concept and infrastructure designed to support the pre-sales phase for companies producing capital goods. Within the ESPRIT project No. 7131 "BIDPREP - An Integrated System for Simultaneous Bid Preparation" enterprises, research institutes and a software vendor cooperate to develop a generally applicable solution.

Keywords

Bid preparation, teamwork, concurrent engineering, distributed processes, object orientation.

1 INTRODUCTION

The preparation of a bid for a one-of-a-kind product tailor-made to customer demands is a complex task as the product specifications are usually incomplete, contain contradictory requirements and undergo last-minute changes. Reliable concepts are hard to produce as the customer sets a tight deadline for submitting the offer. Furthermore, the cost calculation has to be performed precisely in order to ensure a realistic chance of being awarded the contract as well as to realize a profit.

The task may become enormously complex as soon as all EU member countries are fused into one "home market" and — in a broader perspective — when international competition turns into a global encounter. Especially small- and medium-sized companies will face difficulties in their attempts to exploit the market potential. To be competitive requires both optimized organizational structures as well as computerized tools for efficient operation.

A promising concept helping companies keep their competitive edge is *concurrent engineering* [1] involving cross-functional teams from sales, marketing, product and process design, manufacturing as well as R&D. Active cooperation between in-house experts spreads the responsibility for the bid specification to all relevant enterprise activities.

Within the ESPRIT programme the Commission of the European Communities (CEC) is backing the project entitled "An Integrated System for Simultaneous Bid Preparation" (BIDPREP) which aims at developing both a methodology as well as a computerized system capable of supporting the bid preparation process by applying the concurrent engineering concept [2]. In this project, multinational companies are cooperating with research partners from Norway, Denmark, Italy and Germany.

2 THE PROBLEM SITUATION

A bid for a complex product generally consists of a technical concept as well as information about the salesprice, the delivery date, warranty, etc. Fig. 1 depicts the workflow of a typical bid preparation process:

Fig. 1: The Bid Preparation Process

Executing the different activities requires specific knowledge of different domains. Therefore, to prepare a bid for a complex product it is necessary to involve experts from different departments of the enterprise. Fig. 2 describes the relation between activities and resources:

Employee Department		Customer	Sales Agent	Technical Manager	Project Engineer	Designer	Production Planner	Purchaser	Secretary	Supplier
Task										
	Acquisition	X	X							
	Capturing of Customer Requirements	X		X	X	X			X	
	Bid Project Management			X	X					
	Product Design			X	X	X		X		
	Cost Estimation	X			X			X		X
	Order Planning				X		X			X
	Salesprice Determination			X	X					
	Document Preparation			X	X				X	
	Bid Submission	X	X	X	X				X	

NK '95

Fig. 2: Involved personnel in bid preparation

As depicted in Fig. 2, each bid passes a number of experts stemming from different departments which are possibly spread all over the enterprise. Conventional organizational structures have set up borders between these departments which impede communication and interaction as depicted in Fig. 3.

Fig. 3: Sequential Bid Preparation

As a result of this, the final bid often contains inconsistencies. Furthermore, due to a lack of suitable arrangements, redundancies occur in the process which increase the cost of bid preparation. Another aspect to be taken into account is the overall lead time for bid preparation. Performing all activities sequentially, it is often not possible to keep tight submission deadlines which can result in the rejection of the bid by the customer.

3 THE BIDPREP STRATEGY

In times of increasing competition and growing complexity of customer demands in the capital goods industry, "customer orientation" has become a buzz word. We have to understand "customer orientation" as a strategy for fulfilling customer wishes to the utmost extent. This not only affects the quality of the technical solution but also leads to a focus on cost minimization. Due to tight submission deadlines for the bid, time — in this case the lead time of the bid — also has become an important criterion.

Considering these aspects, measures have to be taken in order to enable efficient cooperation, interaction and communication within the bid preparation. Teamwork is a promising concept increasing both the quality and reliability of the bid as well as optimizing the price/performance relation by involving experts from different domains. By performing tasks in parallel, lead time can be reduced. "Simultaneous Bid Preparation" as depicted in Fig. 4 is a concept aiming at the formation of interdisciplinary, temporary teams comprising internal experts of different domains as well as external subsuppliers and the customer himself.

