2 Organizations and Organizational Structures

2.1 Functional and Project Organizations, Typical Goals and Performance Measures

The history of organizations is probably as long as the history of mankind. Early organizations like families or groups of hunters evolved into tribes, kingdoms and empires. The need to survive in a hostile world, to carry out missions too great for a single person and to share scarce resources, are just some of the reasons for the creation of early organizations.

Our modern society and its rapidly developing, complex technology, which results in the specialization of experts in very narrow fields, created an additional reason for the existence of organizations. Most products and services today are based on the integration of hardware, software, data and human expertise – a combination which a single person usually does not fully master. Thus, organizations in the form of expert teams are created to compete in today’s markets.

Organizations designed to produce goods and services are as old as the pyramids in Egypt or the Temple in Jerusalem. Both required the coordinated work of many people in order to be accomplished. The principles of division of labor and specialization are fundamental to many of these organizations. Adam Smith in his book *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776) describes the manufacturing of pins using these principles. The operation that he describes is a result of a well-designed process based on division of labor – each person involved repetitively performs a small part of the work required to manufacture a pin, thus rapidly becoming very efficient in performing the task assigned to him.

The principles of division of labor and specialization are useful only if good coordination is maintained between the different components of the organization. Coordination in a highly repetitive environment is relatively easy to achieve, as exactly the same processes are performed repeatedly by each person involved. Thus special approaches such as the synchronized assembly line can be implemented. If the variety of products or services supplied by the same facility is significant, the problem of coordination is much more difficult to handle. The problem of coordination is most difficult when unique products or services are required by each customer and very little repetitiveness exists. In this case special attention to the scheduling of resources and activities is required and special techniques for project planning and control are used (Shtub et al. 2004).
There is a difference between formal and informal organizations. Most formal organizations are based on a clear definition of responsibility, authority and accountability, while informal organizations are based on common interests, common beliefs, social values, feelings, tradition, etc. The following discussion focuses on formal organizations. There are many forms of such organizations. A few “prototype” organizations are common in business and industry:

The Functional Organization is based on grouping individuals into organizational units according to the function they perform. Thus, individuals dealing with customers and markets are in the marketing division; those responsible for the purchasing of goods and services for the organization are in the purchasing division, while engineers are members of the engineering group. In large organizations each division is usually subdivided into smaller groups to facilitate better coordination and management. Thus, engineers may be divided into those dealing with new product development, and those responsible for manufacturing, quality or field service. The organizational structure of a typical functional organization is depicted in Fig. 2.1.

An advantage of the Functional Organization is the pooling together of similar resources. By pooling people who share a common expertise and responsibility, and providing these groups of experts with suitable facilities and equipment, better

![Fig. 2.1 The functional organization](image-url)
utilization of resources is achieved. Furthermore, the flow of information within each part of the organization is made simple due to common background, terminology and interests of the people in each group. A good flow of information is an important factor that affects organizational learning.

A disadvantage of the functional organization is in its relationship with customers who have special needs. A customer who needs a special service, product or information that is not part of a repetitive business may have to deal with several organizational units. Since communication between different organizational units may be difficult due to the different goals, different interests and different background of the members of these organizational units, the customer may have difficulty getting what he wants.

For individuals in the functional organizations, future career paths are easily developed, authority and responsibility can be clearly defined and, due to its hierarchical structure, the “line of command” is clear.

The functional structure tends to be stable and rigid; thus it fits well organizations competing in a stable market where the same products or services are sold and demand is stable enough to support mass production. Over the years each organizational unit develops its ways and means of performing its function; local objectives become more and more important and a “tradition” is developed that may cause slow reaction to changes in the business, such as changing markets and changes in the technological environment. This stability is valuable when dedicated facilities are used to manufacture large quantities of products using special purpose equipment over a long period of time.

In a functional organization, the order-fulfillment process may cross the functional boundary lines: marketing people deal with the customers trying to obtain orders; the purchasing department is responsible for the on-time delivery of raw materials and component parts needed for the manufacturing process; while operations people are responsible for the scheduling, sequencing and monitoring of the jobs running on the shop floor. The interfaces between different organizational units are difficult to manage due to different goals and different performance measures used by each organizational unit.

