A Handbook of MANAGEMENT TECHNIQUES

Contents

and nature of leisure time, changes in attitude towards health and lifestyles, improvement in education, changes in attitudes towards family roles, changing patterns of work and equal opportunities. In some countries, the religious environment might also be a source of opportunities or threats to companies doing business there.

- *Technological* factors concerning such matters as the Internet, automation, new methods of travel, computer-assisted telephone interviewing, electronic point of sale, new materials and more powerful computing methods. All of these can have a direct influence on the marketing firm, particularly if its own methods of production, or the products/services that it produces, are directly affected by, or actually form, an integral part of the products that it offers to customers. This may be extended to PESTLE, which also covers legal, environmental and ecological factors.

BENEFITS

The potential benefits of marketing are that the company will:

- adopt a systematic approach to assessing and exploiting marketing opportunities;
- view and organize its marketing activities from the consumer's point of view;
- identify, serve and satisfy a defined set of needs of a defined set of customers;
- continually seek product improvements;
- continually develop and improve the way in which products are presented and distributed to customers;
- operate on the basis of clearly defined plans and targets; and
- exercise control to ensure that the required results are achieved.

REFERENCES

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2. Levitt, T, *The Marketing Imagination,* Free Press, New York 1983.
3. Willsmer, R L, *The Basic Arts of Marketing,* Business Books, London 1984.
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5. Levitt, T, 'Marketing myopia', *Harvard Business Review,* July–August 1960.

ACTION

As a result of the analysis the following are actions that can be taken to ensure that a favourable trend continues or to arrest a decline by recycling.

Introduction stage

- Increase advertising and promotional expenditure to accelerate growth.
- Adjust prices to increase penetration.
- Adjust promotional message and sales approaches in response to analysis of consumer reactions.
- Improve product features in response to initial consumer reaction.

Growth stage

- Improve quality.
- Modify product characteristics.
- Extend market into new segments.
- Develop new distribution channels.
- Reduce prices to attract the next layer of price-sensitive buyers.

Maturity stage

- Find new market segments and customers.
- Reposition brand to appeal to a larger or faster-growing segment.
- Encourage increased usage among existing customers.
- Modify product characteristics – new features, style improvements.
- Modify marketing mix, eg cut prices, advertise or promote more aggressively, move into higher-volume market channels.

Decline stage

- Maintain brand in the hope that competitors will withdraw their products.
- Harvest brand, ie maximize profits by reducing costs but keeping up sales pressure.
- Terminate and withdraw the product.

BENEFITS

The main benefit of product life-cycle analysis is that it forces the company to recognize what is happening to its product in the marketplace over

time. Forecasts can be made of future trends and the likely impact of competition. The strengths and weaknesses of the company's product are identified so that the former can be exploited and the latter overcome. Life-cycle analysis is a continuous process which enables the company to review its marketing mix on the basis of a better understanding of the performance of its product.

Again, this approach is also used in manufacturing and takes no account of demand.

Marginal pricing

Marginal pricing fixes the selling price of additional units by reference to the marginal cost of manufacturing each unit.

The theory of marginal pricing is that, after a company's total fixed and variable costs have been covered by the existing volume of production, the cost of producing an extra unit – of marginal production – will only be the total variable cost of producing and selling it. In such circumstances, the selling price of additional goods can be reduced, if necessary, to match the total variable cost without any loss to the company. Any amount by which the selling price exceeds the variable cost of marginal outputs is then an extra or marginal contribution to the company's net profits and fixed costs. Again, this is a manufacturing approach.

Break-even analysis

Break-even analysis uses the concept of a break-even chart to develop a system of target pricing in which the company tries to determine the price that will produce the profit it is seeking. Although profit related, this form of pricing is based on an analysis of total costs, upon which is superimposed an assessment of total revenue.

Break-even analysis determines fixed and variable costs and enables the price-setter to investigate the profit implications of alternative price–volume strategies. As illustrated in Figure 4.1, a break-even chart represents the following elements of costs and revenue:

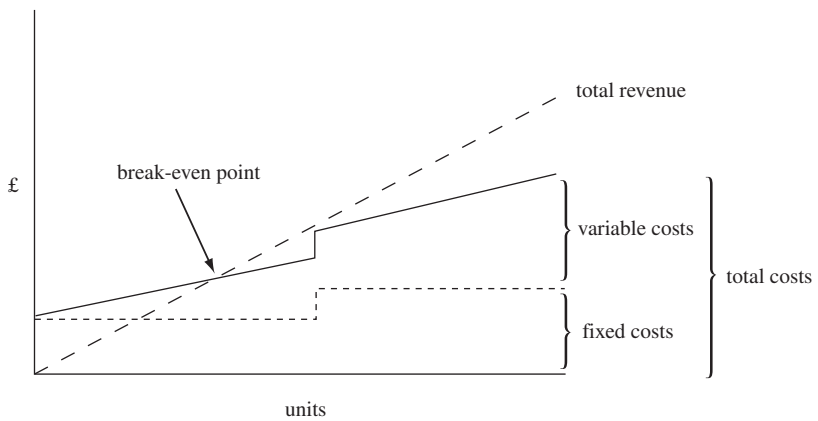

Figure 4.1 *Break-even chart*

Method

A decision is required about which of the following market coverage strategies will produce the best results:

- Undifferentiated marketing – ignoring segments and attacking the whole market, aiming to satisfy the common needs of customers.
- Differentiated marketing – operating in several segments of the market and designing separate offers for each.
- Concentrated marketing – aiming for a large share in one or a few segments.

The decision will be influenced by the following factors:

- Company resources, which will determine the extent of coverage that is achievable.
- Product and market homogeneity – the more homogeneous the product or market, the greater the pressure for undifferentiated targeting.
- Product stage in the life cycle – it might be appropriate to go for wide coverage in the initial stages and to target specific segments as the product matures.
- Competitors' segmentation strategies – the company may wish to target market segments neglected by competitors.

Target marketing strategies

The following strategies can be adopted for target marketing:

- *Differentiated*, where there are multiple marketing mixes for different market segments.
- *Undifferentiated*, where there is a single marketing mix for all customers.
- *Concentrated*, which has one marketing mix for a segment of the entire market.
- *Custom*, which attempts to satisfy each customer's needs with an individual marketing mix.

BENEFITS

Target marketing processes identify the particular direction the company wants to follow in accordance with its understanding of market segmentation. It leads to the development of market positioning strategies.

consumer to advertisements (termed 'off the page') or direct mail shots. A key ratio in such instances will be cost per order (CPO).

Media planning

The media planning process consists of the following steps:

1. *Appraisal of:*
   - sales trend data;
   - brand share data;
   - market seasonality;
   - competitive advertising patterns;
   - purchasing or usage profile by demographic group; and
   - results achieved from other campaigns.
2. *Budgeting,* which will take into account the appraisal and other factors mentioned earlier.
3. *Planning,* which may follow the budgeting process and simply be concerned with deciding on the best method of allocating funds. But the planning process may indicate changes in direction or emphasis that could result in modifications to the budget. The plan will take into account answers to the following questions:
   - Is national coverage required or can a regional policy be adopted?
   - Does advertising need to be more or less continuous, or can a burst strategy be effective within the peak sales seasons?
   - Which target group or groups need to be covered?
   - Is heavyweight activity required at the beginning of the campaign to either launch or relaunch the product or the advertising idea?
   - Which medium or media mix is required to ensure optimum communication of the advertising?
   - What is the weight of advertising required in each medium from both a communication and a competitive point of view?
4. *Buying* – using negotiating skill, research backup and 'muscle' to negotiate the best terms with the media.
5. *Evaluating*. There is no simple method of measuring the effectiveness of an advertising campaign except, of course, indirect response where coupons and orders can be counted. In this field, 'split-run' tests can be run in certain media where different offers or styles are tested in alternate (A or B) copies and the results can be compared directly.

In more conventional advertising the most commonly used methods include market research and sales analysis. *Market research* involves general research into consumer attitudes and responses, or particular research into the reaction to an advertisement (reactions to proposed campaigns can be pre-tested by qualitative research). *Sales analysis* is used especially when area tests are conducted for new products or new

BENEFITS

A marketing information system provides invaluable inputs to the marketing planning process. It acts as a control mechanism as customer reactions are also fed into it from market intelligence, the field sales force or marketing research. Information on sales analysis is fed into the system so decisions can be made as to whether or not forecast sales are being achieved.

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Field Research

DEFINITION

Field research is the conducting of investigations by direct contact or observation to collect fresh information about the attitudes and behaviour of consumers and industrial buyers. It deals especially with:

1. the factors underlying choice and preference;
2. reactions to new product concepts and offerings; and
3. user and non-user profiles.

It also assists in evaluating the effectiveness of alternative channels of distribution. It is to be distinguished from desk research, which simply uses published or otherwise available information.

TECHNIQUES

The principal techniques used in field research are:

1. Sampling.
2. Observation.
3. Questionnaires.
4. Interviewing.
5. Panels.
6. Attitude scaling.

five-point scale on which end points are defined by pairs of adjectives, eg strong–weak, good–bad. Numerical values are then assigned to the scale positions so that comparisons can be made between various brands or between users and non-users of a brand. This is one of the most popular methods because the scale is fairly easy to construct and analyse.

BENEFITS

The benefits of a properly conducted field survey are:

1. specific information is obtained about the dynamics of consumer behaviour;
2. attitudes to new and existing products can be measured; and
3. from this factual information on behaviour and attitudes, conclusions can be reached on shaping marketing strategies or solving marketing problems.