Fig. 4: “Simultaneous Bid Preparation”

To enable the team to perform efficiently, several constraints have to be satisfied. Firstly, the team has to be given the authority to make decisions. Secondly, an experienced employee has to lead the team. Through the cooperation within a team, individual tasks will change. For example, the designer's role as an inventor turns into that of an active team member, coordinator and project manager.

As the described bid preparation team is usually widely spread over different enterprise departments, an efficient computerized tool comes into focus. Acting as a bridge crossing the borders between individual departments, the system has to serve as a medium for communication and information exchange. It has to support access to existing solutions, former bids and available information about the customer.

4 THE CONCEPT OF AN INTEGRATED SYSTEM

The envisaged software system has to fulfill two criteria: Functionality in terms of following an overall bid preparation methodology as well as enabling cooperative work in an enterprise-wide network which might also include subsuppliers.

In order to capture the overall requirements of the enterprises regarding the bid preparation methodology functional modelling was performed by applying IDEF0, a technique based on the SADT approach (hierarchical decomposition of processes). Firstly, the “as-is” situation was captured and analyzed. Both bottlenecks and best practices were determined, following *benchmarking* [3] concepts. Finally, a generally applicable “to-be” situation was defined. As a result of the analysis, requirements in relation to the system have been identified. The system has to:

- reduce the effort of bid preparation,
- enhance cross-functional aspects of the process,
- provide access to former bids & existing solutions,
- support the precise estimation of all costs entailed,
- improve the presentation quality of the bid,
- complement existing systems like MRP, CAD, etc.

In order to support the various activities of the overall bid preparation process, the consortium has decided on a modular structure as depicted in Fig. 5:

Fig. 5: The BIDPREP System Architecture

A *supervisor module* was specified to support the coordination as well as the controlling of all bid-related activities which are performed in several departments. Its main purpose is to serve as a tool for the organization and the management of a bid preparation project.

For the specification of the product design a *bid product modeller* was designed. This module allows the efficient generation of initial product designs based on previously successful designs. The modelling concept is based on an object-oriented "meta-product model" that can be adapted to product models already in use at specific companies.

The cost estimation is realized by applying the *cost-estimation module*. The cost-estimation module employs the successive calculation principle developed by Lichtenberg [4] which presumably improves the reliability of the estimation and accelerates the cost-estimation process. The estimation process is partly based on the design structure of the product, which is provided by the product modeller.

An *order-planning module* determines realistic delivery dates. It provides the traditional features of planning systems for creating and maintaining an order plan. Information about former projects and available resources can be accessed and "what-if" scenarios can be simulated. The order-planning module also accesses the product modeller to retrieve manufacturing information.

Finally, the *document preparation module* eases the compilation of all relevant data into a bid document for submission to the potential customer. As the user configures the various bid sections into a relevant and attractive sequence, the document-preparation module accesses the results of the other modules and transforms them into the necessary formats. The final result is handed over to a standard desktop publishing application, which can — if necessary — be used to fine tune the bid document's layout before it is printed.

External modules may have to be integrated into the BIDPREP system in order to perform certain standard tasks. For example, the document preparation module will use a standard word-processing system to compile the final document.

4.1 The Supervisor

The Supervisor supports the responsible project manager to coordinate the different concurrent bid preparation activities some of which are depicted in Figure 1. The Supervisor informs the project manager about the current status of each task, the responsible team member and the deadline. Critical tasks can easily be ascertained and necessary actions initiated.

In the beginning of the bid preparation process, based on characteristic inquiry data the supervisor informs about similar former bids and orders. Thereby, it eases reuse in order to reduce the production effort, minimize technical risks and improve the quality.

Access to the BIDPREP modules is gained through start-up buttons. In this way, the user needs not know how to start the different modules or where to store the results. Another major task of the Supervisor is its role as a communication tool. Each team member fills in relevant information like changes implemented, problems anticipated, customer reaction, etc. This ensures that each team member is provided with up-to-date information and allows the replacement of a member in case of holiday, illness or obligations for other tasks.