In the functional organization, efficient utilization of resources is a typical goal of the operations function. Measures of productivity, efficiency and resource utilization are frequently used, and are in many instances the basis for promotion decisions and wage incentives. Similar measures are used for other functional areas as well. Total sales per salesperson per month, and the number of purchasing orders executed by the purchasing department per period, are examples of performance measures used in a functional organization.

The use of performance measures that encourage high utilization of resources may lead to poor overall performance of the organization. For example, to achieve high productivity, production people may produce more than required or earlier than needed, thus generating excess inventories. In a similar way, the marketing department may promise unrealistic delivery times to increase the volume of sales, assuming that production will be able to cope with it somehow.
Management of the order-fulfillment process in a functional organizational structure is efficient in a mass production environment where a single product or a well-defined family of products is manufactured on a dedicated facility and delivered to a relatively stable market over a long period of time.

The *Project Organization* is based on grouping people with a common mission. A task force is a typical example. A project has a starting point and a termination point. Thus, the project structure is temporary by definition. In this organizational structure, experts from different disciplines team up to achieve a one-time mission within a given budget and a predetermined timetable. An organization adopting the project-oriented structure will typically have some staff positions that serve all the ongoing projects, along with project managers who are responsible for their corresponding projects.

The organizational structure of a typical project organization is depicted in Fig. 2.2. The advantage of a project structure is that the focus of each team is on the mission and on the customers for whom the project is performed. The project team is structured accordingly to carry out the project mission. Thus, in a Research and Development (R&D) project, scientists and engineers will be the core of the project team while in a construction project architects and construction engineers will take the leading roles.

![Fig. 2.2 The project organization](image-url)
The problem of boundaries between organizational units that is typical to the functional organization is minimized in the project structure. However, a different problem is common to the project structure: resources are not pooled. For example, in a high-tech organization where several R&D projects are performed in parallel within a project structure, the same expertise may be needed on several projects. In a pure project structure the required experts will be assigned to each project even if it is not necessary to have these people on the project all the time, full time.

Since projects are unique – one-of-a-kind undertaking – it is difficult to promote learning. Individual learning may take place if individuals perform the same type of activities again and again in one or more projects. However, organizational learning is a problematic process in the project structure as the organizational structure is continuously changing with the introduction of new projects and the termination of existing projects.

Management of the order-fulfillment process in a project structure is efficient when each customer order is large enough to justify a dedicated project team with a minimum waste of resources. This is the case, for example, in a heavy industry such as shipbuilding.

To overcome the problem of duplicate resources and consequently the low utilization of resources, a combination of the functional structure and the project structure was developed – the matrix structure. In a matrix structure, the functional organization is the basis. Project teams are formed when needed by assigning part-time experts from the functional units to the project managers. Thus, most resources are still pooled together while the customer has a single contact point – the project manager. There are many variations of the matrix structure: if the projects are small, even the project manager may devote only part of his time to the project while being a member of a functional unit. On the other extreme, in a large, complex project, a core project team may be formed with a few experts assigned full time to the project. The project team is supported by people from the functional part of the organization on a part-time-as-needed basis.

The organizational structure of a typical matrix organization is depicted in Fig. 2.3.

In general, the design of an organizational structure is a difficult yet extremely important task. A structure that has been very effective over a long period of time may not perform properly when the environment changes. Thus an order-fulfillment process managed successfully in a functional organization serving a stable market may suddenly fail if competition increases, pushing lead time down while increasing the pressure for a larger variety of end products.

Consider for example the process of new product development. For many years, functional organizations used to have special organizational units responsible for new product development. When marketing identified a need for a new product, the product development department designed the product and produced all the drawings and related documents that define the physical and functional properties of the product. Manufacturing engineering, based on the product definition, developed the processes for manufacturing, assembly and testing of the product and logistics found suppliers for raw materials and components, developed packaging and shipping procedures, etc. In recent years, this functional-oriented process of new
product development has been severely criticized: it is too slow and it does not provide sufficient “value” to the customers.

The process is slow because of its sequential nature. Each organizational unit is like a link in a chain – it gets its input from the previous unit in the process and produces output, which is the input for the next organizational unit that participates in the process. Since only one organizational unit is involved at a time, the duration of the development cycle is the sum of the duration of the processes performed in the participating organizational units.