The process of marketing planning is also described in a model called APACS (Adaptive Planning and Control Sequence) developed by the Marketing Science Institute which sets out the following stages:

Step 1. Define problem and set objectives.
Step 2. Appraisal using SWOT analysis.
Step 3. Determine the tasks to be accomplished and identify the means to achieve these aims.
Step 4. Identify alternative plans and mixes.
Step 5. Estimate the expected results arising from implementation of the alternative plans.
Step 6. Managerial review and decision.
Step 7. Feedback of results and post audit.
Step 8. Adapt programme if required.

The sequence of activities required by these processes is illustrated in Figure 17.1.

ANALYSIS

The analytical stage of marketing planning requires an appraisal of:

1. the current situation: strengths and weaknesses;
2. marketing threats and opportunities; and
3. future trends.

The current situation

This is analysed under the following headings:

1. *Corporate position*:
   - The business the company is in and the salient features of that business.
   - The company's overall objectives, explicit or implied.
   - The company's resources – productive, technical, financial and marketing, and their strengths and weaknesses.
   - The policies of that company, explicit or otherwise, with regard to the use and development of these resources.
   - The special skills or competences possessed by the company.
2. *Marketing description*:
   - Definition of the market and each of its segments.
   - Current size of the market in units and sales revenue for the whole market and each segment.

might, in its narrow sense, be indifferentiable, an individual supplier may differentiate his or her product from competitive offerings through service, product availability, and brand image, and differentiation in one respect or another is the basis for developing a market franchise (E Raymond Corey).[3]

- The main job of distribution is not to get rid of what production makes; it is to tell production what it ought to make (Lyndall F Urwick).[4]
- A product is, to the potential buyer, a complex cluster of value satisfactions... a product has meaning only from the viewpoint of the buyer or the ultimate user. Only the buyer or user can assign value, because value can reside only in the benefits he or she wants or perceives (Theodore Levitt).[5]

THE COMPONENTS OF PRODUCT PLANNING

Product planning requires decisions followed by action on:

1. the product line;
2. the product mix;
3. branding;
4. packaging;
5. new product development.

PRODUCT LINE ANALYSIS

A product line is a group of products that are closely related, either because they have similar characteristics or because they are sold to the same type of customer. Cars would be one product line in a vehicle manufacturing company.

Product line analysis involves looking at, first, the viability of each individual product using *product life-cycle analysis* techniques. Second, product line analysis considers the length of the line. The line is too short if profits can be increased by lengthening it; too long if profits can be increased by shortening it.

Product line analysis will lead to decisions on the extent to which the company wants to:

- extend the product line into the higher or lower end of the market; or
- concentrate in the higher, middle or lower end of the market.

It will also determine policy on the extent to which it is necessary to increase the differentiation of products in the line to increase or maintain sales.

DEVELOPING A WEBSITE

The stages of developing a website are:

1. *Create interest* – the aim is to attract interest (to provide a 'hook') that will generate visits and sales.
2. *Design* – the design of the site should be attractive, but it is equally, if not more, important to ensure that it is easy to navigate. Users must be able to register easily, to find what they want to know quickly, and to place orders or ask for information without getting lost in a complex sequence of actions. Care should be taken over the design of site maps that guide users from one part of the site to another.
3. *Develop content* – the language should be informal and the text needs to be broken down into easily assimilated chunks. The patience of website visitors is limited and if there is too much indigestible material, they will move on.
4. *Programme* – the site needs to be programmed to enable a web browser to use animation, video and possibly, audio files. Multimedia effects can be added and web pages can be programmed to be interactive. It is important to minimize downloading times in order to be user-friendly, however, and the simplest approach may sometimes be the best. Systems need to be set up for handling transactions.
5. *Maximize traffic* – the site should be indexed and cross-referenced so that it is flagged up by the major search engines used by potential customers.
6. *Financing* – finance has to be obtained to fund the development of the website. Static pages (with no interactive elements) are cheaper. The costs will include the design of the site, expenses incurred in inputting material and agency fees.

BENEFITS

The benefits of web marketing are clearly the ability to gain access to many more customers, to enhance brand or company image and to generate interest and sales.

REFERENCE

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- the integrated approach to marketing, service and quality provides a firmer basis for achieving sustainable competitive advantage; and
- the importance of quality and service support is made absolutely clear to *all* staff.

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Database Marketing

DEFINITION

Database marketing uses information held on a computer database about existing or potential customers in such a way as to improve the effectiveness of the marketing and selling activities of the business.

A database is a set of data entries which is held on a computer and organized by a software package. It enables users to relate, collate, summarize and reproduce the data entries in accordance with defined parameters and criteria.

OBJECTIVE

The objective of database marketing is to exploit information held about customers in a way which maximizes the value of such information as a means of targeting them in accordance with their needs and buying habits.

APPLICATIONS

Database marketing is associated primarily with direct mail, which is a method of selling goods or services by means of communication to individuals through the post. Database techniques also offer a means of defining and refining markets.

More specifically, database marketing enables business to:

attached to individual households in the district and sales can be targeted to those who, on the balance of probabilities, are potentially the most responsive customers.
- *Psychographic data* – information about the personal characteristics of customers covering such items as their household, their possessions, their interests and their buying behaviour.

Information sources

The main information sources are as follows:

- *Customer data*. Obviously, this is collected from records of sales transactions. When designing the database it will be necessary to specify precisely what data is required and modify the data-processing systems accordingly. It will be essential to provide precise postcodes (this can be done through a specialized computer bureau).
- *Demographic data*. This can be obtained from the census. It is necessary to analyse each enumeration district (the smallest available building block of census data) to establish its demographic profile – the characteristics of residents in the district. This profile will not accurately describe every household but will probably apply to a sufficiently large proportion of them to justify targeting sales to all residents in accordance with the overall profile. Organizations such as Acorn can provide demographic profiles of their clients' customers.
- *Psychographic data*. This can be provided by organizations such as Behaviour Bank and Lifestyle Selector. They obtain their information through surveys which involve the completion of questionnaires by people and their subsequent analysis.

Setting up software systems

A database marketing system is often founded on some form of DBMS (database management system) upon which is built whatever application software is required. This software can be obtained from a software house as a package, or it can be custom-built by a software consultancy.

BENEFITS

The benefits of database marketing are:

- the ability to generate business at a lower cost per order;
- an increase in the productivity of sales representatives and assistants; and
- the capacity to respond more accurately to customer needs and wants.

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Table 26.1 *Typical operations decisions*

Decision area	Typical operations decisions
Strategic decisions	
Business	What business are we in?
Product	What type of products do we make?
Process	How do we make the products?
Location	Where do we make the products?
Capacity	How big should facilities be?
Quality management	How good are the products?
Other organizations	What are our relations with other organizations?
Tactical decisions	
Layout	How should we physically arrange operations?
Product planning	When should we introduce a new product?
Structure	What structure do we give the organization and the process?
Quality assurance	How do we achieve planned quality?
Logistics	How should we distribute the products?
Maintenance	How often should we maintain equipment and when should we replace it?
Staffing	How many people should we employ and what skills do they need?
Technology	What level is best for planned production?
Procurement	How do we organize purchasing?
Make/buy	Is it better to make or buy components?
Operational decisions	
Scheduling	In what order should we make the products?
Inventory	How much should we order and when should we place orders?
Reliability	How often does equipment break down: what can we do to improve this?
Maintenance	When can we schedule maintenance periods?
Quality control	Are products reaching designed quality?
Job design	What is the best way to do an operation?
Work measurement	How long will operations take?

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Using Operations to Gain a Competitive Advantage

DEFINITION

Almost every organization faces competition from other organizations that make – or could start to make – similar products. To be successful, an organization has to develop its strengths into a distinctive competence that gives it a sustainable competitive advantage.

COMPETITION AND PRODUCTS

Organizations remain competitive by supplying products that customers buy in preference to any alternatives. The operations strategy gives the general concepts for these products and the processes used to make them. The next stage is to add some details to the concepts.

Unfortunately, when we begin to move beyond the general concepts, we quickly meet problems. The first is the obvious difference in the viewpoint of customers and the organization. Customers would like to buy high-quality products with lots of features at very low prices – but organizations would like to make standard products, with few features and higher prices. This is a common theme for operations managers, who are constantly searching for the best compromise between conflicting goals.

Not only do customers and producers want different features in their products but each customer frequently wants a different product. Some people want clothes that are very fashionable, others want them to be

COSTS, REVENUE AND PROFITS DURING THE LIFE CYCLE

Before a new product is introduced, the organization spends money on research, development, design, planning, testing, setting up new facilities and so on. These costs have to be recouped from later income.

In the early stages of the life cycle the unit costs are high. This is mainly because low-volume processes are expensive – but the organization may also try to recover some of the development costs by assigning them as overheads on early sales. At this stage the profit on each unit may also be high, as customers are willing to pay a premium to get a new or novel product. Total revenue is limited by small sales, as shown in Figure 29.3.

Revenue begins to rise when the product moves from introduction to the growth stage. At this point the development costs are recovered and the product starts to make an overall profit. The profit per unit can be high, as customers still view the product as new and are willing to pay a reasonably high price, there is little competition, and new production equipment is working efficiently.

