AAM
Business School

Operations Management

II SEMESTER

(Approved by Alagappa University)

26 Operations Management

Course Content:

Module I: Objectives of Operations Management

Functions of Operations Management – Systems Perspective of Operations Management – Priorities & Challenges of Operations Management - Forecasting - Use of forecasting in operation planning - Techniques of forecasting - Regression analysis, Time series, Moving average, exponential smoothing - Accuracy of forecasts. Plant location concepts - Factors affecting location decisions and techniques - Plant layout concepts - Types of layouts and their characteristics – Performance measures for layout design - Material handling principles and practices – Stages in the product development process

Module II: Inventory Functions & Types of Inventories

Inventory costs - Economic order quantity calculations - Modification of E.O.Q un der quantity discounts. Inventory Control Sy stems (P & Q Systems) -Techniques of Selective Inventory control - Pareto analysis - Just-in-time (JIT) Manufacturing concepts - Kanban system

Module III: Aggregate Production Planning Framework & Strategies

Material requirement planning (MRP) - MRP inputs & outputs - Need for schedulin g - Loading, Sequencing problems and scheduling - Job shop production control

Module IV: Concept of Quality

TQM Concepts - Quality Management Tools - Design of Quality Assurance System - Design of service operations, service capacity planning. Introduction to ISO Standards.

Module V: Aggregate Production Planning Framework & Strategies

Material requirement planning (MRP) - MRP inputs & outputs - Need for scheduling - Loading, Sequencing problems and scheduling - Job shop production control

Text Book

Norman Gaither and Greg Frazier, “Operations Management”, Cengage Publisher s, Ninth Edition

What is operations management?

Operations management is the activity of managing the resources that create and deliver services and products. The operations function is the part of the organization that is responsible for this activity. Every organization has an operations function because every organization creates some type of services and/or products. However, not all types of organization will necessarily call the operations function by this name. (Note in addition that we also use the shorter terms 'the operation' or 'operations' interchangeably with the 'operations function'.) Operations managers are the people who have particular responsibility for managing some, or all, of the resources that comprise the operations function.

Again, in some organizations, the operations manager could be called by some other name. For example, he or she might be called the 'fleet manager' in a distribution company, the 'administrative manager' in a hospital, or the 'store manager' in a supermarket.

Operations in the organization

The operations function is central to the organization because it creates and delivers services and products, which is its reason for existing. The operations function is one of the three core functions of any organization. These are:

the marketing (including sales) function – which is responsible for communicating the organization's services and products to its markets in order to generate customer requests;

the product/service development function – which is responsible for coming up with new and modified services and products in order to generate future customer requests;

the operations function – which is responsible for the creation and delivery of services and products based on customer requests.

In addition, there are the support functions which enable the core functions to operate effectively. These include, for example, the accounting and finance function, the technical function, the human resource's function and the information systems function. Remember that although different organizations may call their support functions by different names, almost all organizations will have the three core functions.

In practice, however, there is not always a clear division between functions. This leads to some confusion over where the boundaries of the operations function should be drawn. In this book, we use a relatively broad definition of operations. We treat much of the product/service development, technical and information systems activities and some of the human resource, marketing, and accounting and finance activities as coming within the sphere of operations management.

We view the operations function as comprising all the activities necessary for the day-to-day fulfilment of customer requests within the constraints of environmental and social sustainability. This includes sourcing services and products from suppliers and delivering services and products to customers

Table 1.1 Some activities of the operations function in various organizations

Internet service provider	Fast food chain	International aid charity	Furniture manufacturer
▶ Maintain and update hardware ▶ Update software and content ▶ Respond to customer queries ▶ Implement new services ▶ Ensure security of customer data	▶ Locate potential sites for restaurants ▶ Provide processes and equipment to produce burgers etc. ▶ Maintain service quality ▶ Develop, install and maintain equipment ▶ Reduce impact on local area, and packaging waste	▶ Provide aid and development projects for recipients ▶ Provide fast emergency response when needed ▶ Procure and store emergency supplies ▶ Be sensitive to local cultural norms	▶ Procure appropriate raw materials and components ▶ Make sub-assemblies ▶ Assemble finished products ▶ Deliver products to customers ▶ Reduce environmental impact of products and processes

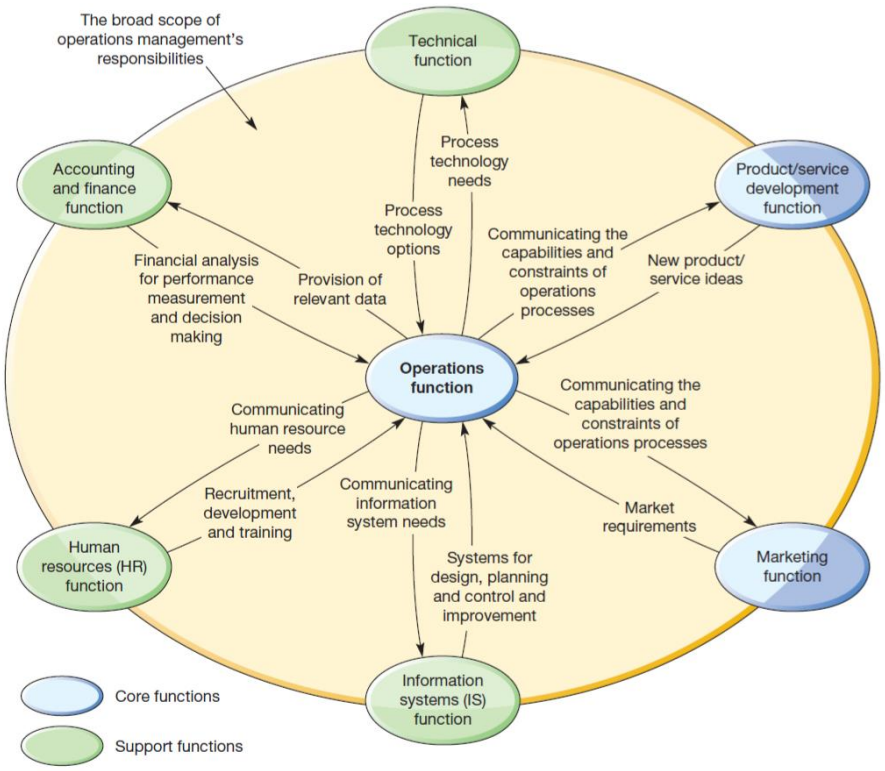


Figure 1.2 The relationship between the operations function and other core and support functions of the organization

Figure 1.2 illustrates some of the relationships between operations and other functions in terms of the flow of information between them. Although not comprehensive, it gives an idea of the nature of each relationship. Note that the support functions have a different relationship with operations than the core functions. Operations management's responsibility to support functions is primarily to make sure that they understand operations' needs and help them to satisfy these needs. The relationship with the other two core functions is more equal – less of 'this is what we want' and more 'this is what we can do currently – how do we reconcile this with broader business needs?'

Operations management in the smaller organization

Operations management is just as important in small organizations as it is in large ones. Irrespective of their size, all companies need to create and deliver their service and products efficiently and effectively. However, in practice, managing operations in a small or medium-size organization has its own set of problems. Large companies may have the resources to dedicate individuals to specialized tasks but smaller companies often cannot, so people may have to do different jobs as the need arises. Such an informal structure can allow the company to respond quickly as opportunities or problems present themselves. But decision making can also become confused as individuals' roles overlap. Small companies may have exactly the same operations management issues as large ones but they can be more difficult to separate from the mass of other issues in the organization. However, small operations can also have significant advantages; the 'Operations in practice' example on Torchbox illustrates this

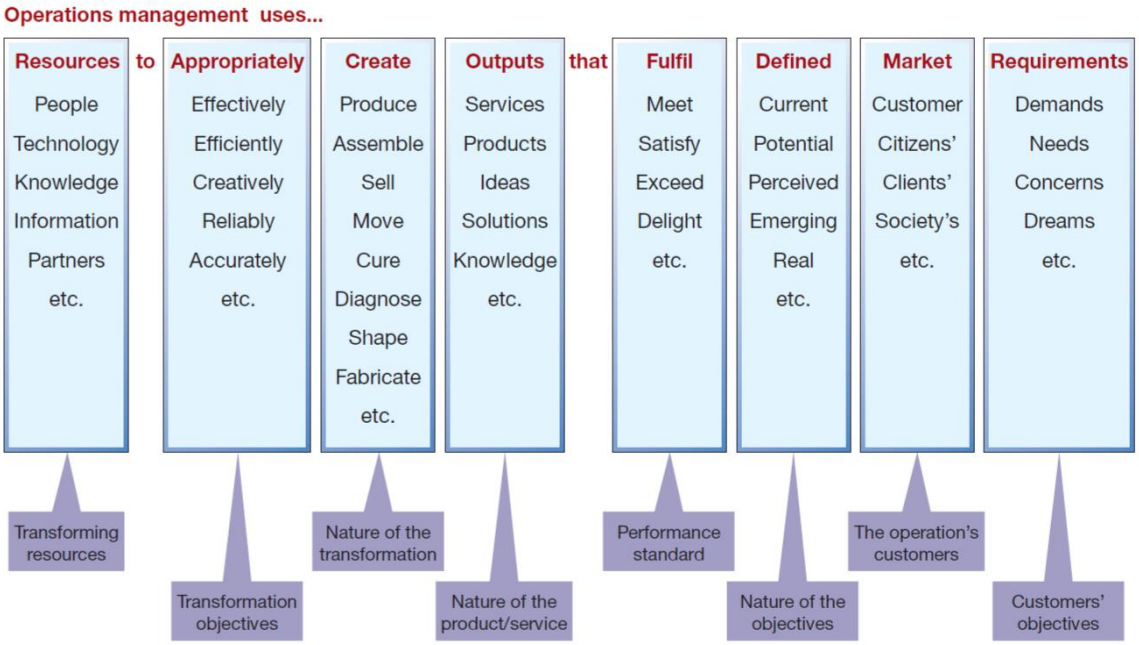


Figure 1.3 Operations management uses resources to appropriately create outputs that fulfil defined market requirements.

The new operations agenda

Changes in the business environment have had a significant impact on the challenges faced by operations managers. Some of them are in response to changes in the nature of demand. Many (although not all) industries have experienced increased cost-based competition while simultaneously their customers' expectations of quality and variety have increased. What is technological possible is also changing rapidly, as are customers' attitude to social and environmental issues. At the same time, political, legal and regulatory structures have changed. In response, operations managers have had to adjust their activities to cope, especially in the following areas:

New technologies – In both manufacturing and service industries, process technologies are changing so fast that it is difficult to predict exactly what their effect will be, only a few years in the future. Certainly, they are likely to have a dramatic effect, radically altering the operating practices of almost all types of operation.

Different supply arrangements – Markets have become more global, often meaning a demand for

a higher variety, or customized products and services. Also, globalized supply markets are opening up new options in how operations source input goods and services. Very few businesses have not considered purchasing from outside their own geographic area. But while bringing opportunities for cost savings, a bigger supply market also brings new problems of long supply chains, supply vulnerability and reputational risk.

Increased emphasis on social and environmental issues – Generally, customers have been developing an increased ethical and environmental sensitivity. This is leading to operations having to change the way they create their products and services, and be more transparent about it. Similarly, there is a greater expectation about the ethical treatment of all an operation's stakeholders, including customers, the workforce, suppliers and society in general.

What is the input–transformation–output process?

All operations create and deliver service and products by changing inputs into outputs using an 'input–transformation–output' process. Figure 1.5 shows this general transformation process model that is the basis of all operations. Put simply, operations are processes that take in a set of input resources which are used to transform something, or are transformed themselves, into outputs of services and products. And although all operations conform to this general input–transformation– output model, they differ in the nature of their specific inputs and outputs. For example, if you stand far enough away from a hospital or a car plant, they might look very similar, but move closer and clear differences do start to emerge. One is a service operation delivering 'services' that change the physiological or psychological condition of patients; the other is a manufacturing operation creating and delivering 'products'. What is inside each operation will also be different. The hospital contains diagnostic, care and therapeutic processes whereas the motor vehicle plant contains metal forming machinery and assembly processes. Perhaps the most important difference between the two operations, however, is the nature of their inputs.

The hospital transforms the customers themselves. The patients form part of the input to, and the output from, the operation. The vehicle plant transforms steel, plastic, cloth, tyres and other materials into vehicles.

Inputs to the process

One set of inputs to any operation's processes are transformed resources. These are the resources that are treated, transformed or converted in the process. They are usually a mixture of the following:

Materials – operations which process materials could do so to transform their physical properties (shape or composition, for example). Most manufacturing operations are like this. Other operations process materials to change their location (parcel delivery companies, for example). Some, like retail operations, do so to change the possession of the materials. Finally, some operations store materials, such as warehouses.

Information – operations which process information could do so to transform their informational properties (that is, the purpose or form of the information); accountants do this. Some change the possession of the information: for example, market research companies sell information. Some store the information, such as archives and libraries. Finally, some operations, such as telecommunication companies, change the location of the information.

