

# Enterprise Information Systems for Large-Scale Engineering Projects

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**Abstract.** ERP systems for manufacturing sector are commercially available and research on ERP systems for manufacturing enterprises is prevalent now. However, little attention has so far been paid on how to establish ERP systems for large scale engineering projects. An ERP system for a specific engineering project is usually not available commercially. In this paper, the methods and models for establishing an ERP system for a large-scale engineering project with unique features are discussed in systems engineering perspectives. First, the necessity for establishing ERP system is analyzed; second, the methods and models for developing the ERP system are discussed; finally, the relative conclusions are given.

## 1 Introduction

In order to respond to the increasing competition in the global marketplace, more and more enterprises are using different kinds of tools to improve and reengineer their business processes. ERP is one of important and typical tools among them. ERP systems are developed to integrate and automate enterprises' business processes in order to maximize benefits with constrained resources. For large-scale engineering projects, ERP systems are in high demand.

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Over the last decade, there has been quite a bit of research focus on ERP systems in manufacturing enterprises. Commercial systems are available for such firms. Research shows that the major reason for implementing ERP system was for standardizing business processes and systems [1]. However, researchers have not paid much attention on how to establish ERP systems for engineering projects and it is not possible to acquire a commercially available and suitable ERP system for a specific engineering project. In this paper, from systems engineering perspectives and systems thinking, the methods and models for establishing ERP systems for large-scale engineering projects with unique features are studied. Li and Li [2] studied the integration of systems concepts into manufacturing information systems as manufacturing managers find that the tasks in manufacturing are not only their responsibility but equally lies on the shoulders of the entire organization in days of highly competitive global markets. In this paper, the methods and models for establishing an ERP system for a large-scale engineering project with unique features are discussed in systems engineering perspectives. The main reasons that systems engineering methodology are applied to establishing the ERP system are that too many details need to be considered, and complex relationships exist among them. Certain issues, such as determining the weights for resource allocation, lead to the need for employing systems engineering methods.

## **2 Reasons to establish ERP system**

The current resource planning procedures of the project are shown in Fig. 1. In general, among resource requests from different customers, about 80% are regular requests that are expected resource demand, another 10% are temporary which are based on adjusted resource demand, and the remaining 10% are emergent ones due to urgent resource need. The resource planning department manages the requests from customers, and develops a resource plan that is based on the previous resource plan, the current resource status, and the various resource requests of the customers. The resource planning department then passes the resource plan, including customers' name, resource ID, scheduled time and date of the resources, any form of restrictive conditions for confirmed requests and so on, to the resource management department.

With the information provided by resource planning department, the resource management department decides the resource types for each application, and calculates volume of resources needed for the requests of customers, monitoring the available quantity of resources, and examining schedules for resource. Then, a short term resource schedule plan can be settled, and the resource plan is checked to see whether any conflicts exist. If one or more conflicts exist, the conflicts are dealt with and corrected manually, and the results are sent to the resource planning department for resource plan generation.

If an emergency resource application occurs that causes a conflict, the resource planning department then submits the emergency resource application to the resource management department and passes the resource plan to the main management department. In addition, the resource management department should provide information on conflicts and the resource schedule to main management department. The resource plan will be regenerated if the main management department requests to do so.

If the main management department approves the resource plan generated by the resource planning department, or receives a “no conflict” from the resource management department, then the resource planning department notifies every customer regarding the expected operation date, time, and other pertinent information. Generally, if a conflict exists among customers’ resource applications, the resource plan need to be regenerated and some adjustments are needed. Emergent and/or temporary resource applications may change the predetermined resource plan and delivery date to satisfy the new requirements. It should be noted that the applications of resource should be conducted in advance because time is needed for the resource to change their status from occupied to available.