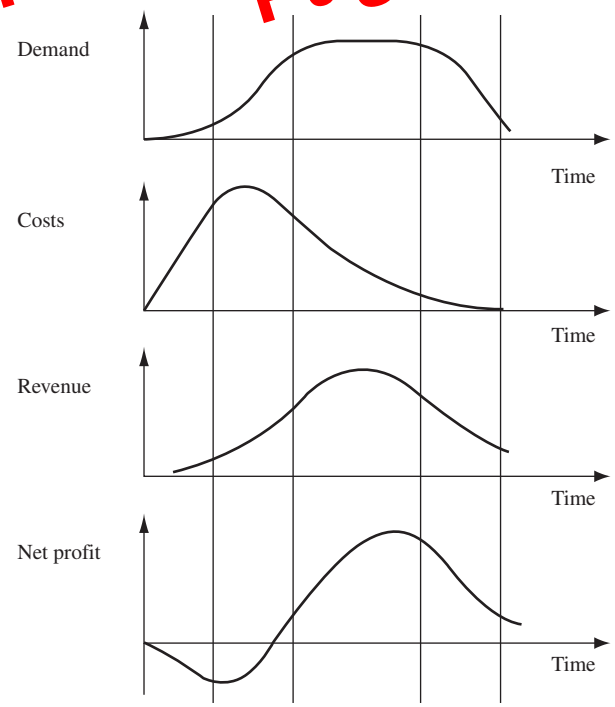

Figure 29.3 *Cost, revenue and profit during a product life cycle*

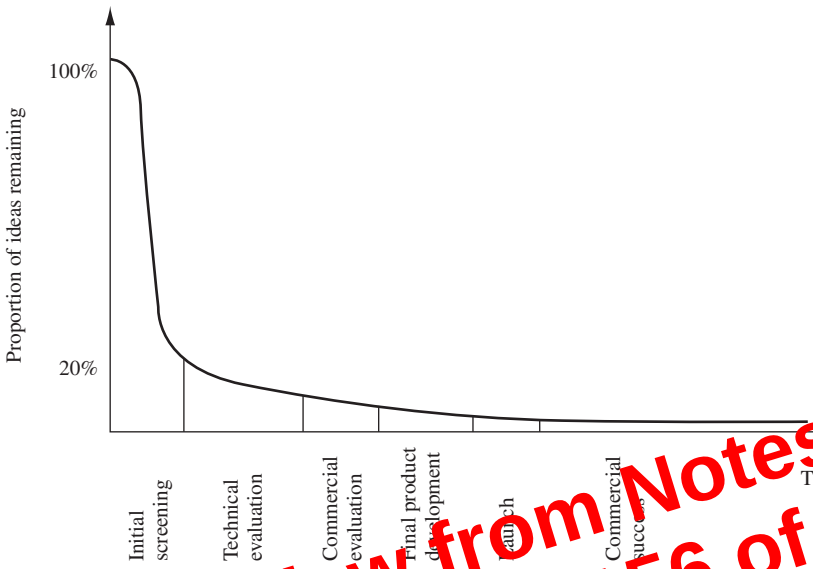

Figure 3.1 *Percentage of original ideas remaining*

- If it is an old idea, why has the organization not made it before?
- Are there problems with patents or competitors?
- Are developments likely to overtake the product?

More specific questions about the product:

- Is the proposed design technically feasible?
- Can it be made with available technology?
- Would it fit into current operations?
- Does the organization have the necessary skills and experience?
- Is there enough capacity in operations?

Prototypes and trials help with these decisions and suggest modifications to the initial designs. At this point, the initial designs for the process are also considered.

Stage 4: commercial evaluation – market and financial analysis

If the product passes the technical evaluation, it moves on to a commercial evaluation to see whether it will make a profit. This stage removes products that:

- customers will not buy;
- are too similar to existing products;
- are so different from existing products that customers will not accept them;
- are in a rapidly declining market;
- do not fit into existing strategies;
- will not make enough profit, or have margins that are too small;
- need too much capital, or have poor returns on investment;
- have too high production or operating costs.

This stage builds a commercial case for continuing development of the product. If this case is sound, the product moves forward to full development.

Stage 5: final product development

Products that pass the feasibility study move on to final design and testing. This is where all the lessons learnt from previous stages, together with the results from customer surveys and any other relevant information, are used in the final designs. The product changes from a prototype or concept model to the final form that customers will see. This design describes the overall package, including the design of any goods, the services offered, materials used, quality measures, and everything else that forms the final product package. This stage also finalizes the details of the process used to make the product.

Stage 6: launch of product

After the development, production starts and the organization offers its new product to customers. This is the first chance to see if the planning has worked and the product will actually be a success. Many products are not successful and are quickly withdrawn. Very few of the initial ideas – perhaps one or two per cent – go through all the stages of development to the point where they are launched on the market. Even fewer become successful products.

CONCURRENT DEVELOPMENT

The six stages described above are carried out roughly in order, but there can be a lot of cycling and repetition. If, for example, the results of the commercial evaluation are unclear, the organization might adjust the designs and initiate a new technical evaluation.

- consumers have become accustomed to high-quality products and will not accept anything less;
- high quality reduces costs.

This list shows why organizations *must* make high-quality products. If they make poor-quality products, customers will simply move to a competitor who is better at meeting their expectations. Although high quality will not guarantee a product's success, low quality will certainly guarantee its failure.

Long-term survival, coming from satisfied customers, is the major benefit of high quality. Other benefits include:

- higher customer satisfaction;
- less waste and increased productivity;
- lower costs and improved profitability;
- reduced warranty costs;
- elimination of procedures for correcting defects;
- reduced administration costs for dealing with customer complaints;
- reduced liability for defects;
- competitive advantage coming from an enhanced reputation;
- larger market share with less effort in marketing;
- enhanced motivation and morale of employees;
- removal of hassle and irritants for managers.

COSTS OF QUALITY

One interesting point from the list above is that higher quality reduces costs. At first this seems to go against the traditional view that increasing quality can only be bought at increasing cost. If you look at the wider costs, however, you see that some actually go down with increasing quality. Suppose, for example, you buy a washing machine with a faulty part. You complain, and the manufacturer arranges for the machine to be repaired. The manufacturer could have saved money by finding the fault before the machine left the factory – and it could have saved even more by making a machine that did not have a fault in the first place.

At this point we should look at the costs of quality in a little more detail. There are four components to the costs of quality – for prevention, appraisal, internal failure and external failure.

Prevention costs are the costs incurred to prevent defects occurring. The quality of a product is largely set at the design stage, so the best way to guarantee high quality is not by inspections during the process but by designing a good product in the first place. Prevention costs cover all aspects of quality that are designed into a product. They include direct

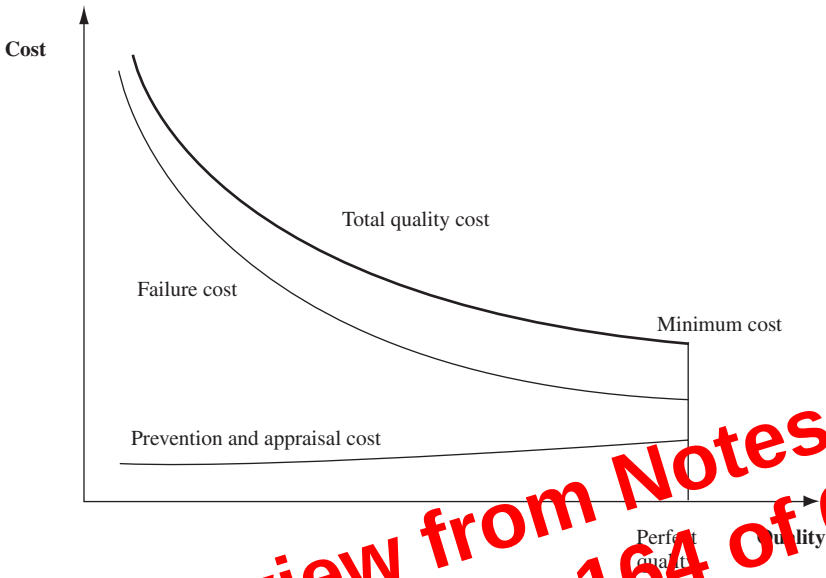

Figure 31.1 *Minimum costs occur with perfect quality*

per cent of sales – with the failure costs being highest. Plotting these components gives the results shown in Figure 31.1. The failure costs are so high that organizations clearly want to avoid them, and the best way of doing this is to make products without defects – in other words, to make products of 'perfect quality', where every unit is guaranteed to be free of any faults. This is the idea of *total quality management*, which is described in the next chapter.

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Table 32.1 *Different attitudes introduced by TQM*

Criteria	Traditional attitude	New attitude with TQM
Importance:	quality is a technical issue	quality is a strategic issue
Cost:	high quality costs money	high quality saves money
Responsibility:	quality assurance department	everyone in the organization
Target:	meet specifications	continuous improvement
Measured by:	average quality level	zero defects
Emphasis:	detecting defects	preventing defects
Attitude:	inspect quality	build quality
Defined by:	organization	customers

changes and developing his ideas of TQM. During this time he compiled a list of '14 principles'.

Deming's 14 principles

1. Create constancy of purpose towards product quality.
2. Refuse to accept customary levels of mistakes, delays, defects and errors.
3. Stop depending on mass inspection but build quality into the product in the first place.
4. Stop awarding business on the basis of price only – reduce the number of suppliers and insist on meaningful measures of quality.
5. Develop programmes for continuous improvement of costs, quality, productivity and service.
6. Institute training for all employees.
7. Focus supervision on helping employees to do a better job.
8. Drive out fear by encouraging two-way communication.
9. Break down barriers between departments and encourage problem-solving through teamwork.
10. Eliminate numerical goals, posters and slogans that demand improvements without saying how these should be achieved.
11. Eliminate arbitrary quotas that interfere with quality.
12. Remove barriers that stop people having pride in their work.
13. Institute vigorous programmes of lifelong education, training and self-improvement.
14. Put everyone to work on implementing these 14 points.