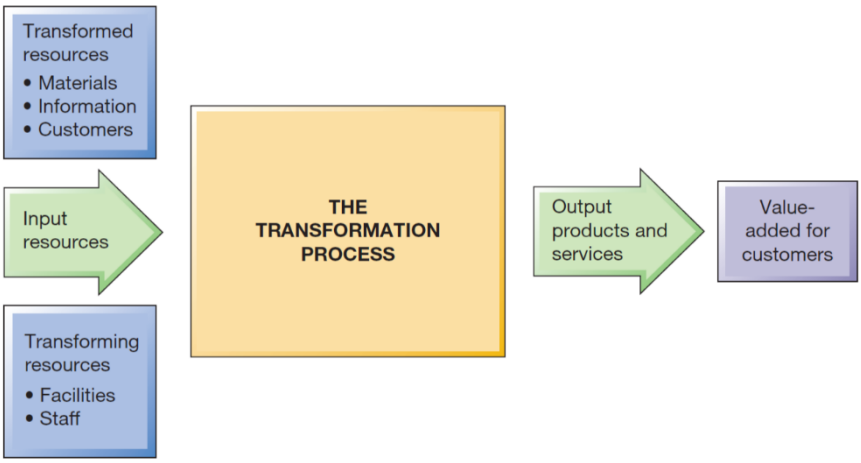


Figure 1.5 All operations are input–transformation–output processes

Customers – operations which process customers might change their physical properties in a similar way to materials processors: for example, hairdressers or cosmetic surgeons. Some store (or more politely accommodate) customers: hotels, for example. Airlines, mass rapid transport systems and bus companies transform the location of their customers, while hospitals transform their physiological state. Some are concerned with transforming their psychological state: for example, most entertainment services such as music, theatre, television, radio and theme parks. But customers are not always simple 'passive' items to be processed. They can also play a more active part in many operations and processes. For example, they create the atmosphere in a restaurant; they provide the stimulating environment in learning groups in education, they provide information at check-in desks, and so on. When customers play this role, it is usually referred to as 'co-production' because the customer plays a vital part in the provision of the product/ service offering.

Some operations have inputs of materials and information and customers, but usually one of these is dominant. For example, a bank devotes part of its energies to producing printed statements by processing inputs of material, but no one would claim that a bank is a printer. The bank also is concerned with processing inputs of customers at its branches and contact centres. However, most of the bank's activities are concerned with processing inputs of information about its customers' financial affairs.

As customers, we may be unhappy with badly printed statements and we may be unhappy if we are not treated appropriately in the bank. But if the bank makes errors in our financial transactions, we suffer in a far more fundamental way. Table 1.2 gives examples of operations with their dominant transformed resources.

The other set of inputs to any operations process are transforming resources. These are the resources which act upon the transformed resources. There are two types which form the 'building blocks' of all operations:

facilities – the buildings, equipment, plant and process technology of the operation;

staff – the people who operate, maintain, plan and manage the operation. (Note we use the term

'staff' to describe all the people in the operation, at any level.)

The exact nature of both facilities and staff will differ between operations. To a five-star hotel, its facilities consist mainly of 'low-tech' buildings, furniture and fittings. To a nuclear-powered aircraft carrier, its facilities are 'high-tech' nuclear generators, and sophisticated electronic equipment. Staff

will also differ between operations. Most staff employed in a factory assembling domestic refrigerators may not need a very high level of technical skill. In contrast, most staff employed by an accounting company are, hopefully, highly skilled in their own particular 'technical' skill (accounting). Yet

Table 1.2 Dominant transformed resource inputs of various operations

Predominantly processing inputs of materials	Predominantly processing inputs of information	Predominantly processing inputs of customers
▶ All manufacturing operations	▶ Accountants	▶ Hairdressers
▶ Mining companies	▶ Bank headquarters	▶ Hotels
▶ Retail operations	▶ Market research companies	▶ Hospitals
▶ Warehouses	▶ Financial analysts	▶ Mass rapid transports
▶ Postal services	▶ News services	▶ Theatres
▶ Container shipping line	▶ University research units	▶ Theme parks
▶ Trucking companies	▶ Telecoms companyies	▶ Dentists

although skills vary, all staff can make a contribution. An assembly worker who consistently misassembles refrigerators will dissatisfy customers and increase costs just as surely as an accountant who cannot add up. The balance between facilities and staff also varies. A computer chip manufacturing company, such as Intel, will have significant investment in physical facilities. A single chip fabrication plant can cost in excess of $5 billion, so operations managers will spend a lot of their time managing their facilities.

Conversely, a management consultancy firm depends largely on the quality of its staff. Here operations management is largely concerned with the development and deployment of consultant skills and knowledge.

Outputs from the process

Operations create products and services. Products and services are different. Products are usually tangible things whereas services are activities or processes. A car or a newspaper or a restaurant meal is a product, whereas a service is the activity of the customer using or consuming that product. Some services do not involve products. Consultancy advice or a haircut is a process (although some products may be supplied in support of the service, such as a report or a hair gel). Also, while most products can be stored, at least for a short time, service only happens when it is consumed or used. So, accommodation in an hotel room for example will perish if it is not sold that night, a restaurant table will remain empty unless someone uses it that evening.

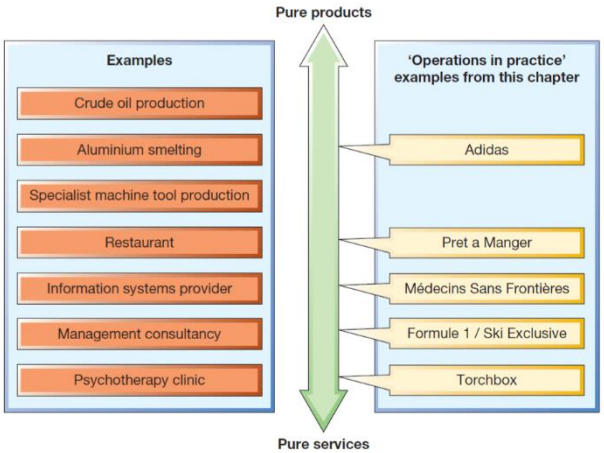


Figure 1.6 The output from most operations is a mixture of products and services. Some general examples are shown here together with some of the operations featured as 'Operations in practice' examples in this chapter.

Operations management is relevant to all parts of the business

All functions manage processes. For example, the marketing function will have processes that create demand forecasts, processes that create advertising campaigns and processes that create marketing plans. These processes in the other functions also need managing, using similar principles to those within the operations function.

Each function will have its 'technical' knowledge. In marketing, this is the expertise in designing and shaping marketing plans; in finance, it is the technical knowledge of financial reporting. Yet each will also have a 'process management' role of producing plans, policies, reports and services. The implications of this are very important.

Because all managers have some responsibility for managing processes, they are, to some extent, operations managers. They all should want to give good service to their (often internal) customers, and they all will want to do this efficiently. So, operations management is relevant for all functions, and all managers should have something to learn from the principles, concepts, approaches and techniques of operations management. It also means that we must distinguish between two meanings of 'operations': 'Operations' as a function, meaning the part of the organization which creates and delivers services and products for the organization's external customers; 'Operations' as an activity, meaning the management of the processes within any of the organization's functions.

Table 1.4 illustrates just some of the processes that are contained within some of the more common non-operations functions, the outputs from these processes and their 'customers'.

Business processes

Whenever a business attempts to satisfy its customers' needs it will use many processes, both in its operations and in its other functions. Each of these processes will contribute some part to fulfilling customer needs. For example, the television programme and video production company, described previously, creates and delivers two types of 'products'. Both of these involve a slightly different mix of processes within the company. The company decides to re-organize its operations so that each product is created from start to finish by a dedicated process that contains all the elements necessary for its production,

Table 1.4 Some examples of processes in non-operations functions

Organizational function	Some of its processes	Outputs from its processes	Customer(s) for its outputs
Marketing and sales	▶ Planning process ▶ Forecasting process ▶ Order-taking process	▶ Marketing plans ▶ Sales forecasts ▶ Confirmed orders	▶ Senior management ▶ Sales staff, planners, operations ▶ Operations, finance
Finance and accounting	▶ Budgeting process ▶ Capital approval processes ▶ Invoicing processes	▶ Budgets ▶ Capital request evaluations ▶ Invoices	▶ Everyone ▶ Senior management, requesters ▶ External customers
Human resources management	▶ Payroll processes ▶ Recruitment processes ▶ Training processes	▶ Salary statements ▶ New hires ▶ Trained employees	▶ Employees ▶ All other processes
Information technology	▶ Systems review process ▶ Help desk process ▶ System implementation project processes	▶ System evaluation ▶ Systems advice ▶ Implemented working systems and aftercare	▶ All other processes in the business

What do operations managers do?

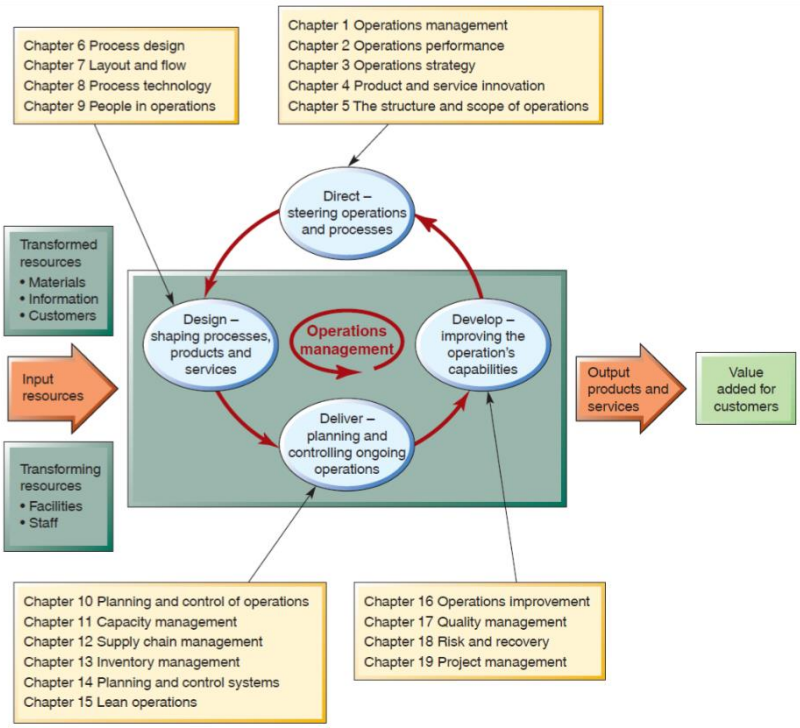
The exact details of what operations managers do will, to some extent, depend on the way an organization defines the boundaries of the function. Yet there are some general classes of activities that apply to all types of operation irrespective of whether they are service, manufacturing, private or public sector, and no matter how the operations function is defined. We classify operations management activities under the four headings: direct, design, deliver and develop.

Directing the overall strategy of the operation. A general understanding of operations and processes and their strategic purpose and performance, together with an appreciation of how strategic purpose is translated into reality, is a prerequisite to the detailed design of operations and process.

Designing the operation's services, products and processes. Design is the activity of determining the physical form, shape and composition of operations and processes together with the services and products that they create.

Planning and control process delivery. After being designed, the delivery of services and products from suppliers and through the total operation to customers must be planned and controlled.

Developing process performance. Increasingly it is recognized that in operations, or any process, managers cannot simply routinely deliver services and products in the same way that they always have done. They have a responsibility to develop the capabilities of their processes to improve process performance.



Forecasting : Roles, Steps and Techniques | Management Function

Meaning of Forecasting:

In preparing plans for the future, the management authority has to make some predictions about what is likely to happen in the future.

It shows that the managers know something of future happenings even before things actually happen.

Forecasting provides them this knowledge. Forecasting is the process of estimating the relevant events of future, based on the analysis of their past and present behaviour.

The future cannot be probed unless one knows how the events have occurred in the past and how they are occurring presently. The past and present analysis of events provides the base helpful for collecting information about their future occurrence.

Thus, forecasting may be defined as the process of assessing the future normally using calculations and projections that take account of the past performance, current trends, and anticipated changes in the foreseeable period ahead.

Whenever the managers plan business operations and organisational set-up for the years ahead, they have to take into account the past, the present and the prevailing economic, political and social conditions. Forecasting provides a logical basis for determining in advance the nature of future business operations and the basis for managerial decisions about the material, personnel and other requirements.

It is, thus, the basis of planning, when a business enterprise makes an attempt to look into the future in a systematic and concentrated way, it may discover certain aspects of its operations requiring special attention. However, it must be recognised that the process of forecasting involves an element of guesswork and the managers cannot stay satisfied and relaxed after having prepared a forecast.

The forecast will have to be constantly monitored and revised—particularly when it relates to a long-term period. The managers should try to reduce the element of guesswork in preparing forecasts by collecting the relevant data using the scientific techniques of analysis and inference.

On the basis of the definition, the following features of forecasting can be identified:

1. Forecasting relates to future events.

2. Forecasting is needed for planning process because it devises the future course of action.

3. It defines the probability of happening of future events. Therefore, the happening of future events can be precise only to a certain extent.

4. Forecasting is made by analysing the past and present factors which are relevant for the functioning of an organisation.

5. The analysis of various factors may require the use of statistical and mathematical tools and techniques.

Role of Forecasting:

Since planning involves the future, no usable plan can be made unless the manager is able to take all possible future events into account. This explains why forecasting is a critical element in the planning process. In fact, every decision in the organisation is based on some sort of forecasting.

It helps the managers in the following ways:

1. Basis of Planning:

Forecasting is the key to planning. It generates the planning process. Planning decides the future course of action which is expected to take place in certain circumstances and conditions. Unless the managers know these conditions, they cannot go for effective planning.

Forecasting provides the knowledge of planning premises within which the managers can analyse their strengths and weaknesses and can take appropriate actions in advance before actually they are put out of market. Forecasting provides the knowledge about the nature of future conditions.

2. Promotion of Organization:

The objectives of an organisation are achieved through the performance of certain activities. What activities should be performed depends on the expected outcome of these activities. Since expected outcome depends on future events and the way of performing various activities, forecasting of future events is of direct relevance in achieving an objective.

3. Facilitating Co-ordination and Control:

Forecasting indirectly provides the way for effective co-ordination and control. Forecasting requires information about various factors. Information is collected from various internal and external sources. Almost all units of the organisation are involved in this process.

It provides interactive opportunities for better unity and co-ordination in the planning process. Similarly, forecasting can provide relevant information for exercising control. The managers can know their weaknesses in the forecasting process and they can take suitable action to overcome these.

4. Success in Organisation:

All business enterprises are characterised by risk and have to work within the ups and downs of the industry. The risk depends on the future happenings and forecasting provides help to overcome the problem of uncertainties.