The problem with a product that provides insufficient value to the customer originates from important decisions regarding the characteristics of the product that are made in the early stages of the product life cycle (product definition and product development stages). These decisions, regarding the product’s physical and functional characteristics, have a major influence on the product’s life cycle cost and therefore on its value to the customer. Since many experts in new product development were not trained to minimize the cost of manufacturing, operating and maintaining products, their decisions represented a local optimum, and frequently resulted in a product design with many functions and options but also very expensive to manufacture, operate and maintain.
In today’s competitive markets, a fast product development process that yields new products with high value to the customers is a must for survival. In many organizations, a new approach to new product development is implemented – Concurrent Engineering (CE). In CE, teams of experts in new product development, manufacturing, operation and maintenance collaborate with the customer to design products with the highest value possible, i.e., the performances that the customer wants for the lowest life cycle cost. In CE, experts from the different areas team up in the process of developing the best possible product (Leenders et al. 2007). CE represents a new organizational structure, which is based on the process, performed by a team. It is different from the project and functional structures as it deals with a specific process: the process of new product development.

An approach similar to CE in new product development is needed for the order-fulfillment process. A new organizational structure – a team responsible for the entire order-fulfillment process – is required. A team of experts in marketing, operations and purchasing is needed to manage the order-fulfillment process from receiving a customer order to the delivery of the required goods and services. A team-based approach to the order-fulfillment process is the key to success in today’s competitive market. The objective of CE is to develop high quality products (quality-based competition) with the lowest life cycle cost (cost-based competition) in the fastest way (time-based competition). A similar objective should be adopted by the team managing the order-fulfillment process, i.e., to develop and maintain an order-fulfillment process that minimizes the lead time from receiving a customer order to supplying it. The order-fulfillment process should minimize the cost of the process and yield high quality in terms of eliminating deviations of actual supply dates from the promised dates.

2.2 The Job Shop, Flow Shop, and Group Technology

The organization of people according to the functional areas in the functional organization, according to a mission in the project organization, or according to the process they perform is in many ways similar to the organization of physical resources on the shop floor. In a manufacturing organization physical resources are machines, tools, inventories of goods, material-handling systems, furniture, office equipment, etc. In a service organization, furniture and office equipment are also used as well as machines of different types (food-processing equipment and refrigerators in a restaurant, or x-ray machines and operating room equipment in a hospital). Like people in the organizational structure, physical resources can be organized or laid out in several ways:

The job shop: This is a functional-oriented layout where machines and equipment, which perform a similar function, are grouped together. Job shops can process a variety of products by routing each product according to the specific process it requires. Like a functional organization, pooling of similar resources is the advantage of the job shop. However, coordination of the manufacturing process of a product requiring processing in different “departments” is difficult, as
each product type has a special manufacturing process and consequently a special sequence of operations on the machines. The layout of a typical job shop is depicted in Fig. 2.4.

*The flow shop:* This is a process-oriented layout in which products with similar routing or manufacturing processes are manufactured on a dedicated facility in which the layout of machines follows the processing sequence of the products. Product movement in the shop follows the machine layout, which follows the product routing; thus management of the flow shop is made easier. Flow shops are a natural approach to the facility layout when a family of products with similar processing requirements is manufactured by an organization. The layout of a typical flow shop is depicted in Fig. 2.5.

*Group technology* is a technique designed to identify products with similar process requirements and to group these products into families processed by the same equipment arranged in a manufacturing cell. By using the Group Technology concept, it is possible to transform a job shop into several flow shops, each processing a family of products that requires a similar sequence of operations. Group Technology is an example of a transformation from a functional structure to a process-oriented structure of the physical layout of a facility. The layout of a typical shop laid out according to the Group Technology principles is depicted in Fig. 2.6.

![Fig. 2.4 The job shop layout](image)
2.2 The Job Shop, Flow Shop, and Group Technology

Fig. 2.5 The flow shop layout

Fig. 2.6 The group technology layout
When Group Technology principles are correctly applied, the order-fulfillment process of the family of products manufactured in a technology cell is managed by the team assigned to the cell. In this case, a team responsible for the entire process manages the order-fulfillment process. The problem is to implement the same approach when families do not exist or when physical relocation of equipment is too expensive. ERP systems provide a solution. It is possible to define “virtual” cells in the model base and to manage these cells based on information provided by the ERP system, as explained in Chap. 10.