Deming's 14 points suggest a new way of thinking in organizations. They emphasize the fact that managers are in control of the organization, and are responsible for its performance. The process is really in two parts: the *system* over which managers have control, and which contributes 85 per cent of the variation in quality; and the *workers* who are under their own control, and who contribute 15 per cent of the variation in quality.

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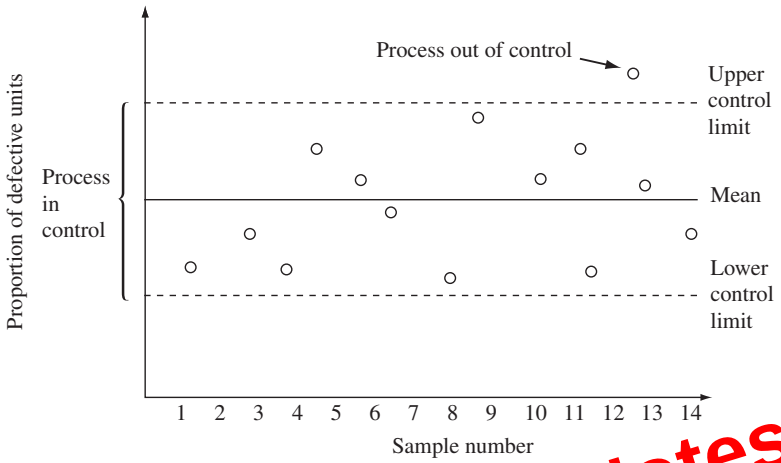

Figure 33.4 *A typical process chart*

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CAUSAL FORECASTING

Causal forecasting looks for a cause or relationship that can be used to forecast. The sales of a product, for example, might depend on the price being charged. If we can find the relationship between the price and sales, we can use a proposed price to forecast expected sales.

The most widely used form of causal forecasting is linear regression, which finds the line of best fit relating two variables. Then a typical result is:

$$\text{Forecast sales} = (125 + 12) \times \text{advertising costs}$$

The calculations for this are fairly straightforward, and Figure 34.3 shows a typical spreadsheet of results.

Inspection	Defect	Forecast	Summary output	
0	92	95.9		
1	86	88.0	*Regression Statistics*	
2	81	80.1	Multiple R	0.9938
3	72	72.2	R Square	0.9877
4	67	64.3	Adjusted R Square	0.9864
5	59	56.	Standard Error	3.0766
6	53	48.6	Observations	11
7	43	40.7		
8	32	32.8		
9	24	24.9		*Coefficients*
10	12	17.0	Intercept	95.8636
			X Variable 1	−7.8818

	Coefficient	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	95.864	1.735454	55.23837	1.05068E−12	91.9377642	99.78951
X Variable 1	−7.8818	0.293345	−26.8687	6.63179E−10	−8.5454117	−7.21822

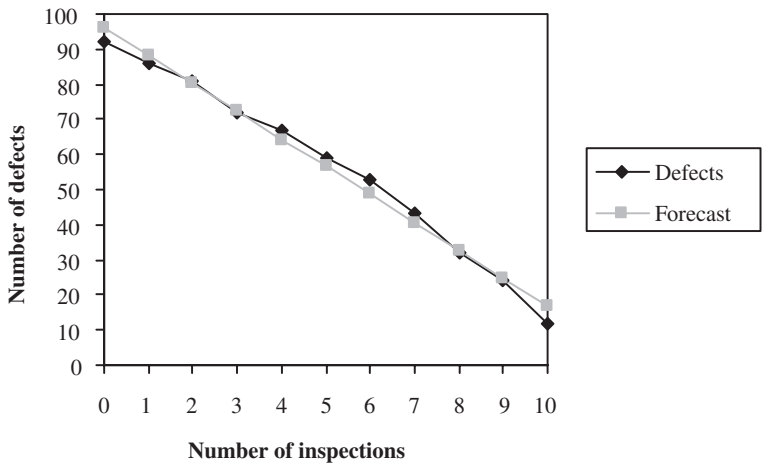

Figure 34.3 *Example of a spreadsheet printout for linear regression*

There are several extensions to simple linear regression, including multiple regression and non-linear regression.

PROJECTIVE FORECASTING

Projective forecasting examines historical values for demand and uses them to forecast the future. Some simple methods include the following:

- *Simple averages*. This simply takes the average of past values as the forecast for the future. The average number of people attending a conference in the past, for example, might give a reasonable figure for next year's attendance.
- *Moving averages*. Usually only a certain amount of historical data is relevant to future forecasts, and all observations older than some specified age can be ignored. A moving average uses this reasoning to take the average demand over the past few periods as a forecast, and ignores any older data.
- *Exponential smoothing*. Exponential smoothing is based on the idea that as data become older they become less relevant and should be given less weight. We can get this declining weight using only the latest demand figure and the previous forecast. To be specific, a new forecast is calculated from:

$$\text{New forecast} = (\alpha \times \text{latest demand}) + [(1 - \alpha) \times \text{last forecast}]$$

where α is a smoothing constant that takes a value of around 0.1.

These three methods can give good results when demand is fairly stable, but they need adjusting for more complicated patterns, such as seasonality or trend. There are several ways of doing this, and the most common:

- separates the overall demand into different components such as underlying demand, trend, seasonality, and cyclical factors;
- forecasts each of these separately;
- recombines the separate results to give the final forecast.

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Pecar, B, *Business Forecasting for Management,* McGraw-Hill, London 1994.

rated by stocks of work in progress, as shown in Figure 35.1. If the process is a service, then the customer becomes involved earlier and we have the system structure shown in Figure 35.2.

WORK STATIONS

Operations along the process are divided into a series of stages, each of which uses resources, such as the machines in a production line, to add value to the product. These stages are known by different names, but are commonly called work stations. Each work station might consist of a single machine, but more often has a cluster of equipment and resources that

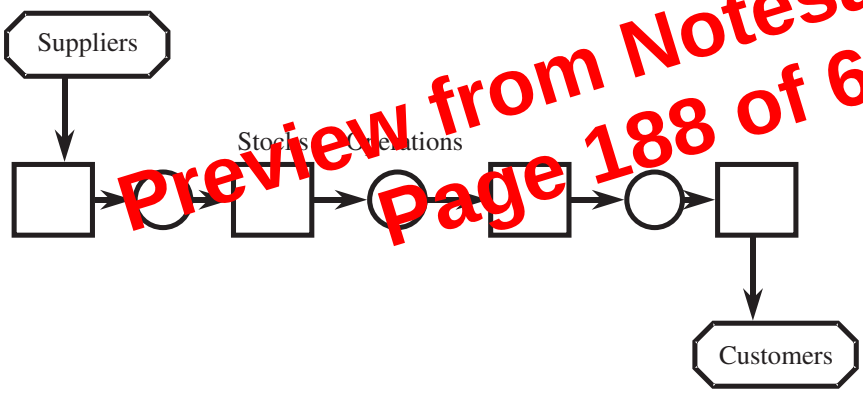

Figure 35.1 *Typical structure of a manufacturing process*

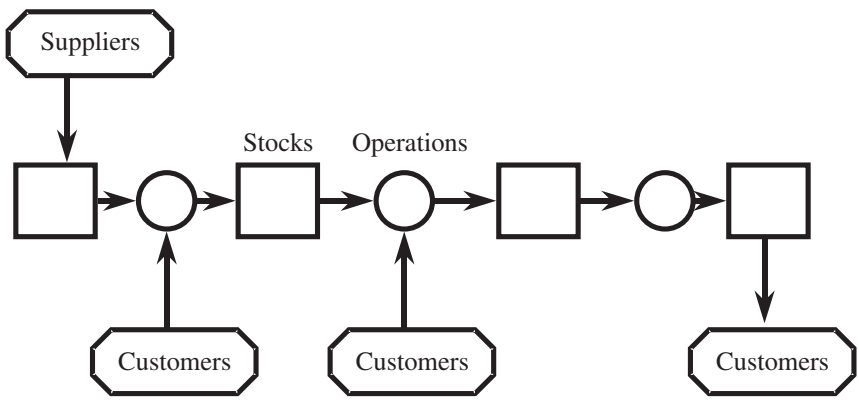

Figure 35.2 *Customers are more involved in service processes*

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Automation in Manufacturing

DEFINITION

Organizations can often improve their performance by using a more automated process. Some types of automation, such as industrial robots, are clearly more common in manufacturing than services. This chapter describes some types of automation for manufacturing, and the next chapter looks at the automation of services.

COMPUTER-AIDED MANUFACTURING

Many people think of automation in terms of assembly lines making cars. These are examples of fixed or hard automation, where specialized equipment is dedicated to making a single product. The process typically has a conveyor moving units along a fixed path between single-purpose, highly specialized machines. The result is an efficient process with little flexibility, of the type that is suited to high-volume production.

A lot of work has been done trying to make high-technology processes more flexible, so that they can be used for lower volumes. The aim is to combine versatility with efficiency to give flexible or programmable automation.

NUMERICALLY CONTROLLED MACHINES

Flexible automation for intermittent processes became possible in the 1950s with numerically controlled (NC) machines. These were originally general-purpose machines that could do a series of tasks without any intervention by an operator. Paper tapes or cards controlled the machines and they could be reprogrammed quickly by simply replacing the tape.