Though forecasting cannot check the future happenings, it provides clues about those and indicates when the alternative actions should be taken. Managers can save their business and face the unfortunate happenings if they know in advance what is going to happen.

Steps in Forecasting:

The process of forecasting generally involves the following steps:

1. Developing the Basis:

The future estimates of various business operations will have to be based on the results obtainable through systematic investigation of the economy, products and industry.

2. Estimation of Future Operations:

On the basis of the data collected through systematic investigation into the economy and industry situation, the manager has to prepare quantitative estimates of the future scale of business operations. Here the managers will have to take into account the planning premises.

3. Regulation of Forecasts:

It has already been indicated that the managers cannot take it easy after they have formulated a business forecast. They have to constantly compare the actual operations with the forecasts prepared in order to find out the reasons for any deviations from forecasts. This helps in making more realistic forecasts for future.

4. Review of the Forecasting Process:

Having determined the deviations of the actual performances from the positions forecast by the managers, it will be necessary to examine the procedures adopted for the purpose so that improvements can be made in the method of forecasting.

Techniques of Forecasting:

There are various methods of forecasting. However, no method can be suggested as universally applicable. In fact, most of the forecasts are done by combining various methods.

A brief discussion of the major forecasting methods is given below:

1. Historical Analogy Method:

Under this method, forecast in regard to a particular situation is based on some analogous conditions elsewhere in the past. The economic situation of a country can be predicted by making comparison with the advanced countries at a particular stage through which the country is presently passing.

Similarly, it has been observed that if anything is invented in some part of the world, this is adopted in other countries after a gap of a certain time. Thus, based on analogy, a general forecast can be made about the nature of events in the economic system of the country. It is often suggested that social analogies have helped in indicating the trends of changes in the norms of business behaviour in terms of life.

Likewise, changes in the norms of business behaviour in terms of attitude of the workers against inequality, find similarities in various countries at various stages of the history of industrial growth. Thus, this method gives a broad indication about the future events of general nature.

2. Survey Method:

Surveys can be conducted to gather information on the intentions of the concerned people. For example, information may be collected through surveys about the probable expenditure of consumers on various items. Both quantitative and qualitative information may be collected by this method.

On the basis of such surveys, demand for various products can be projected. Survey method is suitable for forecasting demand—both of existing and new products. To limit the cost and time, the survey may be restricted to a sample from the prospective consumers.

3. Opinion Poll:

Opinion poll is conducted to assess the opinion of the experienced persons and experts in the particular field whose views carry a lot of weight. For example, opinion polls are very popular to predict the outcome of elections in many countries including India. Similarly, an opinion poll of the sales representatives, wholesalers or marketing experts may be helpful in formulating demand projections.

If opinion polls give widely divergent views, the experts may be called for discussion and explanation of why they are holding a particular view. They may be asked to comment on the views of the others, to revise their views in the context of the opposite views, and consensus may emerge. Then, it becomes the estimate of future events.

4. Business Barometers:

A barometer is used to measure the atmospheric pressure. In the same way, index numbers are used to measure the state of an economy between two or more periods. These index numbers are the device to study the trends, seasonal fluctuations, cyclical movements, and irregular fluctuations.

These index numbers, when used in combination with one another, provide indications as to the direction in which the economy is proceeding. Thus, with the business activity index numbers, it becomes easy to forecast the future course of action.

However, it should be kept in mind that business barometers have their own limitations and they are not sure road to success. All types of business do not follow the general trend but different index numbers have to be prepared for different activities, etc.

5. Time Series Analysis:

Time series analysis involves decomposition of historical series into its various components, viz. trend, seasonal variances, cyclical variations, and random variances. When the various components of a time series are separated, the variation of a particular situation, the subject under study, can be known over the period of time and projection can be made about the future.

A trend can be known over the period of time which may be true for the future also. However, time series analysis should be used as a basis for forecasting when data are available for a long period of time and tendencies disclosed by the trend and seasonal factors are fairly clear and stable.

6. Regression Analysis:

Regression analysis is meant to disclose the relative movements of two or more inter-related series. It is used to estimate the changes in one variable as a result of specified changes in other variable or variables. In economic and business situations, a number of factors affect a business activity simultaneously.

Regression analysis helps in isolating the effects of such factors to a great extent. For example, if we know that there is a positive relationship between advertising expenditure and volume of sales or between sales and profit, it is possible to have estimate of the sales on the basis of advertising, or of the profit on the basis of projected sales, provided other things remain the same.

7. Input-Output Analysis:

According to this method, a forecast of output is based on given input if relationship between input and output is known. Similarly, input requirement can be forecast on the basis of final output with a given input-output relationship. The basis of this technique is that the various sectors of economy are inter-related and such inter-relationships are well-established.

For example, coal requirement of the country can be predicted on the basis of its usage rate in various sectors like industry, transport, household, etc. and how the various sectors behave in future. This technique yields sector-wise forecasts and is extensively used in forecasting business events as the data required for its application are easily obtained.

How can the layout and look of facilities influence performance?

The 'layout and look' of an operation or process means how its facilities are positioned relative to each other and how their general appearance is designed. These decisions will dictate the pattern and nature of how transformed resources progress through the operation or process. They also affect how both the people who staff the operation and, in high-visibility operations (where customers form part of the transformed resource), how customers judge their experience of being in the operation.

Figure 7.2 shows how both layout and look of facilities affect some of the factors on which operations facilities are judged. Layout and look are important decisions. If done badly, they can lead to over-long or confused flow patterns, long process times, inflexible operations, unpredictable flow, high costs, frustration for the people working in the operation and, in high-visibility operations, a poor customer experience. Nor are they always easy to change. A radical re-layout can cause disruption to on-going operations.

So, operations managers can be reluctant to do it too often.

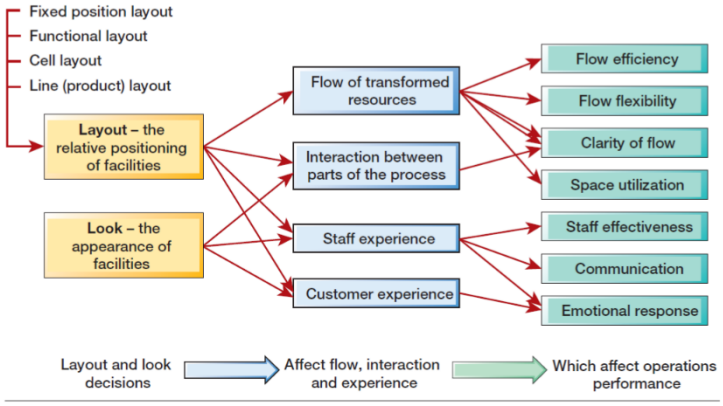


Figure 7.2 The layout and look of facilities involves the relative positioning of transforming resources within operations and processes, and their general appearance, which together dictate the nature and pattern of the flow of transformed resources and the experience of staff and, in high-visibility operations, customers

What makes a good layout?

As with most operations design decisions, what constitutes a 'good' design will depend partly on the strategic objectives of the operation. But whatever 'good' is for any specific operation, it will usually be judged against a common set of criteria, as indicated in Figure 7.2. These are:

The flow of transformed resources – The route taken by transformed resources as they progress through an operation or process is governed by how its transforming resources are positioned relative to each other. Often the objective is to achieve high flow efficiency that minimizes distance travelled. But not always. For some customer transforming operations, supermarkets for example, layout objectives can include encouraging customers to 'flow' in particular ways that maximize sales. However, sometimes high flow efficiency can be achieved only by sacrificing flow flexibility – the ability of transformed resources to take many different routes. Additional objectives can include the clarity of the flow of materials and/or customers and an effective use of the space available in the operation.

The interaction between parts of the process – The individual facilities or parts of a process can suffer or benefit from being positioned close to each other. Dirty processes should not be located near to other parts of the process where their pollution could reduce its effectiveness. Noisy processes should not be located near processes that require concentration (see the 'Operations in practice' example, 'Reconciling quiet and interaction in laboratory layout'). Conversely there may be a positive effect of locating parts of an operation close to each other, for example to encourage communication between staff (see the 'Operations in practice' example of Google's office layout).

Staff experience – An obvious prerequisite for any layout in any type of operation is that it should not constitute any physical or emotional danger to staff. So, 'fire exits should be clearly marked with uninhibited access', 'pathways should be clearly defined and not cluttered', etc. Unnecessary movement, caused by poor layout, will take productive time away from value-adding tasks. But just as important is the 'look, touch, taste, smell and feel' of an operation that will influence the 'employee experience' and hence staff productivity and morale

Customer experience – In high-visibility operations such as retail shops or bank branches, the layout and particularly the look of an operation can help to shape its image and the general experience of customers. Layout and look can be used as a deliberate attempt to establish a company's brand.

Reconciling objectives

As one can see, there are many and various objectives to attempt to achieve during the layout activity. Some, such as safety, security and staff welfare, are absolutely required. Others may have to be compromised, or traded off with other objectives. For example, two processes may have need of the same piece of equipment and could quite feasibly share it. This would mean good use of the capital used to acquire that equipment. But having both processes using it could mean longer and/or more confused process routes. Buying two pieces of equipment would underutilize them, but give shorter distance travelled. The 'Operations in practice' example 'Reconciling quiet and interaction in laboratory layout' is an example of how objectives have to be reconciled.

Most practical layouts are derived from only four basic layout types. These are:

1. Fixed-position layout
2. Functional layout
3. Cell layout
4. Line (sometimes called 'product') layout.

Fixed-position layout

Fixed-position layout is in some ways a contradiction in terms, since the transformed resources do not move between the transforming resources. Instead of transformed resources flowing through an operation, the recipient of the processing is stationary and the facilities and people who do the

Table 7.1 Alternative layout types for each process type

Manufacturing process type	Potential layout types		Service process type
Project	Fixed position layout Functional layout	Fixed position layout Functional layout Cell layout	Professional service
Jobbing	Functional layout Cell layout		
Batch	Functional layout Cell layout	Functional layout Cell layouts	Service shop
Mass	Cell layout Product layout	Cell layout Product layout	Mass service
Continuous	Product layout		

OPERATIONS IN PRACTICE Reconciling quiet and interaction in laboratory layout[3]

The layout of scientific laboratories is rarely straightforward. Not only can different areas of a laboratory require very different service needs (temperature, extraction, lack of vibration, etc.) but also two types of work in which all scientists engage can have different and opposing needs. On one hand, the development of new ideas is encouraged by free, and sometimes random, meetings between researchers. On the other hand, there are times when quiet reflection is vital to work through the implications of those same ideas. Moreover, different individuals have different preferred working patterns. The conversations, discussion and, sometimes noisy, debate between some researchers can both irritate and distract other staff who prefer quiet to think and write up their work. Even in prestigious and high-profile research operations, this conflict can be difficult to reconcile. For example, some of the researchers working at the Francis Crick laboratory in central London complained that its open-plan layout, designed to encourage collaboration, made it difficult to concentrate on their work. Some people like the background noise, which can be similar to working in a café, while others prefer total silence, although many agree that the layout has been extremely successful in terms of promoting ad hoc meetings and has created new collaborations. Professor Alan Penn, who has been investigating how open-plan layouts (for example, those in advertising agencies or science

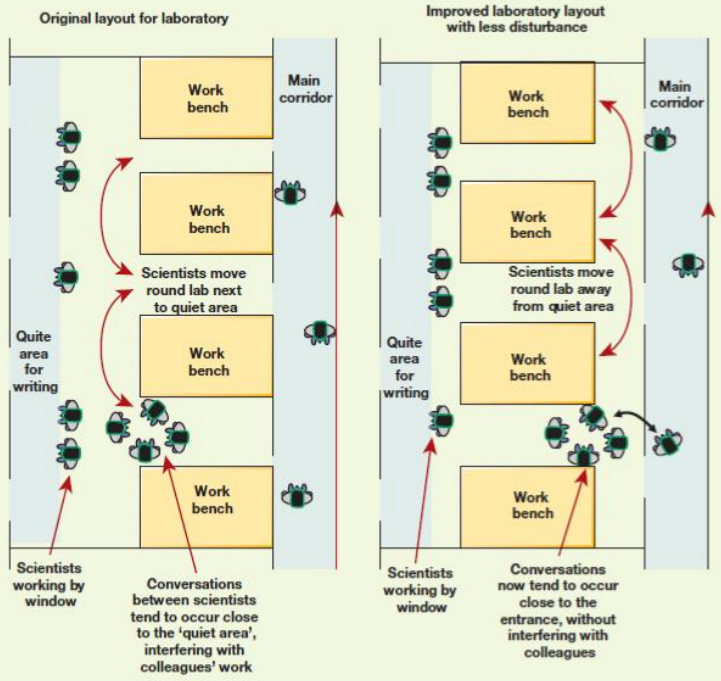


Figure 7.3 Example of an improved laboratory layout that reduces the degree of interference between different types of work (conversations and writing)

Functional layout

In functional layout, similar transforming resources are located together. This may be because it is convenient to group them together, or because their utilization is improved. It means that when transforming resources flow through the operation, they will take a route from activity to activity according to their needs. Different products or customers will have different needs and therefore take different routes.

Usually this makes the flow pattern in the operation very complex. Examples of functional layouts include:

Hospital – some processes (e.g. X-ray machines and laboratories) are required by several types of patient; some processes (e.g. general wards) can achieve high staff and bed utilization.

Supermarket – some products, such as tinned goods, are convenient to restock if grouped together. Some areas, such as those holding frozen vegetables, need the common technology of freezer cabinets.

Others, such as the areas holding fresh vegetables, might be together because that way they can be made to look attractive to customers.