4.2 The Product Modeller

The aim of the Product Modeller is to support the designer in the effective generation of reliable product structures in the bid preparation phase. Tasks to be supported by the Product Modeller include:

- Fast configuration of an initial product design by means of existing product templates containing formalized design knowledge.
- Creation and maintenance of product templates.
- Fine-tuning of initial product designs until the inquiry requirements are met.
- Structural as well as geometrical manipulation of product models.
- Checking of product designs for inconsistencies to be reported to the designer.
- Providing product model data to outside modules.

The Product Modeller meets these requirements by using a flexible, object-oriented product modelling concept and offering a choice of three different views of the product model:

- A *structure view* that extends full control of the object-oriented product model and allows complex structures to be created and maintained.
- An *assembly view*, resembling a structured bill-of-materials, that is especially suited for acquiring an overview of a product model and for initial configuration tasks.
- A *geometry view* for the manipulation of geometrical aspects of a product model.

Any number of views can be open for the same product model at the same time. Changes made in one view will be reflected in the other views immediately.

Similarities between parts and part families can be captured in *part classes* and class inheritance hierarchies. A product model with a very intricate class hierarchy and only a few fixed root parts can be used as a *product model template*, which generates concrete product models on demand. Such concrete product models are examples of *product model instances*, which are characterized by a complete part decomposition. Another important feature of product models is the use of expressions and rules. The main advantage of these features is automation: Expressions automate the recalculation of attributes while rules allow product structures to be changed automatically.

4.3 The Cost Estimation Module

The chance of winning an order and the possibility of obtaining an acceptable contribution margin depend very much on the ability to calculate a reliable cost price of the inquired product or service. The ability of calculating a reliable cost price is often hindered by the lack of exact information available in the bid phase of a product. Therefore, a major part of the calculated cost price depends on estimated values.

Different cost estimation techniques exist. Often, the price is determined by estimation (rule of thumb method). Another widely used method is the weight method i.e. the cost is calculated on the basis of the weight (or some other parameter) of the whole product or a part of it. These methods are suited for a quick assessment of the cost of a product in the early stage of a design but are limited in relation to their reliability. The accuracy of the costs calculated by applying these methods depends on the similarity of the calculated products to previous products as well as on personal judgement and the experience of the calculator.

To overcome these bottlenecks, the BIDPREP project has specified a cost estimation module which is based on the successive calculation method [4] in which the calculator can estimate costs by decomposing the cost factors stepwise until an acceptable result is obtained. The uncertainty of any cost component is quantified by means of statistical figures such as mean value and standard deviation. These figures guide the cost calculator in identifying the weak areas of a calculation task and thereby help the calculator to concentrate the efforts on the critical cost factors. The Cost Estimation Module supports its users with functions like:

- Creating hierarchical cost structures comprising a top level summary sheet and connected sub-level sheets.
- Performing a min-max estimation using minimum, most likely and maximum cost. Results are a mean value and a standard deviation allowing to calculate the uncertainty.
- Adding information concerning parts and activities.
- Easy search and retrieval of existing cost information.

4.4 The Order Planning Module

An important issue within bid preparation for tailor-made products is the planning of the activities needed to implement the product, i.e. how to execute the order project. This "order planning" includes a specification of the necessary activities, related responsibilities, the duration and interdependence of the activities, an estimation of involved engineering and manufacturing resources, the type of subsuppliers and their services, and other equipment needed. In this way, input for the cost calculation is provided. The planning is constrained by the customer requirements in relation to the delivery date.

The Order Planning Module supports its user with functions like:

- Creation and manipulation of the project/manufacturing plan by textual as well as graphical input/output, bar charts or activity networks, resource allocation diagrams, etc.
- Providing access to multi-project planning in order to take into account limited capacities by allowing resource levelling across projects.
- Facilitating access to former plans in order to search and extract information.
- Providing access to shared resource information, i.e. resource pools.
- Allow simulation, i.e. what-if scenarios.

4.5 The Document Preparation Module

The purpose of the Document Preparation Module is to facilitate the compilation of all relevant information generated in the previous steps into an attractive, comprehensive bid document to be submitted to the customer. The document is represented by a hierarchical data structure:

- Document level. Attributes describing this level are project/product reference, responsibility, status, due date, etc.
- Section level. Attributes describing this level are section type, author, status, dates, etc.
- Item level. Attributes describing this level are item type, author, pathname, etc.