Magnetic tapes replaced paper tapes for the control of NC machines, and these, in turn, were replaced by microprocessors. Each of these computerized numerically controlled (CNC) machines is controlled by a dedicated computer, and can do a long series of operations without interruption. These standard machine tools are the most widely used form of automation in manufacturing. They have the advantages of being fast, flexible, giving consistent quality, low unit costs, and being able to do a variety of complicated work. Operators do not do any of the actual work, but they still have to load and unload the machines, check units, make adjustments, change the programmes and so on.

COMPUTER-AIDED MANUFACTURING

Systems where computers assist in the actual manufacturing are called computer-aided manufacturing (CAM). Computerized numerically controlled machines were the first step in this direction, and the next step came in the 1960s with industrial robots. These are usually stationary machines that have programmable arms (or manipulators) with a hand (or effector) at the end. They were first used for welding and paint spraying in car assembly lines, but their costs fell and they have become common for a variety of simple jobs. They are particularly useful for reaching places that are difficult for humans to get at, and for handling dangerous substances, such as explosives, poisons, hot metal ingots or radioactive materials.

FLEXIBLE MANUFACTURING SYSTEMS

The next type of automated production is flexible manufacturing systems (FMS). These combine the computers that control each piece of equipment (CNC machine or robot) so that a number of separate machines are under the control of a central computer. This computer finds the best production schedule, and coordinates operations to achieve this. It also controls the flow of materials, typically using wire-guided vehicles to move products, components, materials and tools between machines. Automatic loading and unloading stations transfer the materials between the transport system and manufacturing equipment. The essential parts of FMS are:

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Automation in Services

DEFINITION

Services provide the intangible parts of products – the parts that are not goods, but that still give benefit to customers. In recent years many services – particularly communications and information processing – have undergone a major transformation as they moved from manual to automated processes.

BACKGROUND

Improvements in electronic communications and information processing have allowed many services to move from manual processes to automated ones. Banking, for example, has become more efficient and cheaper as its automated systems evolved. Unfortunately, many services – like those given by dentists, lawyers, accountants, hairdressers and taxis – are highly customized and are made either singly or in very small batches. These inevitably have high costs. Organizations have tried many ways of reducing these costs by standardizing products and introducing mass processes. The result is that people receive services that are less personal but are a lot cheaper. Once the mass processes are in place, they can introduce automation to work on:

- customers themselves;
- customers' goods;
- information;
- some other aspect of the service.

One warning is that a measure should not be used simply because it is easy to find, or because it shows the organization in a good light. On the other hand, an organization should not ignore important aspects of performance such as staff morale because they are difficult to measure.

FURTHER READING

Belcher, J G, *Productivity Plus*, Gulf Publishing, Houston 1988.
Kaplan, R S, *Measures for Performance Excellence*, Harvard Business School Press, Boston, MA 1990.

41

Comparing Performance

DEFINITION

Absolute measures of performance give little useful information. It is usually much better to use the measures in some form of comparison. There are several standard methods of comparison, of which the most popular is benchmarking.

COMPARING PERFORMANCE

The last chapter showed how measures of performance should give a reasonable view of an organization's operations. These measures can be used to:

- see how well objectives are being achieved;
- compare the current performance of the organization with its performance in the past;
- make comparisons with other organizations that have similar operations;
- compare the performance of different parts of the organization;
- help with decisions about investments and proposed changes to the process;
- measure the effects of changes to operations;
- help with other internal functions, such as wage negotiations;
- highlight areas whose performance should be improved.

It is clear from this list that measures of performance are normally used for some kind of comparison. Absolute measures often have little real

- *storage* – where products are put away until they are needed;
- *delay* – where products are held up;
- *inspection* – which tests the quality of the product.

Then a standard analysis of the process involves six steps. The first three of these describe the current process, while the last three look for improvements:

1. Look at the process and list all the operations in their proper sequence.
2. Classify each step according to operation, movement, storage, delay and inspection. Find the time taken and distance moved in each step.
3. Summarize the process by adding the number of each type of operation, the total time for the process, the rate at which each operation is carried out, and any other relevant information.

These three steps give a detailed description of a process and an example of the resulting chart is shown in Figure 41.3. The next part of the analysis looks for improvements to the process.

Process chart – Part 421/302									
Step number	**Description**	**Operation**	**Movement**	**Inspection**	**Delay**	**Storage**	**Time (mins)**	**Distance (metres)**	**Comments**
1	Fetch component		X				2.5	50	
2	Put components on machine	X					2		
3	Start machine	X					1.2		
4	Fetch sub-assembly		X				3	40	
5	Wait for machine to stop				X		5.2		
6	Unload machine	X					2		
7	Inspect result			X			1.5		
8	Join sub-assembly	X					5		
9	Move unit to machine		X				2.5	25	
10	Load machine to start	X					2		
11	Wait for machine to stop				X		5		
12	Unload machine	X					1.4		
13	Carry unit to inspection area		X				2	25	
14	Inspect and test			X			5.2		
15	Carry unit to finish area		X				1.4	20	
16	Finish unit	X					5.5		
17	Final inspection			X			3.5		
18	Carry unit to store		X				5.3	45	
Summary:		#							
	Operations	7					19.1		
	Movements	6					16.7	205	
	Inspections	3					10.2		
	Delays	2					10.2		
	Storage	0					0		
Totals:		**18**					**56.2**	**205**	

Figure 41.3 *Example of a process chart*

- *Plan*: look at the current operations, collecting data and designing improvements.
- *Do*: implement the improvements.
- *Check*: see if the new operations actually bring the improvements that were expected.
- *Act*: confirm the changes if they were successful, and make adjustments if they were not.

As this is a cycle that aims to bring a continual stream of improvements, the next stage is to go back to the start and plan the next changes.

RATE OF IMPROVEMENT

Critics of *kaizen* and its incremental approach to change say that continually tinkering with a process gives an impression of uncertainty and lack of leadership. It might also move the process in the wrong direction, as an attractive small change might block the way for much bigger gains in another direction. The major criticism, however, is that incremental changes do not get to the root of problems and look for dramatic improvements. If you have a fundamentally bad process, then making small adjustments will still leave you with a bad process. What you should do is stop tinkering with the current process, and start designing a new, ideal one. This would give a fundamental, sudden and dramatic change in operations, typical of the breakthrough that comes when introducing new technology (see Figure 42.1). The best known approach of this kind is business process re-engineering (BPR). 'Business process reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed' (Michael Hammer, 1996).

Business process re-engineering focuses the organization on the whole process of supplying products for customers. This is not a new idea, and BPR offers no new methods, but it is a useful way of summarizing several related ideas. Some of its main principles are:

- organizations should concentrate on the whole process rather than on the separate activities that make up the process;
- the process should be designed across functions and allow work to flow naturally through the process;
- managers should strive for dramatic improvements in performance by radically rethinking and redesigning the process;
- information technology is fundamental to re-engineering as it allows radical new solutions to problems;
- work should be done where it makes most sense;

Accept that the new methods are only temporary, and continually look for further improvements.

FURTHER READING

Gouillart, F and Kelly, J, *Transforming the Organization,* McGraw-Hill, New York 1995.

Hammer, M, *Beyond Reengineering*, HarperCollins, New York 1996.

Imai, M, *Kaizen, the Key to Japan's Competitive Success*, McGraw-Hill, New York 1986.

Robbins, H and Finley, M, *Why Change Doesn't Work*, Orion Business Books, London 1997.

leave either dissatisfied customers or underused resources. If capacity is less than demand, the organization cannot meet all the demand and it loses potential customers. If capacity is greater than demand, the organization meets all the demand but it has spare capacity and underused resources.

To match capacity and demand we can use the general approach to planning described in the last chapter. Unfortunately, there are some specific problems associated with capacity planning, including its discrete nature and the timing of capacity changes.

Discrete capacity

Demand comes in relatively small quantities and can take almost any value, but capacity usually comes in large, discrete amounts. Typically capacity can be increased by building another factory, buying another machine or employing another person. This gives problems with matching discrete capacity to continuous demand. Suppose that demand for a product rises steadily over time. Capacity is increased at some point, but the increase will come as a discrete step, giving three basic strategies (illustrated in Figure 44.1):

- capacity can be more or less matched to demand, so that sometimes there is excess capacity and sometime a shortage;
- capacity can be made at least equal to demand at all times, which needs more investment in facilities and gives lower utilization;
- capacity can be added only when the additional facilities would be fully used, which needs lower investment and gives high utilization, but restricts output.

There is no way to avoid this problem, but managers need to find the best alternative by balancing the costs and benefits. Factors that encourage organizations to increase capacity early, as shown in Figure 44.1(b), are:

- uneven or variable demand;
- high profits, perhaps for a new product;
- high cost of unmet demand, possibly with lost sales;
- continuously changing product mix;
- uncertainty in capacity;
- variable efficiency;
- capacity increases that are relatively small;
- low cost of spare capacity, which might be used for other work.

The main factor that makes organizations delay an increase in capacity until the last possible moment, as shown in Figure 44.1(c), is the capital cost.

- Should we use stocks to meet changing demand?
- Should we use subcontractors to cover for peak demands?
- Should we change the size of the workforce with demand?
- How can we change work patterns to meet changing demand?
- Are shortages allowed, perhaps with late delivery?
- Should we change prices to adjust the demand?
- Can we smooth demand by any other means?

STABLE PRODUCTION

An important question for aggregate planning is how much variation there should be in production levels – should production change with demand or should it be more stable? There are obvious advantages in having stable production, including:

- planning and scheduling resources is easier;
- the flow of products is smoother;
- there are fewer problems with product changes;
- there is no need to hire and fire employees;
- employees have regular work patterns;
- larger lot sizes reduce costs;
- stocks can be reduced as there is less variation;
- throughput can be faster;
- experience with a product reduces problems.