Machining the parts which go into aircraft engines – some processes (e.g. heat treatment) need specialist support (heat and fume extraction); some processes (e.g. machining centres) require the same technical support from specialist setter–operators, or need high utilization. Like most functional layouts, a library has different types of user with different traffic patterns. The college library in Figure 7.5 has put its users into three categories, as follows (in fact very similar to the categories used by retail customers).5

Browsers – who seek interesting or useful materials by surfing the Internet, browsing shelves and examining items, and moving around slowly while assessing the value of items.

Destination traffic – who have a specific purpose or errand and are not deterred from it by surroundings or other library materials.

Beeline traffic – who concentrate on goals unconnected with personal use of the library: for example, messengers, delivery staff, or maintenance workers.

Based on studies tracking these different types of customer, the library derived the following guide rules for the layout of its library.

Position displays and services that need to be brought to users' attention at the front of the facility.

To the right of the entrance should be: new acquisitions; items that might be selected on impulse and have no satisfactory substitutes; and items that require repeated exposure before users select them.

On the left at the front should be items that probably will not be used unless there is maximum convenience for the user, such as reference books.

The circulation desk should be on the left of the entrance, the last thing the user passes before leaving.

Cell layout

A cell layout is one where the transformed resources entering the operation are pre-selected (or pre-select themselves) to move to one part of the operation (or cell) in which all the transforming resources, to meet their immediate processing needs, are located. The cell itself may be arranged in either a functional or line (see next section) layout. After being processed in the cell, the transformed resources may go on to another cell. In effect, cell layout is an attempt to bring some order to the complexity of flow that characterizes functional layout. Examples of cell layouts include:

'Lunch' products area in a supermarket – some customers use the supermarket just to purchase sandwiches, savoury snacks, cool drinks, yoghurt, etc. for their lunch. These products are often located close together so that customers who are just buying lunch do not have to search around the store.

Maternity unit in a hospital – customers needing maternity attention are a well-defined group who can be treated together and who are unlikely to need the other facilities of the hospital at the same time that they need the maternity unit.

Some computer component manufacture – the processing and assembly of some types of computer parts may need a special area dedicated to the manufacturing of parts for one particular customer who has special requirements such as particularly high-quality levels.

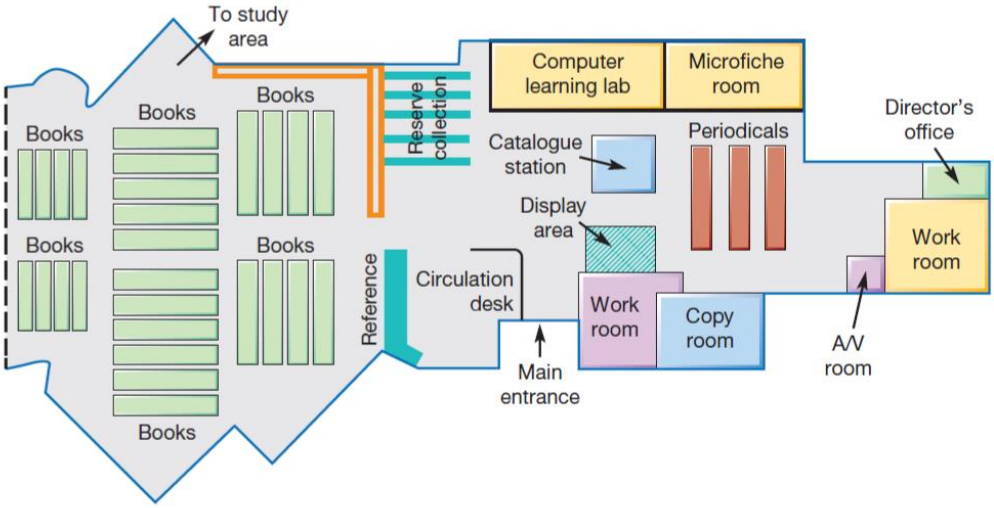


Figure 7.5 An example of a functional layout in a library

goods (shoes, books and drinks would not usually be located together) but because they are needed to satisfy the needs of a particular type of customer. The store management calculates that enough customer come to the store to buy 'sports goods' in particular to devote an area specifically to them.

Line (product) layout

Line layout involves locating the transforming resources entirely for the convenience of the transformed resources. Each product, piece of information or customer follows a prearranged route in which the sequence of activities required corresponds to the sequence in which facilities have been located. The transformed resources 'flow' along a 'line' according to their 'product' needs. This is why this type of layout is sometimes called flow or product layout. Flow is clear, predictable and therefore relatively easy to control. Usually, it is the standardized requirements of the product or service that lead to operations choosing line layouts. Examples of line layout include:

Mass-immunization programme – all customers require the same sequence of clerical, medical and counselling activities.

Self-service cafeteria – generally the sequence of customer requirements (starter, main course, dessert and drink) is common to all customers, but layout also helps control customer flow.

Automobile assembly – almost all variants of the same model require the same sequence of processes.

But don't think that line layouts are not changing. Even Toyota, the best known of all automobile companies, which routinely uses this type of layout is rethinking the assembly line. The appreciation of the Japanese Yen has made it difficult for vehicles made in Japan to compete; and while Toyota, like other Japanese firms, has built factories in other parts of the world, if is still wants to manufacture in Japan, cost savings have to be made. Figure 7.7 shows just two of the ideas that Toyota is employing at its Miyagi factory in Japan to make assembly lines even more efficient. The top illustration shows how Toyota has positioned vehicles sideways rather than the conventional lengthways positioning. This is a simple idea, but it has the advantage of

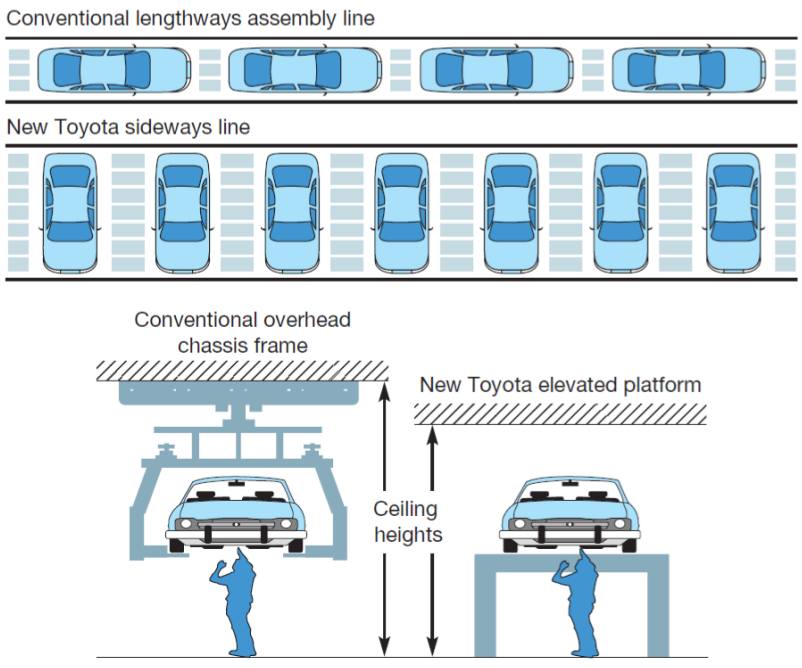


Figure 7.7 Contrasting arrangements in product (line) layout for automobile assembly plants

Mixed layouts

Many operations either design hybrid layouts that combine elements of some or all of the basic layout types, or use the 'pure' basic layout types in different parts of the operation. For example, a hospital would normally be arranged on functional layout principles – each department representing a particular type of function (the X-ray department, the surgical theatres, the blood-processing laboratory, and so on). Yet within each department, quite different layouts could be used. The X-ray department is probably arranged in a functional layout, the surgical theatres in a fixed-position layout and the blood-processing laboratory in a product layout.

Another example is shown in Figure 7.8. Here a restaurant complex is shown with three different types of restaurant and the kitchen which serves them all. The kitchen is arranged in a functional layout, with the various processes (food storage, food preparation, cooking processes, etc.) grouped together. The traditional service restaurant is arranged in a fixed-position layout. The customers stay at their tables while the food is brought to (and sometimes cooked at) the tables. The buffet restaurant is arranged in a cell-type layout with each buffet area having all the processes (dishes) necessary to serve customers with their starter, main course or dessert. Finally, in the cafeteria restaurant, all customers take the

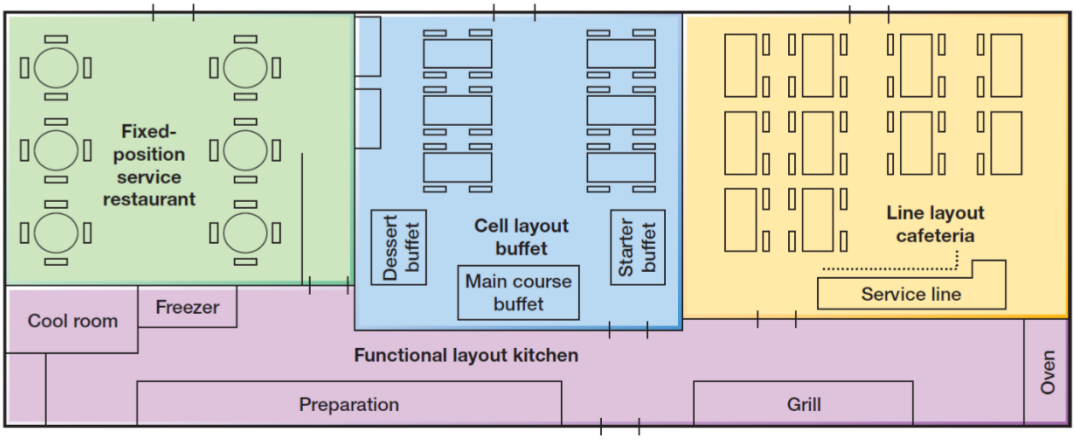


Figure 7.8 A restaurant complex with all four basic layout types

What type of layout should an operation choose?

The importance of flow to an operation will depend on its volume and variety characteristics. When volume is very low and variety is relatively high, 'flow' is not a major issue. For example, in telecommunications satellite manufacture, a fixed-position layout is likely to be appropriate because each product is different and because products 'flow' through the operation very infrequently, so it is just not worth arranging facilities to minimize the flow of parts through the operation. With higher volume and lower variety, flow becomes an issue. If the variety is still high, however, an entirely flow-dominated arrangement is difficult because there will be different flow patterns. For example, the library in Figure 7.5 will arrange its different categories of books and its other services partly to minimize the average distance its customers have to 'flow' through the operation. But, because its customers' needs vary, it will arrange its layout to satisfy the majority of its customers (but perhaps inconvenience a minority).

When the variety of products or services reduces to the point where a distinct 'category' with similar requirements becomes evident but variety is still not small, cell layout could become appropriate, as in the sports goods cell in Figure 7.6. When variety is relatively small and volume is high, flow can become regularized and a line layout is likely to be appropriate, as in an assembly plant (see Figure 7.9).

Although the volume–variety characteristics of the operation will narrow the choice down to one or two layout options, there are other associated advantages and disadvantages, some of which are shown in Figure 7.10. However, the type of operation will also influence the relative importance of these advantages and disadvantages.

For example, a high-volume television manufacturer may find the low-cost characteristics of a product layout attractive, but an amusement theme park may adopt the same layout type primarily because of the way it 'controls' customer flow.

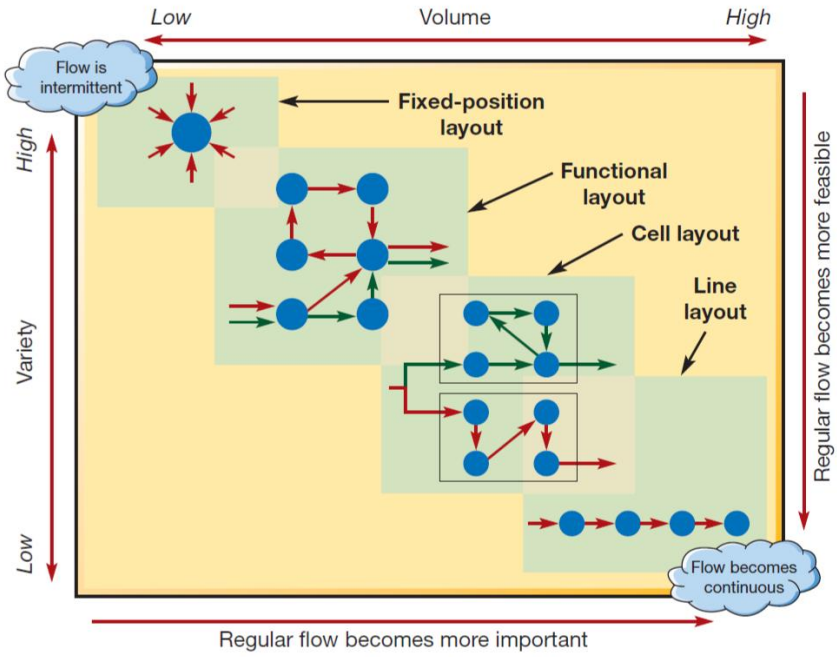


Figure 7.9 Different process layouts are appropriate for different volume–variety combinations

What Is Economic Order Quantity (EOQ)?

Economic order quantity (EOQ) is a calculation companies perform that represents their ideal order size, allowing them to meet demand without overspending. Inventory managers calculate EOQ to minimize holding costs and excess inventory.

It doesn't matter if your business sells jelly beans, appliances, furniture or airplanes. Finding the economic order quantity for every product you purchase is almost certain to impact the bottom line. Every business that manages inventory can benefit from measuring and following the EOQ.

Key Takeaways

Economic order quantity is a metric that represents the ideal order size to minimize costs for the business.

Economic order quantity is a useful formula for businesses of all sizes and types that order and hold inventory.

Inventory management systems and ERP systems can automate economic order quantity calculations, so your business makes the best, most informed decisions regarding orders and inventory management.

Economic Order Quantity (EOQ) Explained

Economic order quantity is a useful metric for businesses that buy and hold inventory for manufacturing, resale, internal use or any other purpose. Businesses that follow EOQ look at all costs related to purchasing and delivery while also factoring in demand for the product, purchase discounts and holding costs.