2.3 Operations Management and Its Interface with Other Functional Areas: Restructuring the Order-Fulfillment Process

Coordination between functional organizational units performing the order-fulfillment process in the functional organization is a difficult task. This is due to the fact that similar goals, terminology and experiences are shared between people in the same organizational unit but not across different units in the organization. To improve the order-fulfillment process, a solution similar to product development teams in Concurrent Engineering, new product development and a solution similar to the order-fulfillment process in Group Technology is needed – a solution based on assigning the responsibility for the whole order-fulfillment process to one team having a common goal to achieve better coordination among everybody involved in the process.

The order-fulfillment process begins with the customer. Two pieces of information are needed at this point: The cost of the product, and the delivery lead time. As discussed in the next chapter, in the functional organization we assume that marketing can receive the first information from the accounting system, while lead-time information is readily available from operations. In reality, however, both cost and lead time are changing continuously over time, i.e., both are dynamic; and their momentary value depends on the current load on the shop floor (Feldman and Shtub 2006).

Once a customer’s order is generated, the interface with suppliers is important: purchasing of raw materials and parts, as well as subcontracting (make or buy) decisions are part of the next step in the process. Purchasing people need to know what to order, in what quantities and what is the required due date for these orders. The common assumption, that the operations function provides a clear-cut answer to these questions may be misleading, as explained later in detail. This is due to the basic assumption that lead time is an input to the operations planning and control information system. In reality this input is a guess and the actual value depends not only on the shop load but also on the very same guess that is used as input. Furthermore, required quantities of purchased parts and material as well as required due dates change continuously over time due to the dynamic nature of operations. Finally, make or buy decisions are based on the current and future load on the shop floor – information that is ever changing and usually not known to
the purchasing people. Thus, a purchasing department that is not continuously involved in the order-fulfillment process may not deliver the right parts and materials in the correct quantity, on time.

The order-fulfillment process – from customer needs to manufacturing, through purchasing and subcontracting, is subject to uncertainty. Customers change or cancel orders, forecasts of demand are subject to errors, availability of manufacturing resources is subject to machine breakdown and employee absenteeism, while suppliers’ lead times, quantities and quality are all subject to random variation.

A well-integrated order-fulfillment process is required in order to cope with the dynamic, uncertain environment. The organization which supports such a process should not be divided by functional lines and should focus on one goal and coordinate all of its efforts to achieve this goal – a competitive order-fulfillment process that outperforms competition in cost, quality, flexibility and time.

Integrated Production and Order Management starts with a new organizational structure – the establishment of a team responsible for the entire order-fulfillment process. This team deals with the customers – forecasting demand and managing customer orders; it is also responsible for manufacturing and it is the link to suppliers and subcontractors. A single manager is responsible for the entire order-fulfillment process and he performs his job with the help of his team. This concept of an integrated team is difficult to implement in organizations where functional units exist. A well-structured order-fulfillment process can be implemented once the team is established. This process provides clear answers to the following questions:

- Why should the process be performed (goals)?
- What should be done to perform the process successfully (workflow)?
- When should it be done (scheduling and timetabling)?
- How should it be done (operations)?
- Who should do it (roles)?
- What information should be provided, to whom and in what format?
- What performance measures should be used (cost, quality, flexibility and time)?

Designing the order-fulfillment process is intended to answer these questions.

Problems

1. Select an organization that you are familiar with and draw its organizational chart. Explain the tasks performed by each function, its goals and performance measures.
2. Discuss the application of division of labor in a restaurant and in a supermarket.
3. Explain the difference between the formal organization and the informal organization in a university.
4. Under what conditions is the project organizational structure most appropriate? Give an example.
5. Write a job description for a project manager for a Research and Development project and a job description for a manager of an engineering department in a matrix organization. Explain the goals and responsibilities of each position.

6. Find an article about a successful organization. Based on the article explain how success is measured and assessed.

7. Consider the layout of a typical hospital. Is it similar to a job shop, a flow shop or a group technology-based layout?

8. Explain the interfaces between the operations manager of a fast food chain and other functional managers. Focus on the flow of information and on the decisionmaking processes.

9. Discuss the pros and cons of group decisionmaking. Under what conditions is group decisionmaking the preferred approach? Give an example where group decisionmaking is preferred and a counter-example where group decision-making is not recommended.

10. Use democracy as an example of group decisionmaking. Discuss the different levels of group decisionmaking based on this example.
ERP
The Dynamics of Supply Chain and Process Management
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