Stable production has many advantages but it is not always the best option. In practice there are three ways in which an organization can meet uneven demand:

- *Chase demand,* where production exactly matches demand. This gives no stocks, but the organization has to change production every period, hiring or firing workers, changing production levels, and so on.
- *Produce at a constant production rate*, where production is constant at the average demand for the planning period. Since demand is variable, the differences between supply and demand are met by building or using stocks.
- *Have a mixed policy*, which is a combination of the first two policies. Here there are some changes in production rate, but not in every period. The policy tries to compromise by having fairly stable production, but reduces the inventory costs by allowing some changes. In practice, this is the most commonly used plan.

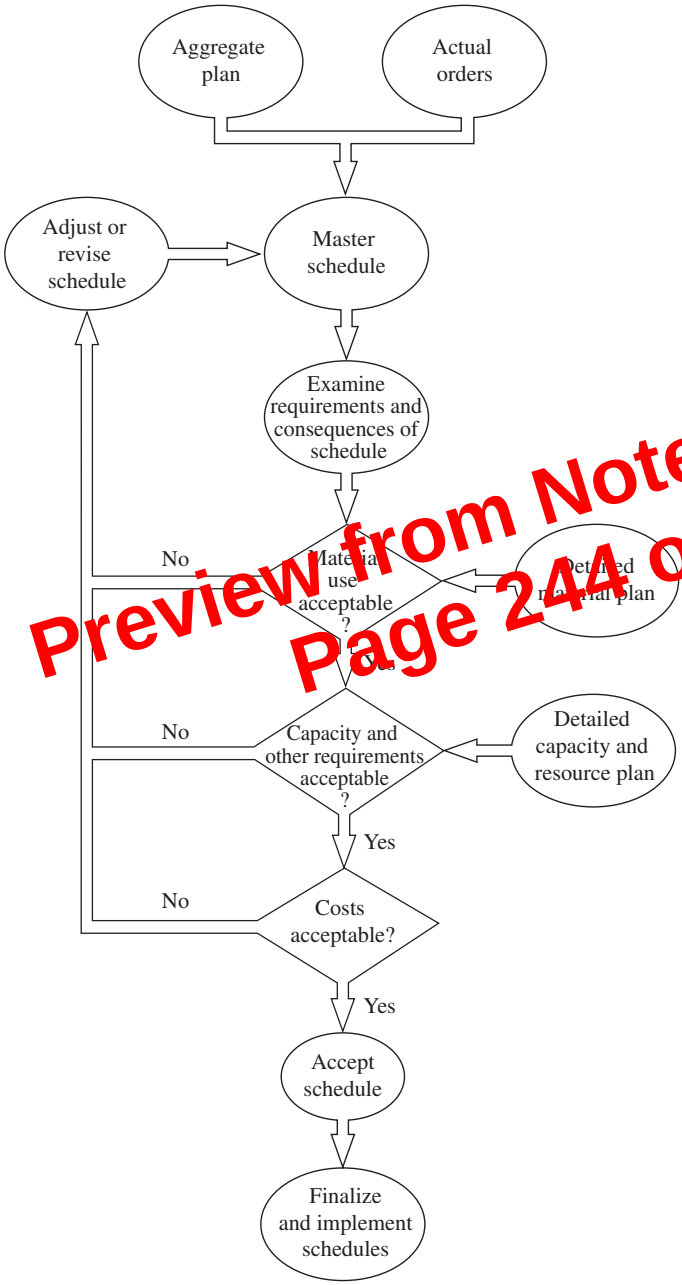

Figure 46.1 *Designing a master schedule*

If this ratio is low, the time to complete the job is short compared with the time available, and the job becomes urgent. If the ratio is high, there is plenty of time left and the job is less urgent.

Other scheduling rules

These examples illustrate the type of scheduling rules that can be used. There are many alternatives, and an organization might schedule jobs in the order of least work remaining, fewest operations remaining, longest first, least slack first (where slack is the time remaining until the job is due minus the time needed for processing it) and so on. There is a huge variety of simple scheduling rules, and more complicated ones to deal with different circumstances.

OPTIMIZED PRODUCTION TECHNOLOGY (OPT)

Simple scheduling rules can give good results but better solutions might need more complicated rules. Typically these combine a hierarchy of rules, together with more formal analyses and simulations. One method of scheduling that has received a lot of attention was developed by Goldratt, who described the theory of constraints. This concentrates on the capacity of a process – particularly the bottlenecks that limit production. The only way of increasing production is to remove the bottlenecks, but when one bottleneck is removed another is created. The theory of constraints looks for ways of improving efficiency by systematically removing the current bottleneck.

Optimized production technology (OPT) is a software package that is based on the theory of constraints. Like many similar packages, OPT is a proprietary product and the details of its operations are not published – but it is based on a series of well-known principles:

- Balance the flow through the process rather than the capacity. The production schedule should give the best flow of products through the process and need not keep all resources busy.
- The utilization of an operation that is not a bottleneck is not set by its own capacity, but by some other operation in the process.
- Activating a resource (which means doing work that is really needed) is not the same as using the resource (which might include work that is not really needed at the particular time).
- An hour lost at a bottleneck cannot be recovered, and gives an hour lost for the entire process.

The aim of a planning control system is to monitor actual performance, and allow adjustments when things do not go as planned. There are two main parts to a system.

The first part records the progress of jobs and gives information back to managers. It checks details of jobs' progress, and reports on times, efficiency, productivity, utilization and other measures.

The second part occurs when circumstances change or there is some disruption. Then the control system adjusts the schedules, or takes whatever action is necessary to allow revised plans.

Essentially the control system feeds back all information that managers need to see how operations are going, and whether they need to make any adjustments or more severe changes. To be more specific, the control system:

- ensures that jobs are scheduled according to plans;
- warns of problems with resources, delivery dates and so forth;
- makes sure that materials, equipment and operators are available for each job;
- assigns jobs to specific orders and set delivery times;
- checks progress as jobs move through the process;
- makes final adjustments as necessary to plans;
- allows rescheduling if there is a major disruption to plans;
- gives information on current activities;
- gives feedback on performance.

Associated documents

Many control systems are based around a dispatch list. This shows the schedules as an ordered list of the jobs to be done each day, their importance and how long each will take. In essence, the control system keeps a check of this list, and makes sure that each job is done at the planned time.

Other inputs to the control system might include stock levels, bills of materials (which list all the materials needed for a product), routes that products move through equipment, and delivery dates for specific jobs. The main outputs from a control system are status and exception reports – they show what should be happening and what is actually happening.

Some organizations link the control system to an input/output report, which keeps a check on the units entering an operation and those leaving. Obviously these should match or work is accumulating somewhere.

Control and planning

In principle, planning is done before operations, and then control takes over while the operations are actually being performed. But suppose, as

often happens, there are discrepancies between plans and actual performance. Then the control system reports these, or it might take a more active part in overcoming the problems. It might, for example, suggest revisions to the schedules, or actually do the rescheduling. In such cases, there is not really a clear separation between planning and control, and the two functions tend to merge.

FURTHER READING

Browne, J, Harhen, J and Shivnan, J, *Production Management Systems* (2nd edition), Addison Wesley, Reading, MA 1996.

Sink, D S, *Productivity Management: Planning, evaluation, control and improvement*, John Wiley, New York 1985.

Continuing this line of reasoning, the approach could design schedules for equipment, people working on the process, cash flows, and many other resources. Eventually the master schedule could form the basis for planning most of the resources used in a process. This is the aim of MRP II. Its purpose is to synchronize all of a manufacturer's operations to achieve the production described in the master schedule.

Manufacturing resource planning II is an integrated system, with all parts linked back to a production plan. In practice it is very difficult to get this level of complete integration. Most organizations do not attempt to develop full MRP II but use parts of the system – perhaps controlling physical distribution through distribution resources planning.

ENTERPRISE RESOURCE PLANNING

Manufacturing resource planning II can produce schedules for a wide range of resources, and in its complete form schedules most of the resources within an organization. But it concentrates on the internal operations. Many organizations recognize that they can get more efficient operations by extending their systems to other activities – and organizations – within the supply chain. In other words, organizations along the supply chain cooperate, exchange information and integrate their systems. A single organization can get benefits by using MRP II to plan its operations, but it can get even more benefits by extending this approach to suppliers. This is the basis of enterprise resource planning (ERP).

Enterprise resource planning extends MRP II to include more functions, particularly those that involve interactions with other organizations. It extends the MRP systems to include a series of suppliers and customers along the suppy chain. Then the production plans of a supplier are co-ordinated to the precise requirements of its customers.

Enterprise resource planning relies on trust and a free flow of information between organizations. Even then, the resulting systems can be extremely complicated. It is fair to say that ERP is currently still being developed and is not widely used.

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Luscombe, M, *MRP II: Integrating the business*, Butterworth-Heinemann, London 1993.

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whatever action is needed to overcome the differences. This will allow them to eliminate stocks and have operations done just as they are needed.

You can imagine JIT on a car assembly line. Just as the chassis moves down the line to a work station, an engine arrives at the same point and is fitted. This is repeated for all parts. As the car body arrives at another work station, four doors also arrive and are added. All the way down the line materials arrive just at the time they are needed, so the car is assembled in one smooth process.