Experienced business owners and managers understand that purchasing and finding the ideal inventory levels can be complex. When your vendors offer volume discounts and other incentives to purchase more, EOQ can help you decide on the right place to draw the line.

EOQ relies on the economic order quantity formula (found below). That gives you a data-driven result to help optimize business profitability.

Why Is Economic Order Quantity (EOQ) Important?

Economic order quantity is a key metric for your organization's sustainability because ordering too much can lead to high holding costs and take resources away from other business activities, like marketing or R&D, that could further boost sales or reduce costs.

Inventory is a type of working capital. Working capital represents business assets needed for regular operations. But too much working capital can eat into your profits, and it also represents a big opportunity cost.

EOQ may not be extremely helpful when managing your office supply closet. It's most important when looking at large, high volume or expensive purchases. As your orders and inventory grow and scale, EOQ has a greater impact on profits.

What Does Economic Order Quantity (EOQ) Tell Businesses?

Economic order quantity tells businesses the ideal order size for every product they buy. The EOQ formula assumes annual demand for a product is relatively flat. If you are in a growing business, EOQ may not be the best way to calculate your order size, as those numbers could change frequently.

Once you work through EOQ, you should know the optimal number of orders per year and the ideal order size. You may adapt the EOQ model to factor in pricing discounts, backorders, defective items and more.

With your EOQ results, you should have an optimal supply chain order schedule for the entire year.

Benefits of Economic Order Quantity (EOQ)

The main benefit of using EOQ is improved profitability. Here's a list of benefits that all add up to savings and improvements for your business:

Improved Order Fulfilment: When you need a certain item or something for a customer order, optimal EOQ ensures the product is on hand, allowing you to get the order out on time and keep the customer happy. This should improve the customer experience and may lead to increased sales.

Less Overordering: An accurate forecast of what you need and when will help you avoid overordering and tying up too much cash in inventory.

Less Waste: More optimized order schedules should cut down on obsolete inventory, particularly for businesses that hold perishable inventories that can result in dead stock.

Lower Storage Costs: When your ordering matches your demand, you should have less products to store. This can lower real estate, utility, security, insurance and other related costs.

Quantity Discounts: Planning and timing your orders well allows you to take advantage of the best bulk order or quantity discounts offered by your vendors.

Challenges of Economic Order Quantity (EOQ)

While many businesses want to use EOQ to determine order sizes, it isn't always easy to achieve. When determining EOQ, you may run into these challenges:

Poor Data: One of the biggest challenges of determining EOQ is access to accurate and reliable data. Manual or spreadsheet-driven systems may provide low-quality or outdated information, which can lead to inaccurate calculations.

Outdated Systems: Old and outdated systems may have incomplete data and lead to missing out on potential savings. An inventory management system or cloud-based ERP can solve this problem.

Business Growth: The EOQ formula is ideal for businesses with consistent inventory needs. With a fast-growing business, relying on EOQ can lead to inventory shortages.

Inventory Shortages: If you're just starting to use this method, it often generates smaller orders. If you are too conservative with your calculations, you could wind up under-ordering.

Seasonal Needs: Seasonality can make EOQ more challenging, but not impossible. This is because there could be major changes in customer demand throughout the year.

Calculating Economic Order Quantity (EOQ)

Calculating economic order quantity requires high school-level algebra. Once you get the variables from your inventory management system, it's easy to plug in the numbers and calculate EOQ. When you use a robust ERP, these calculations may all be handled for you, including order costs like inventory ordering costs, holding costs and stock out costs.

Three Variables (or Inputs) Used to Calculate EOQ

There are several variations of the formula used to calculate EOQ. One popular EOQ formula is based on these variables, also called inputs:

D = Demand in units (annual)

S = Order cost

H = Holding costs (per unit, per year)

Economic Order Quantity (EOQ) Formula

$$EOQ = \sqrt{[2DS/H]}$$

EOQ Examples

To best understand how economic order quantity works, here's an example. Let's say a business uses its ERP platform to determine demand, order cost and holding costs per unit, per year over the last year and expects similar demand next year.

Demand from last year was 10,000 units. The average order cost was $5,000. The holding cost is $3 per unit, per year.

EOQ = √ [2 x D x S / H]

= √ [(2 x 10,000 x $5,000) / $3]

= √ [33,333,333.33]

= 5,774 units

Based on this company's results, the economic order quantity is 5,774 units per order, roughly twice per year.

How to Use EOQ to Improve Inventory Management

When you calculate EOQ, you know the ideal order size to maximize profits for your organization. It prevents guessing, and there's less cause for concern about overordering or running out of stock. You can follow the data and the numbers to make the best long-term decision for your business's inventory needs.

If you run a large business, a business that requires expensive inventory, or a business with high inventory holding costs, EOQ could have a significant impact on your business, improving operational efficiency, cash flow and profits for years to come.

Inventory control in Operations Management

Inventory control is a planned approach of determining what to order, when to order and how much to order and how much to stock so that costs associated with buying and storing are optimal without interrupting production and sales. Inventory control basically deals with two problems:

When should an order be placed? (Order level), and

How much should be ordered? (Order quantity).

These questions are answered by the use of inventory models. The scientific inventory control system strikes the balance between the loss due to non-availability of an item and cost of carrying the stock of an item. Scientific inventory control aims at maintaining optimum level of stock of goods required by the company at minimum cost to the company.

Objectives of Inventory Control

To ensure adequate supply of products to customer and avoid shortages as far as possible.

To make sure that the financial investment in inventories is minimum (i.e., to see that the working capital is blocked to the minimum possible extent).

Efficient purchasing, storing, consumption and accounting for materials is an important objective.

To maintain timely record of inventories of all the items and to maintain the stock within the desired limits.

To ensure timely action for replenishment.

To provide a reserve stock for variations in lead times of delivery of materials.

To provide a scientific base for both short-term and long-term planning of materials.

Benefits of Inventory Control

It is an established fact that through the practice of scientific inventory control, following are the benefits of inventory control:

Improvement in customer's relationship because of the timely delivery of goods and service.

Smooth and uninterrupted production and, hence, no stock out.

Efficient utilization of working capital. Helps in minimizing loss due to deterioration, obsolescence damage and pilferage.

Economy in purchasing.

Eliminates the possibility of duplicate ordering.

Techniques of Inventory Control

In any organization, depending on the type of business, inventory is maintained. When the number of items in inventory is large and then large amount of money is needed to create such inventory, it becomes the concern of the management to have a proper control over its ordering, procurement, maintenance and consumption. The control can be for order quality and order frequency. The different techniques of inventory control are: (1) ABC analysis, (2) HML analysis, (3) VED analysis, (4) FSN analysis, (5) SDE analysis, (6) GOLF analysis and (7) SOS analysis. The most widely used method

of inventory control is known as ABC analysis. In this technique, the total inventory is categorized into three sub-heads and then proper exercise is exercised for each sub-heads.

ABC analysis:

In this analysis, the classification of existing inventory is based on annual consumption and the annual value of the items. Hence we obtain the quantity of inventory item consumed during the year and multiply it by unit cost to obtain annual usage cost. The items are then arranged in the descending order of such annual usage cost. The analysis is carried out by drawing a graph based on the cumulative number of items and cumulative usage of consumption cost. Classification is done as follows:

ABC analysis

The classification of ABC analysis is shown by the graph given as follows.

ABC classification

ABC classification

Once ABC classification has been achieved, the policy control can be formulated as follows:

A-Item:

Very tight control, the items being of high value. The control need be exercised at higher level of authority.

B-Item:

Moderate control, the items being of moderate value. The control need be exercised at middle level of authority.

C-Item:

The items being of low value, the control can be exercised at gross root level of authority, i.e., by respective user department managers.

HML analysis:

In this analysis, the classification of existing inventory is based on unit price of the items. They are classified as high price, medium price and low cost items.

VED analysis:

In this analysis, the classification of existing inventory is based on criticality of the items. They are classified as vital, essential and desirable items. It is mainly used in spare parts inventory.

FSN analysis:

In this analysis, the classification of existing inventory is based consumption of the items. They are classified as fast moving, slow moving and non-moving items.

SDE analysis:

In this analysis, the classification of existing inventory is based on the items.

GOLF analysis:

In this analysis, the classification of existing inventory is based sources of the items. They are classified as Government supply, ordinarily available, local availability and foreign source of supply items.

SOS analysis:

In this analysis, the classification of existing inventory is based nature of supply of items. They are classified as seasonal and off-seasonal items. For effective inventory control, combination of the techniques of ABC with VED or ABC with HML or VED with HML analysis is practically used.

Pareto Analysis Step by Step

Pareto Analysis is a statistical technique in decision-making used to select a limited number of tasks that produce a significant overall effect. It uses the Pareto Principle (also known as the 80/20 rule), the idea that by doing 20% of the work, you can generate 80% of the benefit of doing the entire job.

Take quality improvement, for example. A vast majority of problems (80%) are produced by a few fundamental causes (20%). This technique is also called the vital few and the trivial many.

In the late 1940s, Romanian-born American engineer and management consultant Joseph M. Juran suggested the principle. He named it after Italian economist Vilfredo Pareto, who observed that 80% of income in Italy went to 20% of the population. Pareto later carried out surveys in some other countries and found that a similar distribution applied to his surprise.

We can apply the 80/20 rule to almost anything:

80% of customer complaints arise from 20% of your products and services.

80% of delays in the schedule result from 20% of the possible causes of the delays.

20% of your products and services account for 80% of your profit.

20% of your sales force produces 80% of your company revenues.

20% of the defects of a system causes 80% of its problems.

The Pareto Principle has many applications in quality control. It is the basis for the Pareto diagram, one of the critical tools used in total quality control and Six Sigma.

PMBOK uses Pareto ordering to guide corrective action and help the project team fix the problems causing the most significant number of defects first.

Pareto Analysis

Here are eight steps to identifying the principal causes you should focus on, using Pareto Analysis:

Create a vertical bar chart with causes on the x-axis and count (number of occurrences) on the y-axis.

Arrange the bar chart in descending order of cause importance, the cause with the highest count first.

Calculate the cumulative count for each cause in descending order.

Calculate the cumulative count percentage for each cause in descending order. Percentage calculation: {Individual Cause Count} / {Total Causes Count}*100

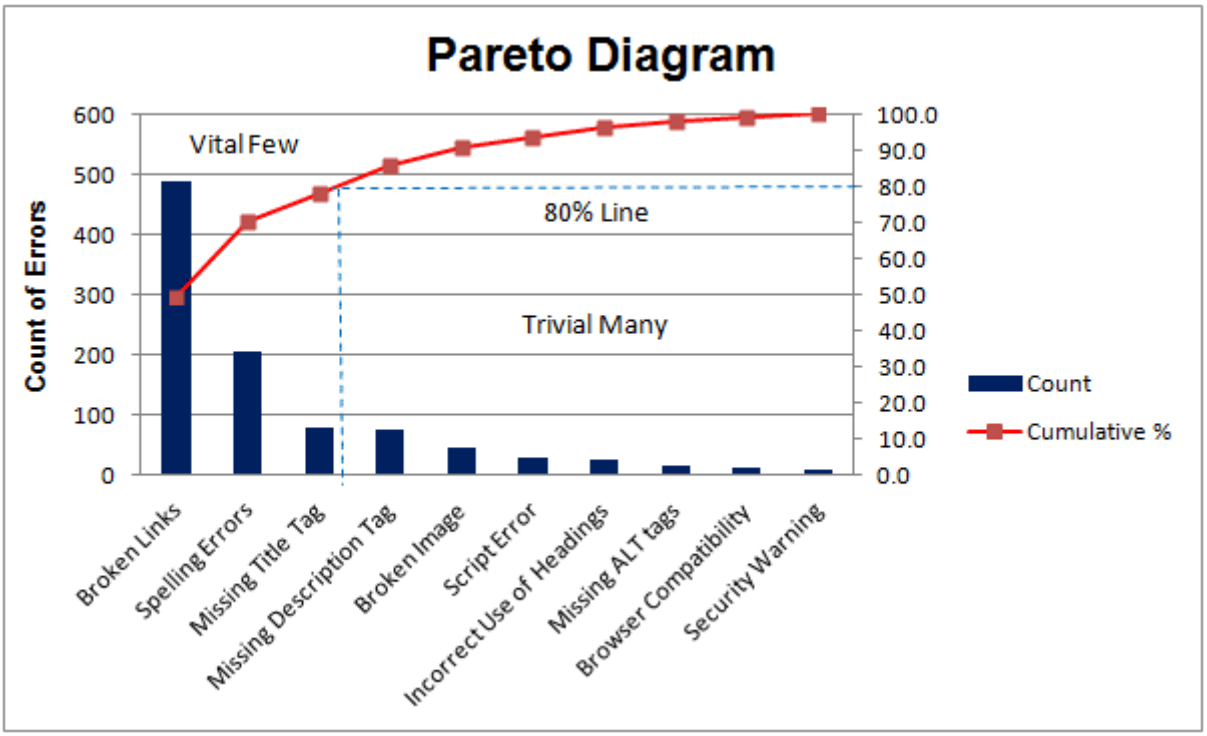
Create a second y-axis with percentages descending in increments of 10 from 100% to 0%.

Plot the cumulative count percentage of each cause on the x-axis.

Join the points to form a curve.

Draw a line at 80% on the y-axis, running parallel to the x-axis. Then drop the line at the point of intersection with the curve on the x-axis. This point on the x-axis separates the important causes on the left (vital few) from the less important causes on the right (trivial many).

Here is a simple example of a Pareto diagram, using sample data showing the relative frequency of causes for errors on websites. It lets you see what 20% of cases are causing 80% of the problems and where you should focus efforts to achieve the most significant improvement. In this case, we can see that broken links, spelling errors and missing title tags should be the focus.