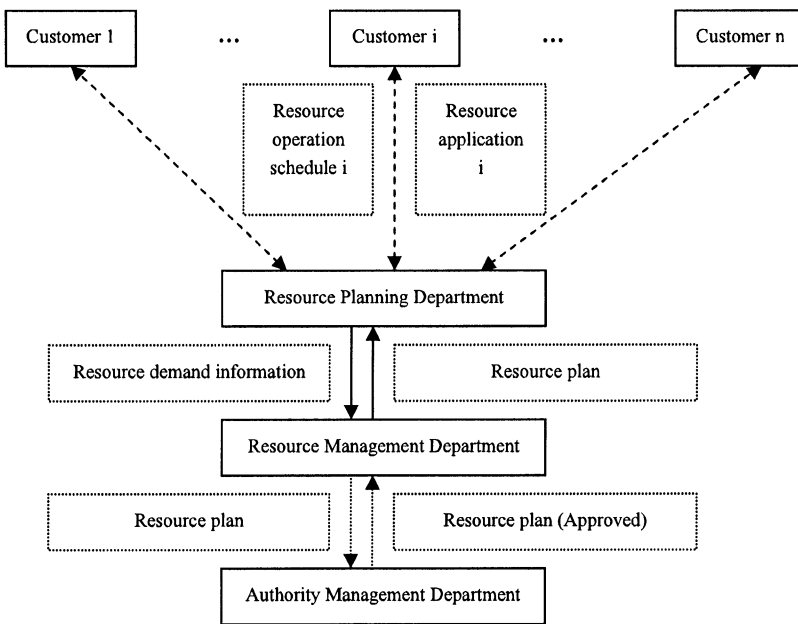


Fig. 1. Current resource planning procedures

In the above we describe the existing resource planning procedures of engineering projects that have several limitations such as:

- Resource planning tasks such as procedure processing, resource scheduling, plan generation, and information delivery, are not fully computerized, integrated and automated yet.
- Too much data or information need to be checked, such as the past resource plan, current available resource, and resource occupation during next period.
- Resource plan generation needs to be adjusted and changed manually when emergency and/or temporary resource applications occur.
- Time-consuming manual resource planning is required whenever there is a change in resource condition.
- Those models for optimizing resource utilization have not been used. As a result, sometimes some important resource requests from customers are denied; and resources of the engineering project are not used effectively.
- Conflict eluding models are not well developed. For this reason, resource requests of customers are denied frequently.

### **3 Main Methods and Models to establish the ERP system**

#### **3.1 Reengineering resource planning procedures**

The reengineered procedures of the resource planning system are shown in Fig. 2.

#### **3.2 Optimizing models**

(1) Maximizing resource utilization model

Maximizing resource utilization model is a model which can provide customers with a flexible and efficient resource plan on condition that all available resources of the engineering project are utilized properly (Fig. 3).

(2) Minimizing resource utilization model

Minimizing resource utilization model is a model that minimizing resources of the engineering project is considered on condition that all customers' requirements are met (Fig. 4).