EFFECTS OF JIT

JIT has much wider effects than simple stock control, and really involves a change in the way an organization looks at its operations. Its supporters described it as 'a way of eliminating waste' or 'a way of focused problem solving'. It starts with the aim of organizing operations to occur at exactly the right time, and becomes a way of eliminating all waste from an organization. We can illustrate its effects on some aspects of operations.

- *Stocks*. Just-in-time assumes that stocks serve no useful purpose but rather hide problems. It is better to solve these problems, remove the differences between supply and demand, and eliminate stocks.
- *Quality*. When operations are done just-in-time, any defects would cause disruptions. This reinforces the need for perfect quality, which was discussed in Chapter 32.
- *Suppliers*. Just-in-time systems rely totally on their suppliers, and they recognize that customers and suppliers are partners with a common objective. They should work closely together and form long-term partnerships and alliances.
- *Employees*. Just-in-time recognizes that the distinction between 'managers' and 'workers' is meaningless, and the welfare of all employees depends on the success of the organization. All employees are treated fairly and equitably, with a stake in the success of the company.
- *Production*. Every time there are changes to a process, there are delays, disruptions and costs. Just-in-time says that these changes waste resources and should be eliminated, so it needs a stable environment, which makes large numbers of a standard product.

If we continue arguing in this way we can list the key elements in JIT operations, which include:

- a stable environment, making standard products with few variations;
- continuous production at fixed levels, probably with automated, high-volume operations;

KANBANS

With JIT, messages are passed between operations using *kanbans,* which is the Japanese for a card, or some form of visible record. There are several ways of using *kanbans*, with the simplest method as follows.

All materials are stored and moved in standard containers. A container can only be moved when it has a *kanban* attached to it. When an operation needs more materials a *kanban* is attached to an empty container and this is taken to the preceding operation. The *kanban* is then attached to a full container, which is returned to the operation. The empty container is a signal for the preceding operation to start work on this material and it produces just enough to refill the container.

There are more complicated uses of *kanbans*, often based on a 'movement *kanban*' and a 'production *kanban*', but you can see the main features as:

- A message is passed backwards to the preceding work station to start production, and it only makes enough to fill a container.
- Standard containers are used which hold a specific amount. This amount is usually quite small, and is typically 10 per cent of a day's needs.
- The size of each container is the smallest reasonable batch that can be made and there are usually only one or two full containers at any point.
- A specific number of containers and/or *kanbans* is used. This effectively fixes the amount of work in progress.
- The stock of work in progress can be controlled by limiting the size of containers and the number of *kanbans*.
- Materials can only be moved in containers, and containers can only be moved when they have a *kanban* attached. This gives a rigid means of controlling the amount of materials produced and time they are moved.

Although it is simple to administer, this system makes sure that stocks of work in progress cannot accumulate.

BENEFITS OF JIT

Some of the benefits of JIT include:

- always having the right quantities of materials arriving in time for use;
- lower stocks of raw materials and work in progress;
- reduced lead times;
- shorter time needed to make a product;
- higher productivity and equipment utilization;

6. *Handover*. At some point the project is finished, when all the work has been done and the end results have been achieved. The results are handed over to the customers.

STAKEHOLDERS IN PROJECTS

Many people may have an interest in a project. Together, these form the stakeholders, who include:

- *owners* – the customers for whom the project is done;
- *sponsors or champions* – who support the project and overcome problems within the owners' organization;
- *project team* – the people who do the actual work and execute the project;
- *project manager* – who controls the project team and is responsible for the work;
- *contractors/subcontractors* – outside organizations that are brought in to do parts of the work;
- *external parties* – other people who may be affected by the project.

From an operations point of view, the key figure in a project is the project manager. Their job is to bring together all the resources and make sure the project is a success. Ideally they bring a range of general management skills, have wide experience of different operations, and act as facilitators, ensuring that conditions are right for other people to do their jobs properly.

Projects usually have a matrix organization, where staff from different functions are brought together into a team for a specific project. Each person is still based within his or her original functional area, but they all have another responsibility to the project manager.

PROJECT PLANNING

The aim of project management is to complete the project successfully – giving customers the product they want, keeping within the specified time and within the budget. This needs effective project planning to:

- identify all the activities in the project, together with the order in which these activities have to be done;
- estimate the time of each activity, the total length of the project, and the time when each activity must be finished;
- find how much flexibility there is in the timing of activities, and which activities are critical to the completion time;

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Meredith, J R and Mantel, S J, *Project Management* (3rd edition), John Wiley, New York 1995.

Figure 53.1 *'Bathtub curve' showing the probability of breakdown with age*

work perfectly from the start. At the other end of equipment life, however, there is less that can be done to alleviate the effects of ageing. As equipment gets older it breaks down more often, develops more faults, gives lower quality, slows down and generally wears out.

Sometimes this change is slow – like the fuel consumption of a car, which rises over a period of years. Sometimes the change is very fast, like a bolt that suddenly breaks. The only way of reducing the effects of ageing is to use planned or preventive maintenance.

PREVENTIVE MAINTENANCE

With preventive maintenance, equipment is inspected and vulnerable parts are replaced after a certain period of use. A car, for example, has a regular service to replace filters, oil, plugs and other vulnerable parts. By replacing parts that are worn, or are most likely to wear, the equipment is restored to give continuing, satisfactory performance. There are four approaches to the replacement of these vulnerable parts:

- keep a check on parts, look for specific signs of wear, and replace them when these signs first appear;
- replace parts after a specified period of working;
- replace parts when some measure of performance falls below an acceptable level;
- replace parts when they actually fail.

The first three of these, and particularly the second, have elements of planned maintenance, which have advantages over the alternative of waiting for equipment to fail and then doing the necessary repairs. These advantages include:

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Supply-chain Management

DEFINITION

The supply chain consists of all the organizations and operations along which products move from the original suppliers of materials through to the final customers. Supply-chain management (SCM) is responsible for all the physical movement through this chain.

THE SUPPLY CHAIN

The final product of one organization is the raw material of another, so materials are moved through a series of organizations and operations between original suppliers and final customers. These operations form the supply chain, as illustrated in Figure 54.1 for the supply of paper.

Logistics or supply-chain management is responsible for making sure materials are delivered to the place they are needed at the right time. It looks at three types of movement:

- *Movement of raw materials from supplies into the organization* – including purchasing, inward transport, receiving, storage and retrieval of goods.
- *Movement of work-in-progress within the organization* – including handling, movement and storage of goods during operations.
- *Movement of finished goods from the organization out to customers* – including packaging, storage and retrieval from warehouses, shipping and distribution to customers.

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66

Inflation Accounting

DEFINITION

Inflation accounting is the technique used to adjust financial accounts to allow for the effect of inflation. Inflation can be defined as a decline in the purchasing power of money due to an increase in the general level of prices.

REASONS FOR INFLATION ACCOUNTING

Financial accounts are the basis on which the success of a business is measured and on which investors can find out whether or not their investment is safe and will produce a reasonable return for them. Financial accounts therefore have a significant effect on the business, and shareholders are particularly interested in them from the point of view not only of obtaining a good return on their investment but also of maintaining the value of that investment. But if this value is expressed in terms of historical costs, without allowing for the impact of inflation, it could be illusory. Hence the need for inflation accounting. These issues are considered in more detail below.

Influence of financial accounts

Financial accounts have a major influence on:

balance sheet at the highest level it can, then the useful economic life will be as long as possible. If, on the other hand, the company wishes its fixed asset values to reduce quickly, it will choose much shorter lives. As Jameson suggests, 'the useful life decision is taken by determining first, what answer is required and second, by assessing what useful life will give that answer'.

Depreciation method

Different methods of depreciating assets (eg straight-line, reducing-balance – see Chapter 65) can influence the balance sheet value of an asset. Changing from one method to another can make a significant impact on profits. Terry Smith (see, also, Further Reading section) quotes a major company as having inflated the average growth in profits over the years 1985–90 from 14.3 to 16.7 per cent by changing its depreciation method.

CURRENT ASSETS

Legal manipulation when accounting for current assets can take place in the areas of stocks and work-in-progress, debtors and cash.

Stocks

The higher the value of stock at the end of the year, the higher the profit. However, this year's closing stock is next year's opening stock, so a high figure at the end of one year will reduce next year's profits. Massaging stock values from one year to the next will not create profit in the long run but will enable a creative accountant to smooth profits by either boosting one year's profit or hiding an unexpected and embarrassingly high profit in a particular year.

Massaging stock figures can be achieved by varying methods of accounting for stock. For example, stock can be valued at the direct, out-of-pocket cost of its acquisition, or on the basis of the additional costs of getting the stock into place. Indirect labour costs and certain overheads can be included or excluded from the stock valuation.

Stock holdings can be increased deliberately at the end of the year, which allows companies to carry forward production overheads and boost the current year's profits. Alternatively, stocks could be run down to reduce current profit levels. Thus the accounting system will have the effect of advancing or retarding the recognition of profit, and this has the appearance of creating or hiding profit in the short run.

In some cases accountants might want to accelerate the charging of expenses to smooth profits. They do so by making provisions against future expenses. If the provision is too large it can be released in future periods to boost profits. Auditors have had difficulty in challenging over-provisions as they are at least prudent in effect in the year they are set up. The practice of making large provisions when taking over another company (known as 'big bath' provisions) became so prevalent that in 1998 the UK Accounting Standards Board issued FRS 12 'Provisions, contingent liabilities and contingent assets' to restrict the making of provisions to very specific circumstances. Accordingly, the scope for creative accounting in this area is much diminished.