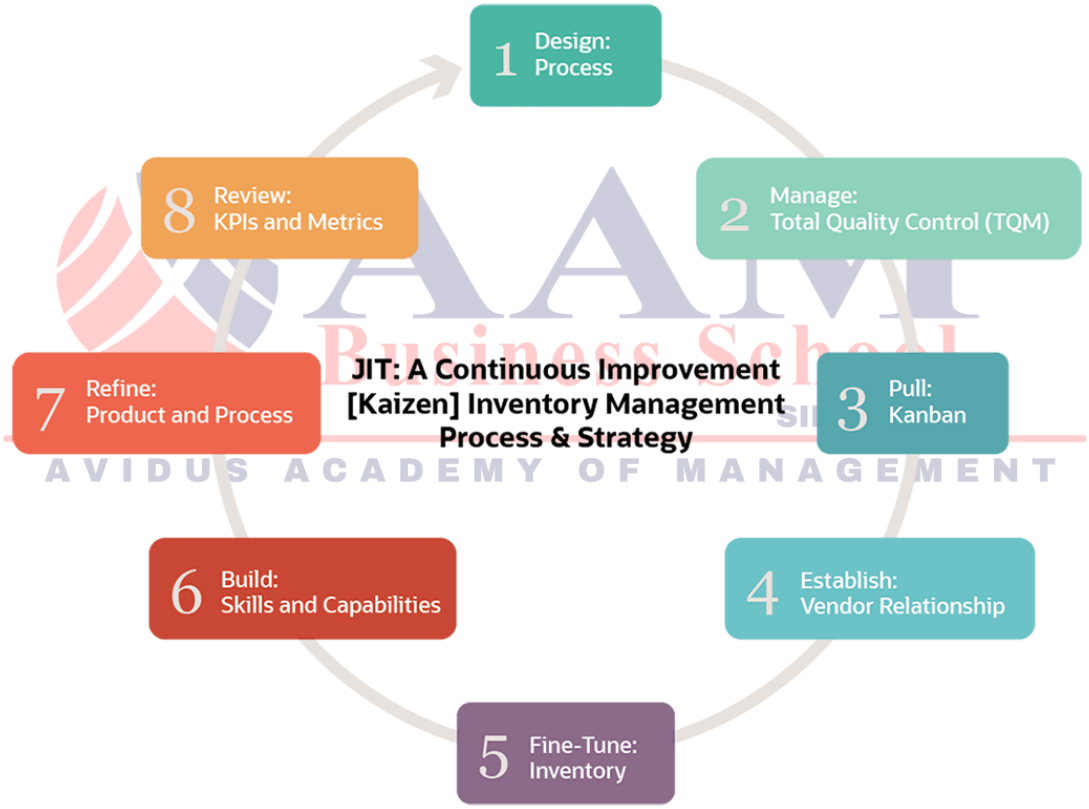
The value of the Pareto Principle for a project manager is that it reminds you to focus on the 20% of things that matter. Of the things you do for your project, only 20% are crucial. That 20% produces 80% of your results. Identify, and focus on those things first, but don't entirely ignore the remaining 80% of the causes.

How Does Just-in-Time Inventory Management Work?

JIT inventory management ensures that stock arrives as it is needed for production or to meet consumer demand, but no sooner. The goal is to eliminate waste and increase the efficiency of your operations. Since the main objective is often quality and not the lowest price, JIT requires long-term contracts with reliable suppliers.

JIT is what's known as a lean management process. In JIT, all parts of any production or service system, particularly people, are interconnected. They inform each other and are mutually dependent on generating successful outcomes. This practice's origin comes from Kaizen, a Japanese term meaning "change for the better." Originating in Japan, the business philosophy looks to continuously improve operations and involve all employees, from assembly line workers to the CEO. Like JIT, the goal is to reduce waste and improve quality.

The JIT Process Diagram and Steps



Organizations may vary in how they implement JIT in their environment, but the general steps are the same. This diagram shows how the cycle of continuous improvement works in JIT inventory management.

Steps in Cycle of Continuous Improvement for JIT Inventory

Design: The JIT process begins with a review of the essential manufacturing building blocks: product design, process design, personnel and manufacturing planning. Then plans are put into place to eliminate disruption, minimize waste and build a flexible system.

Manage: A Total Quality Management (TQM) review ensures there is continuous improvement throughout the process. A management review defines workers' roles and responsibilities, defines and measures statistical quality control, stabilizes schedules, and checks out load and capacity schedules and levels.

Pull: Educate the team on production and withdrawal methods using signaling methods like Kanban. Review lot size policies and reduce lot sizes.

Establish: Vendor relationships are vital to the success of JIT. Review vendor lists. Settle on preferred suppliers, negotiate contracts, discuss lead times, delivery expectations and usage metrics and measures. Learn how to make the most of them in the supply chain.

Fine-tune: Determine inventory needs, policies, controls and reduce inventory movements.

Build: Inform your team about the skills and capabilities it needs to complete its work and conduct team education and empowerment sessions to educate them.

Refine: Reduce the number of parts and steps in production by refining, standardizing and reviewing the entire process.

Review: Define and implement quality measures and metrics and conduct a root cause analysis of any problems. Emphasize improvements and track trends to improve every aspect of JIT.

Advantages of JIT Inventory Management

JIT inventory management boosts a company's ROI by lowering inventory carrying costs, increasing efficiency and decreasing waste.

Waste Reduction: The JIT inventory management model eliminates overordering and excess of all kinds.

Reduce Obsolete Inventory and Dead Stock: Low inventory levels significantly reduce the risk of inventory going unsold and sitting in the warehouse obsolete.

Reduce Defective Product Loss: Defective inventory items are easier to identify and fix when production levels are low, which reduces scrap costs.

Improved Efficiency: JIT eliminates the costs that come with extra raw materials, unneeded inventory and product storage.

Raise Inventory Turnover Ratios: Greater efficiency brings higher inventory turnover.

Minimal Inventory Obsolescence: The high inventory turnover rate keeps items from sitting in your facility for too long and becoming obsolete.

Minimize Raw Materials on Hand: Receiving deliveries in the smallest possible quantities—sometimes multiple times per day—virtually eliminates raw material inventories.

Local Sourcing: When suppliers are located near a company's production facility, the shortened distances contribute to timely deliveries. On-time, reliable delivery of goods reduces the need for safety stock.

Greater Productivity: JIT enhances productivity by reducing the time and resources involved in manufacturing processes.

Faster Product Turnaround: Manufacturers can more quickly produce products.

Shorter Production Runs: With JIT, manufacturers can deliver new products more quickly and easily.

Simplify Change Orders: Having less raw material stock to draw down before product changes makes it easier to implement engineering change orders to existing products.

Smoother Production Flow: JIT can eliminate bottlenecks and delays across the entire production process.

Shorter Production Cycles: JIT shortens manufacturing time, which decreases lead times for customers.

Reduce Product Defects: Production mistakes can be spotted faster and corrected, which results in fewer defective products.

Shorter Production Runs: Fast equipment setup times reduce production runs, lowering investment in finished goods.

More Functional Production Cells: Employees walk individual parts through the processing steps in a work cell, which reduces scrap levels. Cell models also eliminate work-in-process queues that build up at more specialized workstations.

Compressed Operations: Arranging production work cells near each other limits the amount of work-in-process inventory moving between cells.

Lower Costs: Receiving goods on an as-needed basis reduces inventory costs.

Reduce Working Capital: The low inventory levels that come with JIT limit the amount of working capital needed.

Lower Holding Costs: Inventory holding costs (like those for warehousing) are minimal because less space is used.

Lower Cash Investment: Companies invest less cash in inventory because JIT doesn’t require having a lot of stock on hand.

Reduce Large Raw Material Spends: In JIT, businesses order raw material when needed, so cash is available for other uses that could be more valuable to the company.

Reduce Labor Costs: Labor expenses are lower since the number of person-hours required to fulfill orders is usually fewer than full-time production.

Improve Quality: A flexible workforce can focus on making quality products with lower defect rates. Better outcomes increase customer satisfaction and reduce the cash outlay for production.

Reduce Work-in-Progress Goods: Fewer items moving on the shop floor allows teams to focus on building high-quality products.

Less Damage: Since minimal inventory is on hand, storage-related accidents decline.

Certified Quality: Suppliers guarantee quality in advance. So, deliveries go straight to production areas instead of being held in receiving to await inspection.

To support these goals, you can invest in new technology or update existing solutions that will link your system with your suppliers to coordinate the delivery of parts and materials.

JIT Inventory Methodology

The JIT inventory methodology uses a variety of techniques to smooth operations. The lean method focuses on optimizing organization, paying attention to detail, having small lot sizes, increasing transparency, fostering cell manufacturing and using a pull (rather than push) approach.

Techniques Involved in JIT Inventory Methodology

Order: Maintain a high level of physical and organizational discipline.

Better Quality: Eliminate defects through attention to detail and continuous improvements.

Reduced Setup Time: Create flexible changeover approaches when setups need to adjust to meet customer demand.

Small Lot Size: In JIT, one is the ideal lot size. The small size reduces in-process inventory, carrying costs, storage space, and makes for easier inspection and rework.

Load Uniformity: Leveling is a control mechanism that achieves a stable, level daily schedule.

Flow Balance: Flow scheduling organizes throughput for even distribution of energy and labor.

Diversified Skills: Cross-trained workers can be deployed to different areas to keep production moving.

Visibility for Control: Using communication tools, like those found in Kanban, keeps the entire team informed of inventory levels.

Ongoing Maintenance: Ongoing oversight and focus on detail, including the machinery and tools the business uses every day, helps maintain a low defect, low problem environment.

Use Fitness: JIT spaces designed to fit each process speeds up production. One workstation pulls output from the one before it, as needed, based on a master schedule or customer demand.

Logical Plant Layout: Product-oriented design makes assembly easier and more efficient.

Strong Supplier Network: Strong relationships with vendors make JIT inventory most effective.

Worker Immersion: Every team member should be dedicated to the process and colleagues to achieve JIT goals.

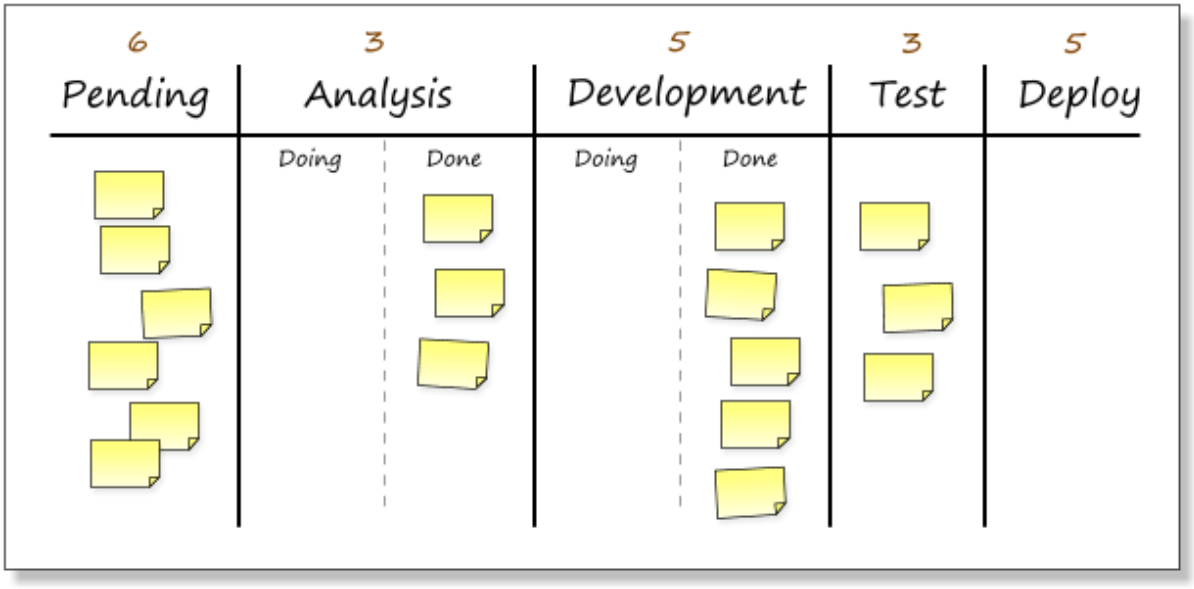
Cell Manufacturing: Create an environment where groups can work as quickly as possible to make as many products as they can and limit the waste they create.

Pull System: The process of only replacing products once they've been used in production.

Why Is Kanban a Critical Element for the JIT Inventory System?

Kanban is the “nervous system” of lean JIT production, controlling work-in-progress production and inventory movement. Kanban is crucial when it comes to eliminating manufacturing waste due to overproduction.

More traditional mass production methods use push inventory strategies based on the estimated number of expected sales. Kanban’s pull system creates more flexibility on the production floor because a company only produces goods based on actual orders. Kanban uses cards (paper or digital) to track the progress of production on a factory floor. As inventory moves through the manufacturing process, Kanban cards reflect that progress and can signal when it’s time to order more stock.



Questions to Ask If You Are Considering JIT Inventory Management

Before converting to JIT inventory management, assess if the entire organization is ready. Consider these six factors: turnarounds, forecasting, flexibility, vendors, workforce and technology.

6 Questions to Ask Before Converting to JIT Inventory Management

Turnarounds: Can my products be manufactured or supplied quickly?

Forecasting: Do I have enough confidence in my sales forecast to accurately depict fluctuating consumer demand, including seasonality?

Flexibility: Do I have enough flexibility in my supply chain and manufacturing to adapt to disruptions like supplier disruptions or natural disasters?

Vendors: Are my suppliers reliable enough to deliver on time, every time? Is my order fulfillment system efficient enough to get orders through on time even when they have to compensate for supply chain delays?