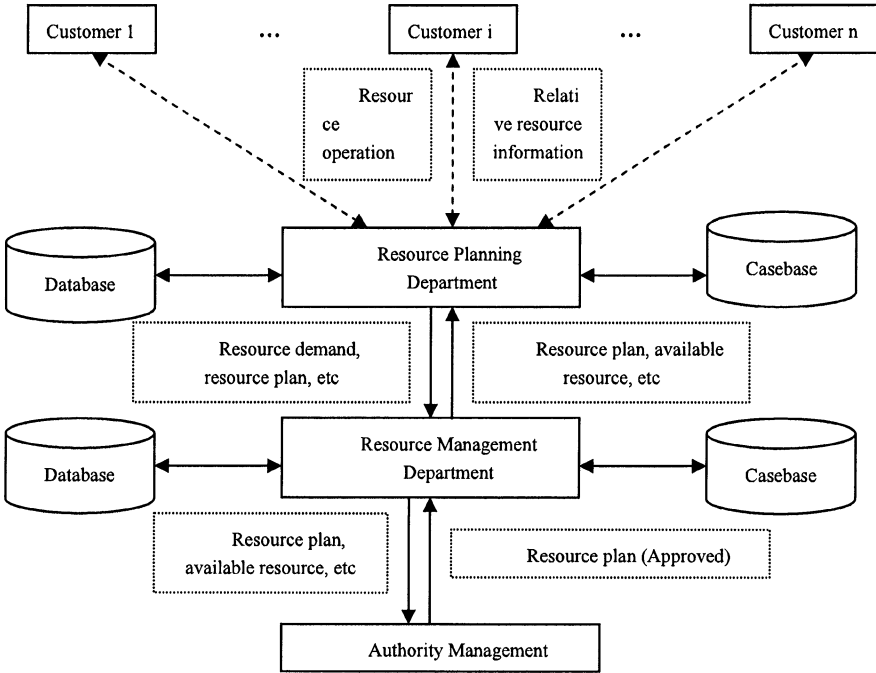


Fig. 2. Reengineered procedures

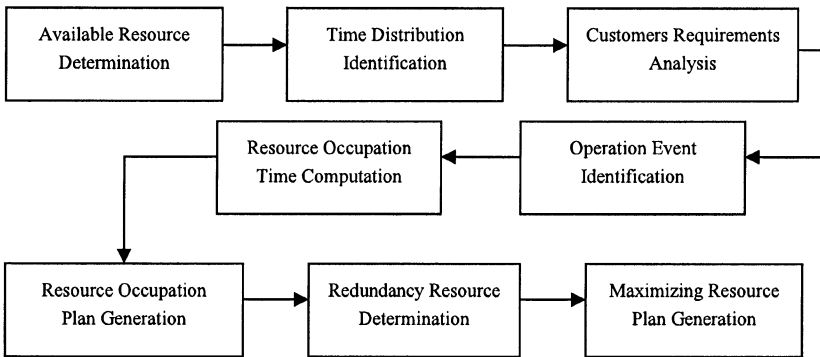


Fig. 3. Maximizing resource utilization modeling

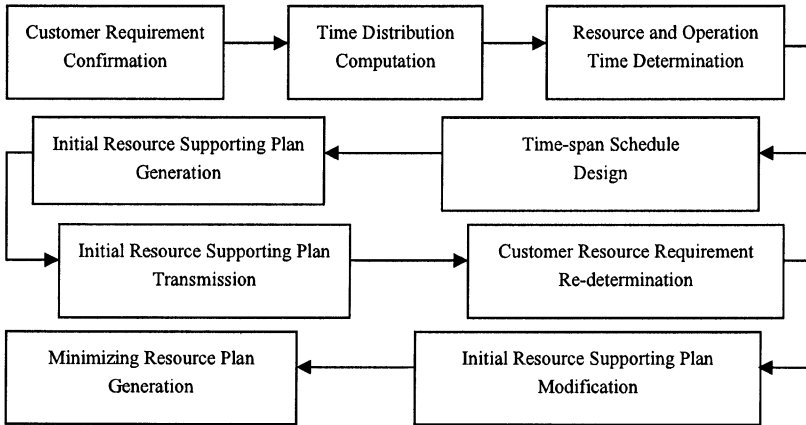


Fig. 4. Minimizing resource utilization modeling

**3.3 Conflict eluding model**

Conflict eluding model is used to eliminate the conflicts during resource planning process. These conflicts not only include the conflicts among resource applications from different customers, such as overlapping applications, contradictory applications, etc, but the conflicts between customers’ resource applications and resource supporting capability provided by the engineering project (Fig. 5).

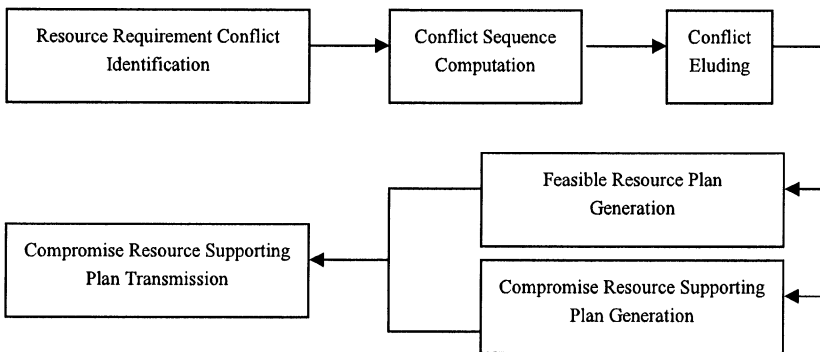


Fig. 5. Conflict eluding modeling

## 4 Conclusions

ERP system is an effective tool to plan enterprises' resources. It is equally true for engineering projects. Unfortunately, it is difficult to acquire a commercially available ERP system to meet all the resource planning requirements for an engineering project with unique features. ERP systems for this kind of engineering projects should be developed in house. In this paper, from systems engineering perspectives, the methods and models to establish an ERP system for a large-scale engineering project were studied and the main conclusions of the research in this paper include:

- (1) To use the resources effectively and to fully meet resource application requirements simultaneously depends on using the optimized models. The pertinent optimized models of resource planning system of the engineering project, including maximizing and minimizing resource utilization models, are presented in this paper.
- (2) Models to elude resource planning conflicts, for instance, the conflicts among resource application requirements of different customers and the conflicts between customers' resource requirement and resource supporting capability provided by the engineering project, are crucial for the resource planning system. The relative conflict-eluding models are discussed in this paper.

## References

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