5 IMPLEMENTATION

5.1 Multi-platform implementation

The BIDPREP system has been implemented in two different environments. Firstly, to demonstrate the operability of the system in a distributed environment, a multi-platform environment has been selected. The *Common Object Request Broker Architecture* (CORBA) [5] as proposed by the *Object Management Group* (OMG) has been adopted as the base architecture for module integration. CORBA enabled the development of the individual modules in four different countries on different platforms. Fig. 6 depicts the resulting architecture.

Fig. 6: Implementation of BIDPREP in a multi-platform environment

The Supervisor is implemented on a Sun workstation equipped with SunOS 1.4 using the event driven language XPLAIN. The Product Modeller is implemented on a Sun workstation equipped with SunOS 4.1.3. The data is stored in an Oracle database. The Product Modeller provides a complex programming interface based on the CORBA architecture allowing access and manipulation of product models from within other applications and BIDPREP modules.

Both the cost calculation as well as the order planning module operate on a WINDOWS NT platform. The implementation of the cost estimation module is based on the relational database Paradox, while VisualPlanner from ViSolutions Oy has been adapted in relation to the specification of the order planning module. The Document Preparation Module has been implemented on a Sun workstation using Word Perfect as a text processor.

Other applications which may already be in use at a companies site can also be integrated into the system. Since most commercial applications available today do not provide a CORBA interface, application shells will have to be developed that translate CORBA service requests into the appropriate application protocol.

5.2 MS-Windows implementation

The previously described multi-platform implementation of the BIDPREP system provides a powerful infrastructure capable of supporting bid preparation in a heterogeneous environment. The applied CORBA architecture has been evaluated as a future-oriented integration mechanism allowing interaction between various platforms with different operation systems.

However, small and medium-sized companies may not intend to invest in a UNIX environment. Since they might already be using various applications operating under MS-Windows, they would prefer a pure PC-based solution. Therefore, the BIDPREP methodology has with some restrictions also been implemented on a MS-Windows platform [6] as depicted in Fig. 7.

Fig. 7: The MS-WINDOWS implementation of BIDPREP

As Fig. 7 displays, for most of the activities standard software packages are available on the market. The main aim of BIDPREP system development in this environment was to add value to these software packages in terms of system adaptation (programming of procedures defined within the BIDPREP methodology) as well as system integration. CORBA as a distribution mechanism of the UNIX-based solution has been replaced by OLE 2.0 as well as by the use of Application Programming Interfaces (APIs).

6 CONCLUSION

Efficient preparation of bids for complex products requires both organizational measures like

- overcoming department boundaries
- concurrent execution of the related activities in temporary teams
- early involvement of subsuppliers and customers

as well as the introduction of innovative information technology

- based on an integrated concept
- supporting communication and interaction between all team members
- allowing quick access to existing information from former bids or orders executed

Within the BIDPREP project, a methodology addressing these aspects has been defined. A software system based on this methodology has been specified and implemented in two different ways. Within the following months it is envisaged to develop a commercial software packages based on these prototypes.

7 REFERENCES

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8 BIOGRAPHY

Prof. Dr.-Ing. Bernd Hirsch, professor for production systems design, management and control at the University of Bremen and Director of BIBA, received his degree in mechanical engineering in 1965, his doctorate at Aachen Technical University in 1969 and a honorary professorship at Hannover University in 1979. His professional career includes fourteen years of corporate production management experience in the European aerospace industry. He has authored many published papers and is a member of the IFIP Working Group 5.7. His research interests focus on production and automation technology, human-centered CIM, one-of-a-kind as well as distributed manufacturing and technology management and transfer functions.

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Dr.-Ing. Klaus-Dieter Thoben studied mechanical engineering at the TU Braunschweig. After finishing his studies, he was employed at the University of Bremen in the Faculty of Production Engineering. He received his doctor of engineering degree in CAD applications in 1989. In the same year he joined BIBA, where he led the CAD/CAM laboratory. Since 1991 he has headed the Department of Computer-Aided Design, Planning and Manufacturing. His special interests are computer-aided techniques and applications in product development, CIM and simultaneous engineering.

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