Workforce: Implementing a JIT system requires total support and understanding from every operational division, especially employees. JIT relies on multi-functional, cross-trained employees to perform several duties so team members can fill in when and where needed in the production line cell. Is my workforce committed and up to the task?

Technology: Does my inventory management software support JIT inventory management?

Shifting to JIT or any new system requires preparation, research and buy-in. Find out how to increase profits and streamline productivity by reading the guide to inventory planning.

Who Uses Just-in-Time Inventory Management?

Commonly associated with manufacturing, various businesses—from automakers to health care—use JIT inventory management.

Verticals that Use JIT Inventory Management

Apparel: JIT is an ideal way to lower the high cost of inventory in the clothing business. Stocking apparel is costly and risky because more inventory needs to be carried to meet the variety of styles, sizes and colors needed to meet customer demand.

Aerospace: The risk of delay and cost overruns is higher in this vertical than in many other industries. JIT mitigates those issues and saves valuable space in plants.

Automotive: JIT was born in the automotive space to improve capacity and be more competitive. The practice is still in use today by car companies worldwide.

Big Box Retailers: Stores like Walmart and Target schedule the arrival of merchandise—like back to school, seasonal weather and Christmas goods—as demand rises for specific items based on forecasting and past experience. They clear shelves to make room for the next season's goods when interest wanes.

Construction: In construction, waste is waiting, storing inventory and moving materials frequently. Proponents of the lean methodology have adapted JIT to mitigate these issues.

Fast Food: Franchises need to keep a substantial inventory of ingredients on hand. However, food is only made when there's an order. JIT procedures eliminate waste and using fresh ingredients gives chains a marketing advantage.

Florists: A florist can use JIT by ordering flowers only based on customer demand. When florists shop the flower market, they know the amount and specific items to buy.

Health Care: Many health care organizations turn to JIT inventory management to keep supplies lean and expenses low. The industry faces tighter profit margins tied to care costs and rate cuts for reimbursements.

Manufacturers: In manufacturing, speed to market and production costs can make or break a company. JIT helps reduce flow times within production systems and improve response times from suppliers and customers.

On-Demand Publishing: On-demand publishing is the epitome of JIT inventory management. Book manuscripts are printed and assembled only when sold. JIT reduces wasteful destruction of books and returns of unsold inventory.

Publishing: Independent publishers and self-publishers use just-in-time delivery to print and assemble books on an as-needed basis to reduce costs due to unsold inventory.

Retail: JIT focuses on having enough stock to satisfy demand—and nothing more. In the past, retailers carried a surplus so they wouldn't run out of desired items and lose out on potential sales. However, this isn't an option for stores operating on a tight budget. With a JIT model, the goal is to

physically stock zero inventory until a customer places an order. Learn how to reduce inventory in retail operations.

What Companies Use JIT Inventory Management?

A number of the most successful companies in the world, including Amazon and Apple, use JIT inventory management and build strong supplier relationships to maintain their competitive position.

Just-in-Time Inventory Examples

JIT is uniquely suited to drive value in manufacturing environments and service businesses that must match output with customer demand. For many companies, this emphasis on timing helps them keep and increase their market presence.

Major corporations in every industry take advantage of JIT inventory management, including:

Amazon.com: The ecommerce retail giant uses a variation of JIT: setting up dedicated space inside key suppliers' warehouses. Amazon has a small fenced off area within Proctor & Gamble's (P&G) Pennsylvania warehouse, for example. P&G loads products onto pallets and simply moves them to the Amazon area. Amazon employees then package, label and ship products directly to consumers who ordered them. The Pennsylvania location is five miles from P&G's largest manufacturing plants and near major cities in the Northeast and Canada. Amazon can meet the critical 24-hour delivery window with P&G personal care products.

Apple: With one central warehouse in the U.S. and about 150 critical global suppliers, Apple has strategic and robust vendor relationships. Production outsourcing has made Apple leaner, resulting in stocking most inventory in retail stores and less overstock. This approach has helped make the technology company one of the world's most profitable businesses.

The Boeing Company: Beginning in the mid-1990s, Boeing applied JIT across the enterprise to work more closely with suppliers and remove redundancies, reduce costs and improve product quality. Boeing continues to transform itself into an integrator of large parts and systems and implements lean manufacturing principles. The company relies heavily on its supply base to meet customer demand.

Dell Technologies: Dell adopted Lean/JIT operations in the 1980s with direct-to-consumer sales. The company would order parts when it made a sale to a customer. Rather than stock a warehouse full of pre-assembled computers, Dell reduced costs and lead times with JIT. The company eventually became a well-known computer brand.

Grayton: The high-end watchmaker was the first to adopt lean manufacturing strategies in the watch industry. As a result, Grayton increased its cash flow by 70% in one year. The company created a streamlined, cost-efficient, fast fashion manufacturing model—a challenging feat in the traditionally entrenched watch industry.

Harley-Davidson USA: The motorcycle manufacturer curtailed its large inventory habits by using the JIT method to solve inefficiency. Harley-Davidson reduced its inventory by 75%, eliminating extra warehousing costs. The company is responsive to customer orders with minimal lead time, increasing its productivity along the way.

Kellogg Company: Kellogg's is a large-scale food manufacturer that stores only enough inventory to meet customer orders. The company uses JIT for operations, production, inventory and distribution. It optimizes production and inventory costs and budgets with JIT. Kellogg obtains its raw food materials from primary suppliers worldwide to produce 40 different types of cereals and snacks.

Motorola: The company uses a "zero-latency" status view to shows inventory levels in real time. As a result, Motorola reduced needs by 20% and reduced the average time to resolution from weeks to sometimes just hours.

Nike: In 2012, Nike implemented JIT to improve its disconnected production facilities across Southeast Asia. Since then, the company cut lead times by 40%, increased productivity by 20% and can introduce new models 30% faster.

Tesla: Despite Tesla's growth, the company cannot independently enjoy the same economies of scale as large auto manufacturers. Tesla takes ownership of its supply chain, keeps minimal inventory and essentially manufactures on demand. This practice helps Tesla have more capital available because it isn't tied up with surplus inventory.

Toyota Motor Corporation: Toyota is one of the most well-known examples of companies using the JIT method. When a client places an order, Toyota only receives raw materials in the factory when it is ready to start building the automobile. This process minimizes inventory holding costs.

Zara SA: Operating under the motto inventory = death, the fast fashion leader owns its supply chain and brings goods to market extraordinarily quickly. Zara locks in 50-60% of its line by the start of the season. That means the company designs and manufactures up to 50% of its clothes in the middle of the season. When a particular style or design suddenly comes into vogue, Zara reacts by creating new products and getting them into stores while the trend is still cresting.

TQM – Total Quality Management – Definition, Principles & Importance

In order to understand "Total quality management", first we have to understand what does 'Quality' actually mean?

'Quality' is generally referred to a parameter which decides the inferiority or superiority of a product or service. It is a measure of goodness to understand how a product meets its specifications. Usually, when the expression "quality" is used, we think in the terms of an excellent product or service that meets or even exceeds our expectations. These expectations are based on the price and the intended use of the goods or services. In simple words, when a product or service exceeds our expectations we consider it to be of good quality. Therefore, it is somewhat of an intangible expression based upon perception.

W. Edwards Deming, Armand V. Feigenbaum and Joseph M. Juran jointly developed the concept of TQM. Initially, TQM originated in the manufacturing sector but it can be applied to all organizations.

The concept of TQM states that every employee works towards the improvement of work culture, services, systems, processes and so on to ensure a continuing success of the organization.

TQM is a management approach for an organization, depending upon the participation of all its members (including its employees) and aiming for long-term success through customer satisfaction. This approach is beneficial to all members of the organization and to the society as well.

Definition of TQM

Total Quality Management is defined as a customer-oriented process and aims for continuous improvement of business operations. It ensures that all allied works (particularly work of employees) are toward the common goals of improving product quality or service quality, as well as enhancing the production process or process of rendering of services. However, the emphasis is put on fact-based decision making, with the use of performance metrics to monitor progress.

The key principles of Total Quality Management

- Commitment from the management
- Plan (drive, direct)
- Do (deploy, support, and participate)
- Check (review)
- Act (recognize, communicate, revise)
- Employee Empowerment
- Training
- Excellence team
- Measurement and recognition
- Suggestion scheme
- Continuous Improvement
- Systematic measurement
- Excellence teams
- Cross-functional process management
- Attain, maintain, improve standards
- Customer Focus
- Partnership with Suppliers
- Service relationship with internal customers

- Customer-driven standards
- Never compromise quality
- Process Oriented
- Thinking about the process
- Handling of the process
- Processes which are result oriented
- Decision Making Based on Facts Only and Not on Opinions
- Integrated, strategic and systematic approach to ensure the entire organisation is aligned
- Communication must be open and at all levels of the organisation.

Benefits of Total Quality Management

The benefits arising from the implementation of a Total Quality Management in an organization are:

This will increase the awareness of quality culture within the organization.

A special emphasis on teamwork will be achieved.

TQM will lead to a commitment towards continuous improvement.

Essential requirements for successful implementation of TQM

Commitment: Quality improvement (in all aspects) must be everyones' job in the organization. An apparent commitment from the top management, breaking down the barriers for continuous quality improvement and steps required to provide an environment for changing attitudes must be provided. Training and support for this should be extended.

Culture: There should be proper training to effect the changes in attitude and culture.

Continuous Improvement: Recognize improvement as a continuous process, and not merely a one-off program.

Customer Focus: Perfection in service with zero defects and full satisfaction to the end-user whether it's internal or external.

Control: Ensure monitoring and control checks for any deviation from the intended course of implementation.

- Plan
- Do
- Check
- Act

This is also referred to as the PDCA cycle.

Planning Phase: This phase is the most crucial phase of total quality management. Under this phase, employees have to come up with their respective queries and problems which need to be addressed. The employees apprise the management of different challenges which they are facing in their day to day operations and also analyze the root cause of the problem. They need to do the required research and collect significant data which would help them find solutions to all the problems.

Doing Phase: In this phase, a solution for the identified problems in the planning phase is developed by the employees. Strategies are devised and implemented to crack down the challenges faced by

employees. The efficiency and effectiveness of solutions and strategies are also evaluated in this stage.

Checking Phase: Under this phase, a comparison analysis of before and after is done in order to assess the effectiveness of the processes and measure the results.

Acting Phase: This is the last phase of the cycle, in this phase employees document their results and prepare themselves to address other problems

Beliefs about Total Quality Management

Following are the universal Total Quality Management beliefs:

Satisfaction of the customer/owner is the measure of quality.

Everyone is an owner.

Continuous Quality improvement must be there.

Analysis of the processes is the key to quality improvement.

Constant TQM is not possible without consistent, active and enabling leadership by managers at all levels.

It is important to incessantly improve the quality of the products and services which we are supposed to provide to our customers/owners.

7 Best Quality Management Tools For Process Improvement

Quality management emerged as an area of expertise when organizations understood the importance of delivering products and services at optimal levels. A lot of organizations started using a different variety of quality management tools. Earlier, the main focus of all companies was to produce on time. As long as the deliveries went out at the given deadline, nothing else would matter. Over time, they realized that customer satisfaction was not just based on timely deliveries. It was, in fact, focused on delivering services at a superior quality.

This is what quality management takes care of. Quality management is a set of tools and processes utilized by organizations of all sizes across many industries to help them deliver their products and services of consistent and high quality on time. Quality management has several benefits, which are discussed in the article below. The article also talks about the most fundamental tools of quality management.

Benefits of Quality Management Tools

Quality management tools have a lot of benefits when implemented correctly. The main goal for organizations is to work hard, not smart, and then create an environment that encourages productivity and achievement of business goals. Some of the most widely known advantages of quality management tools are:

- Quality management tools are cost-efficient options. In research conducted by the Center of Economic and Business Research, it was noted that the benefits of investment in quality management were sixteen fold. For every dollar invested in a quality management tool, the organization saved $16. They also increased their profit margin by $3

- Quality management tools help improve end-user satisfaction. Since the main goal of quality management is to improve the quality of the deliveries, it results in improving the satisfaction level of the end-user or the customer
- Quality management tools improve efficiency. Quality management tools are methods that eliminate errors and focus on the improvement of processes. This way, teams and the organization as a whole can operate in a more efficient manner
- Quality management tools improve productivity. Quality management tools help employees eliminate chances of error and reduce the time it takes to do tasks. This motivates teams and helps boost productivity
- Quality management tools help reduce waste. There are many different types of waste that an organization can incur. Waste of time, human resources, energy, physical assets, and more. Quality management tools optimize processes, thereby reducing waste significantly

Many such benefits come with using quality management tools. They help reduce errors, create a more driven culture and work environment, improve communication, help companies maintain compliance, and more. Adopting the right quality management tool can help companies save a lot of time and resources, improve the overall quality of delivery and processes, as well as generate a high ROI. Some of the most commonly used quality management tools are listed below.

7 Basic Quality Management Tools

Quality management tools listed below were greatly emphasized upon by Kaoru Ishikawa, who was instrumental in creating total quality management and maximizing productivity by improving the quality of deliveries in the manufacturing industry. These seven basic quality management tools are also known as the 'old' seven or the 'first' seven. They are:

Cause and effect diagram or the Fishbone diagram

- Control chart
- Pareto chart
- Stratification
- Check sheet
- Histogram
- Scatter diagram
- The Fishbone Diagram

Kaoru Ishikawa created the Fishbone diagram or the cause and effect diagram. It was created as a means for problem-solving purposes. The diagram is also referred to as a Fishbone diagram because it resembles a fishbone upon completion. The cause and effect diagram lists out a problem and then lists out the possible causes for the problem and its effect or result.

The main problem that impacts quality is listed out on the right side of the diagram, and all the possible causes leading up to the problem are listed out on the left side.

Control Chart

A control chart is used to maintain the quality assurance of a product or service. It takes all historical data into account to find an average or mean line of quality, which is drawn out on a graph. Other limits are added to the chart (both upper and lower) using data to see what type of variations are taking place. Once the variations have been listed out on the graph, quality management

professionals or quality assurance professionals can find the causes of what is affecting the process, both positively and negatively.

A control chart helps monitor the quality of deliveries and expectations from the end-users or customers. It helps create a predictable outcome with each delivery and helps the quality management team identify negative variations that need to be worked on or eliminated.

Pareto Chart

A Pareto chart is also known as the 80-20 rule of quality management. Here, organizations assume that most of the problems they face with quality management in any process are caused by the biggest factors. These problems are listed out as 80% of all problems, and their causes are listed out to be 20% of the biggest factors.

A Pareto chart is a combination of a line graph and a bar graph. The values are shown by using the bar graph in the Pareto chart, and the line graph shows the total impact. This way, organizations can find the biggest causes of their problems with quality and implement measures to reduce them.

Stratification

Stratification is used to divide different factors that could affect the quality of delivery into separate groups. All the collected data is split up to create and observe different patterns of factors that affect quality. The stratification method is widely used for data analysis in terms of quality assurance.

Check Sheet

A check sheet is a quality management and assurance tool used to find the frequency of an error or problem or a specific value. This makes it easier to spot errors or patterns causing errors and defects, as well as the frequency of their occurrence in a process. Creating a check sheet is simple. It is also fairly easy to understand. It is often used as a preliminary tool for other tools in quality management because it simplifies the whole process of problem identification.

Histogram

A histogram helps quality analysts and management professionals accurately analyze different types of information they have available on different data groups to help create controls to improve the quality of any process.

A sample is taken and divided into different groups, after which the frequency of the data is calculated. This helps in the identification of areas of improvement in a process. The low performing areas show up in less frequency on the histogram, and quality management professionals can then find the root cause of the problem and solve it.

Scatter Diagram

A scatter diagram is used to find the relationship between A and B. For example, if B is facing an issue with packaging, a scatter diagram can be used to find A, which is the main reason that B takes place. This way, all possible causes to the defects to the quality of a product or process can be identified easily, after which the quality management professionals can create and implement focused solutions to solve the main cause.

How are ISO standards developed?

The International Organization for Standardization has a six-stage process for developing standards. The stages include the following:

Proposal stage. The first step in developing a new standard starts when industry associations or consumer groups make a request. The relevant ISO committee determines whether a new standard is indeed required.

Preparatory stage. A working group is set up to prepare a working draft of the new standard. The working group is composed of subject matter experts and industry stakeholders; when the draft is deemed satisfactory, the working group's parent committee decides which stage occurs next.

Committee stage. This is an optional stage during which members of the parent committee review and comment on the draft standard. When the committee reaches consensus on the technical content of the draft, it can move to the next stage.

Enquiry stage. The draft standard at this stage is called a Draft International Standard (DIS). It is distributed to ISO members for comments and, ultimately, a vote. If the DIS is approved at this stage without any technical changes, ISO publishes it as a standard. If not, it moves to the approval stage.

Approval stage. The draft standard is submitted as a Final Draft International Standard (FDIS) to ISO members. They vote to approve the new standard.

Publication stage. If ISO members approve the new standard, the FDIS is published as an official international standard.

ISO participating members vote on standards approvals. A standard must receive affirmative votes from at least two-thirds of participating members and negative votes from no more than one fourth of participating members.

What is ISO certification?

As it relates to ISO standards, certification is a certifying body's assurance that a service, product or system meets the requirements of the standard. While ISO develops the standards, third-party certification bodies certify conformity with those standards.

According to the ISO, the phrase "ISO certification" should never be used to indicate that a product or system has been certified by a certification body as conforming to an ISO standard. Instead, ISO suggests referring to certified products or systems using the full identification of the ISO standard.

For example, instead of "ISO certified", ISO recommends using the phrase "ISO 9001:2015 certified." This fully identifies the standard being certified, including the version -- in this case, the version of ISO 9001 released in 2015.

While ISO does not do certifications, its Committee on Conformity Assessment works on standards related to the certification process.

How do businesses become ISO certified?

The process of getting certified for an ISO standard can be expensive, time-consuming and potentially disruptive to the business. Before taking any steps to get certified, determining the need for certification can be the most important step.

The first step in becoming certified is determining whether certification is worth the costs. Some reasons that organizations pursue certifications include the following:

Regulatory requirements. Some businesses and products require certification that they meet common standards.

Commercial standards. When certification is not a regulatory requirement, products and services that are certified to meet minimum standards are a necessity for some industries.

Customer requirements. Even where there is an industry standard or regulatory requirement for certification, some customers such as government agencies, may prefer or require certification.

Improved consistency. Certification can help large organizations deliver consistent quality assurance across business units as well as across international borders.

Customer satisfaction. Enterprise customers that use a product or service in different contexts and countries appreciate consistent performance. Compliance with standards can also help the certified organization resolve customer issues.

The certification process for ISO standards varies, depending on the standard and the certifying body. For popular standards, organizations may need to first review and select a suitable certification body. Recommendations for the steps to follow to get certified in the ISO's quality management standard, ISO 9001:2015, include the following:

- understand the ISO standard;
- identify trouble areas, where operations do not meet ISO requirements;
- formally document processes, procedures and plans to improve trouble areas;
- implement ISO standards;
- conduct an internal audit to check conformance with the standard before the official audit; and
- undergo formal compliance audit or certification process.

Material Requirements Planning (MRP)

Material Requirements Planning (MRP) is a standard supply planning system to help businesses, primarily product-based manufacturers, understand inventory requirements while balancing supply and demand. Businesses use MRP systems, which are subsets of supply chain management systems, to efficiently manage inventory, schedule production and deliver the right product—on time and at optimal cost.

How MRP works

An MRP system accelerates the manufacturing production process by determining what raw materials, components and subassemblies are needed, and when to assemble the finished goods, based on demand and bill of materials (BOM). It does this by asking three main questions:

- What is needed?
- How much is needed?
- When is it needed by?

The answers to these questions provide clarity into what materials are needed, how many and when to fulfill the required demand and help facilitate an efficient and effective production schedule.

Why is MRP important?

MRP gives businesses visibility into the inventory requirements needed to meet demand, helping your business optimize inventory levels and production schedules. Without this insight, companies have limited visibility and responsiveness, which can lead to:

- Ordering too much inventory, which increases carrying costs and ties up more cash in inventory overhead that could be used elsewhere.
- Inability to meet demand because of insufficient raw materials, resulting in lost sales, cancelled contracts and out-of-stocks.
- Disruptions in the production cycle, delaying sub-assembly builds that result in increased production costs and decreased output.

Manufacturing companies rely heavily on MRP as the supply planning system to plan and control inventory, scheduling and production, but MRP is also relevant in many other industries, from retail to restaurants, to create balance between supply and demand.

MRP Steps and Processes

The MRP process can be broken down into four major steps:

Identifying requirements to meet demand

The first step of the MRP process is identifying customer demand and the requirements needed to meet it, which starts with inputting customer orders and sales forecasts.

Using the bill of materials required for production, MRP then disassembles demand into the individual components and raw materials needed to complete the build while accounting for any required sub-assemblies.

Checking inventory and allocating resources

Utilizing the MRP to check demand against inventory and allocating resources accordingly, you can see both what items you have in stock and where they are—this is especially important if you have inventory across several locations. This also lets you see the status of items, which gives visibility into items that are already allocated to another build, as well as items not yet physically in the warehouse that are in transit, or on order. The MRP then moves inventory into the proper locations and prompts reorder recommendations.

Scheduling production

Using the master production schedule, the system determines how much time and labor are required to complete each step of each build and when they need to happen so that the production can occur without delay.

The production schedule also identifies what machinery and workstations are needed for each step and generates the appropriate work orders, purchase orders and transfer orders. If the build requires subassemblies, the system takes into account how much time each subassembly takes and schedules them accordingly.

Identifying issues and making recommendations

Finally, because the MRP links raw materials to work orders and customer orders, it can automatically alert your team when items are delayed and make recommendations for existing orders: automatically moving production in or out, performing what-if analyses, and generating exception plans to complete the required builds.

MRP Inputs

How well your MRP system works depends on the quality of the data you provide it. For an MRP system to work efficiently, each input must be accurate and updated. Here are some of the inputs an MRP depends on:

- **Demand** – Including sales forecasts and customer orders. When working with predicted demand, a system that is integrated with an enterprise-wide ERP system allows forecasting using historical sales vs. just sales forecasts.
- **Bill of materials (BOM)** – Keeping a single updated version of the bill of materials is essential for accurate supply forecasting and planning. A system that's integrated into the enterprise-wide inventory management system avoids version control issues and building against outdated bills, which results in reworks and increased waste.
- **Inventory** – It's essential to have a real-time view of inventory across the organization to understand what items you have on hand and which are en route or have purchase orders issued, where that inventory is and what the inventory's status is.
- **Master production schedule** – The master production schedule takes all build requirements and plans machinery usage, labor and workstations to account for all outstanding work orders to be completed.

MRP Outputs

Using the provided inputs, the MRP calculates what materials are needed, how much is needed to complete the build and when in the build process they are needed.

With this information defined, businesses are able to execute on just-in-time (JIT) production, scheduling production based on material availability. This minimizes inventory levels and carrying costs, as inventory is not stored in the warehouse for future production but arrives as needed. By scheduling materials to arrive and production to begin soon after, businesses can move materials through the workflow process without delay.

The MRP lays out the plan of when materials should arrive, based on when they're needed in the production process, and when subassemblies should be scheduled. Using a master production plan and taking into account subassembly build times minimizes materials sitting on shelves and bottlenecks in the build process.

Benefits of MRP

MRP systems allow you to plan and schedule production efficiently, making sure materials move through the work order quickly and helping businesses fulfill customer orders on time.

An MRP system that is integrated across an organization eliminates manual processes, such as pulling historical sales and existing inventory. You spend less time building Gantt charts and production flows to understand when and where you need product available, which frees up time and removes a layer of complexity.

When builds are complex and require multiple sub-assemblies within the work order, it's easy to miscalculate timing. An MRP helps you understand all of the components that go into each sub-assembly and how long it takes to complete each step, preventing delays in the production cycle and increasing production yield.

MRP Challenges

Although using an MRP solution is a far better than using spreadsheets for supply planning, it's only as good as the data you put into it. The better a business understands and documents its processes, the better an MRP system can serve them.

You need to make sure you input correct inventory availability, time to complete a subassembly, waste calculations and lead-times from vendors. Otherwise, your production schedule will be inaccurate—an MRP can't define the production build timeline and materials required if the data isn't accounted for in the inventory record, bill of materials and master production schedule

MRP vs. ERP

MRP systems focus specifically on planning and controlling how goods are assembled using multiple raw materials or components by controlling inventory, componentry and the manufacturing process.

Enterprise resource planning (ERP) systems are an offshoot of MRP systems, spurred by businesses finding a need for the same level of planning and oversight for other operations such as payroll, finances and supplier management. ERP systems plan for resources across the entire organization, including: financial management, order management, customer relationship management, people, procurement, warehousing and fulfillment.

Scheduling in Production and Operation Management

Scheduling can be defined as "prescribing of when and where each operation necessary to manufacture the product is to be performed." It is also defined as "establishing of times at which to begin and complete each event or operation comprising a procedure". The principle aim of scheduling is to plan the sequence of work so that production can be systematically arranged towards the end of completion of all products by due date.

Principles of Scheduling

1. **The principle of optimum task size:** Scheduling tends to achieve maximum efficiency when the task sizes are small, and all tasks of same order of magnitude.
2. **Principle of optimum production plan:** The planning should be such that it imposes an equal load on all plants.
3. **Principle of optimum sequence:** Scheduling tends to achieve the maximum efficiency when the work is planned so that work hours are normally used in the same sequence.

Inputs to Scheduling

1. Performance standards: The information regarding the performance standards (standard times for operations) helps to know the capacity in order to assign required machine hours to the facility.
2. Units in which loading and scheduling is to be expressed.
3. Effective capacity of the work centre.
4. Demand pattern and extent of flexibility to be provided for rush orders.
5. Overlapping of operations.
6. Individual job schedules.

Scheduling Strategies

Scheduling strategies vary widely among firms and range from 'no scheduling' to very sophisticated approaches. These strategies are grouped into four classes:

1. **Detailed scheduling:** Detailed scheduling for specific jobs that are arrived from customers is impracticable in actual manufacturing situation. Changes in orders, equipment breakdown, and unforeseen events deviate the plans.
2. **Cumulative scheduling:** Cumulative scheduling of total work load is useful especially for long range planning of capacity needs. This may load the current period excessively and under load future periods. It has some means to control the jobs.
3. **Cumulative detailed:** Cumulative detailed combination is both feasible and practical approach. If master schedule has fixed and flexible portions.
4. **Priority decision rules:** Priority decision rules are scheduling guides that are used independently and in conjunction with one of the above strategies, i.e., first come first serve. These are useful in reducing Work-In-Process (WIP) inventory.

This book is published by

AAM Business School

The Only B School in South India to offer

PAY AFTER PLACEMENT

50+ Companies recruit from our campus every year

Inviting new-age companies looking for great talent for accelerating their growth

AAM Students are certified in the following domains

- Recruitment & Selection
- Compensation & Benefits (Payroll)
- Investment Banking & Capital Markets
- NISM Certification
- MIS
- Emotional Intelligence
- Corporate Communication
- Personality Development
- Leadership Development
- Entrepreneurship
- G Suite
- MS Office Suite
- Digital Marketing
- Art of Networking
- Tally ERP 9 Certification
- HR Analytics

AUTHOR OF THIS BOOK

ALEX MELWYN, MBA (HRM)

Corporate HR & Training Consultant

Avidus Academy Of Management

No 64, 35, Josier St, Tirumurthy Nagar, Nungambakkam, Chennai 600034

www.avidus.net

Follow us on

aamindia

aambusinessshool244