CONCLUSION

The existence of creative accounting in the above fields and others such as pre-acquisition write-downs, disposals, brand accounting, pension fund accounting and currency mismatching has been demonstrated clearly by Terry Smith. It flourishes because of pressure from the City for sustained profitability, and because total precision in the application of the law and accounting standards is virtually impossible in these and other areas. There is often room for judgement, and although auditors are there to ensure that a 'true and fair view' is expressed by the accounts, they are not always in a position to challenge the judgements and assumptions made by company accountants.

The UK Accounting Standards Board responded to the challenge of creative accounting and many of its pronouncements during the 1990s were directly aimed at curtailing the worst practices. FRS 5 'Reporting the substance of transactions' did much to curb the use of artificial structures and transactions. Its theme was 'substance over form'. In addition, the enforcement of accounting standards became a reality in the 1990s with the formation of the Financial Reporting Council and its enforcement body the Financial Reporting Review Panel. The Panel has the power to investigate and force the correction of accounts that it believes do not show a true and fair view.

FURTHER READING

The original version of this chapter drew heavily on Michael Jameson's *A Practical Guide to Creative Accounting* (Kogan Page, London 1988). Illustrations of creative accounting techniques used by companies may be found in *Accounting for Growth* by company financial analyst Terry Smith (Century, London 1992 and 1996). This book became famous for its 'blob guide', which scored companies by the number of creative accounting practices used.

Creative Accounting and the Cross-eyed Javelin Thrower (McBarnet, D and Whelan, C, Wiley, Chichester 1999) is an academic review of the challenge of creative accounting and the battle against it during the 1990s. It does not set out to be a creative accounting guide, although it does offer some strategies for taking on the Financial Reporting Review Panel. It has several informative appendices dealing with the enforcement process.

- *Cost–volume–profit analysis* – the study of the relationship between expenses, revenue and net income in order to establish the implications on profit levels of changes in costs, volumes (production or sales) or prices.
- *Profit–volume charts,* which specifically reveal the impact of changes in volume on net income.
- *Break-even analysis*, which indicates the point where sales revenue equals total cost and there is neither profit nor loss. It also shows the net profit or loss that is likely to arise from different levels of activity.
- *Sales mix analysis,* which calculates the effect on profits of variations in the mixture of output of the different products marketed by the company.
- *Financial budgeting,* which deals with the creation of budgets (statements in quantitative and financial terms of the planned allocation and use of the company's resources). The basic form of budget is a static budget, ie one which assumes a constant level of activity.
- *Flexible budgets,* which take account of a range of possible volumes or activity levels.
- *Zero-based budgeting*, which requires managers to justify *all* budgeted expenditure and not to prepare budgets as no more than an extension of what was spent last year.
- *Budgetary control,* which compares actual costs, revenues and performance with the fixed or flexed budget so that, if necessary, corrective action can be taken or revisions made to the budget.
- *Overhead accounting* – direct attention to the identification, measurement and control of overheads.
- *Responsibility accounting*, which defines responsibility centres and holds the managers of those areas responsible for the costs and revenues assigned to them.
- *Capital budgeting* – the process of selecting and planning capital investments based on an appraisal of the returns that will be obtained from the investments. The main capital appraisal techniques comprise *accounting rate of return, payback* and *discounted cash flow*.
- *Risk analysis,* which assesses the danger of failing to achieve forecasts of the outcome or yield of an investment.

USES

Objective

The main objective of management accounting is to provide management information which will help managers to optimize their decisions with a view to improving present performance and providing for longer-term profitable growth. Management accounting could therefore be described as the development and maintenance of a management information system.

- *indirect expenses*, such as rent and rates, depreciation of plant and insurance.

The total of indirect material and labour costs plus indirect expenses is known as the *factory overhead*. *The total product cost* or total manufacturing expense is the sum of prime costs and factory overheads. *Other indirect expenses or overheads* which are incurred on activities or to pay for facilities or services other than those connected with production include:

- marketing and selling costs;
- distribution costs – warehousing, depots or transportation;
- research and development costs; and
- administration expenses – the costs of administrative departments such as finance, personnel and the corporate office, plus any corporate costs such as rent, rates and insurance that cannot be charged directly to manufacturing.

The relationship between these costs is illustrated in Figure 70.1.

Classification of costs by behaviour

Costs may be classified into three patterns of behaviour:

1. *Variable*, where the cost varies directly or proportionately to the level of activity. Direct material is an example of a variable cost. In this case the variable cost per unit is constant, irrespective of changes in the level of activity.
2. *Non-variable or fixed*, where the total cost remains unchanged over a period of time regardless of changes in the levels of activity. The most regular fixed-cost items are rent and rates, management salaries and

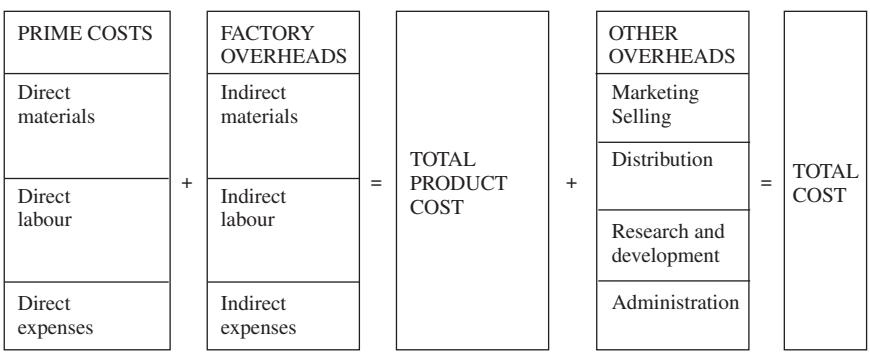

Figure 70.1 *The make-up of total costs*

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Absorption Costing

DEFINITION

Absorption or full costing is the practice of assigning all costs, both fixed and variable, to operations or products. Some absorption costing systems set expenses such as general administration, financial costs and selling expenses against revenue in the profit-and-loss account so that the outcome is simply the cost of production. In a full historical cost system, however, all administration and sales expenses are also absorbed into production costs.

COST OF PRODUCTION

In an absorption cost system the cost of production consists of:

1. *Prime costs* – direct material and direct labour.
2. *Production overheads* – indirect materials and wage costs arising in such areas as stores, packing, maintenance, the salaries of factory managers and supervisors, and the costs of power, heating and lighting, and depreciation.

The process of relating these costs to production is called assignment.

The selling value of the goods produced minus the full cost of production is the factory profit.

In any case, the resources consumed by products are unrelated to direct labour costs. Costs are therefore allocated to products in ways which are not connected to actions taken within a cost centre.

Some companies have recognized the declining role of direct labour and use two additional allocation bases – materials-related expenses and machine hours or processing time. According to Kaplan and Cooper, however, this still does not guarantee that the allocation of overheads will not distort product costs, and cost centre managers may not get the control information they need.

As a result, decisions on pricing and product mix are being made on the basis of inaccurate data. Profits are frequently understated on high-volume products and overstated on speciality items. A further problem is that cost centre managers do not get the right information for controlling their costs. Operating costs are reported too late and are too aggregated to benefit production cost centre managers.

One reason for this reluctance to trace overhead costs to products and allocate costs more accurately according to the use of resources was that the expense of collecting data made it hard to justify more sophisticated allocation procedures. However, information costs are no longer a barrier. And for operations under computer control, digital data is easily captured to record what, when and how much was produced. Automatic bar-code reading of parts combined with local area networks permit continual tracking of parts and operatives. Cost control systems can record these data and provide frequent, accurate reports on output and resource consumption.

A further reason for the reliance on traditional methods is that they were originally designed for inventory valuation, which, in accordance with financial accounting principles, requires manufacturers to allocate periodic production costs to all items produced. For this purpose, an aggregated, simplistic method of assigning overhead costs to products is quite acceptable – accountancy principles do not require that allocated overhead costs be casually related to the demands of individual products.

But as Kaplan argues, cost system designers have failed to recognize that their systems need to address three different functions:

- inventory valuation for financial and tax statements, allocating period production costs between goods sold and goods in stock;
- operational control, providing feedback to production and department managers on the resources consumed (labour, materials, energy and other services) during an operating period;
- individual product cost measurement.

Kaplan and Cooper argue that no single system, especially one based on the aggregate allocation of overheads, can adequately cover all three functions. The traditional method of allocation is appropriate for

4. Establish the demands made by particular products on activities, using the cost drivers as a measure of demand.
5. Trace the cost of activities to products according to a product's demand for each activity.

The rules developed by Kaplan and Cooper for this process are:

- focus on expensive resources, thus directing attention to resource categories where the new costing process has the potential to make big differences on product costs;
- emphasize resources whose consumption varies significantly by product and product type – look for diversity; and
- focus on resources whose demand patterns are uncorrelated with traditional allocation measures, such as direct labour, materials and processing time, thus identifying resources with the greatest potential for distortion under traditional systems.

This process cannot be done with surgical precision, but, as Kaplan and Cooper say:

> It is better to be basically correct with activity-based costs, say within 5 or 10 per cent of the actual demands a product makes on organizational resources, than to be precisely wrong (perhaps by as much as 200 per cent) using outdated allocation techniques.

ABC may not be appropriate for all companies, particularly those where overheads are relatively small and which do not produce a wide range of products. But many of the benefits of ABC can still be obtained by implementing a partial system which focuses only on the most important activities.

Nor should the method be used to produce monthly profit statements. Traditional methods can be used for that, leaving ABC to support strategic decision making, profitability analysis and the control of manufacturing costs.

BENEFITS

Activity-based costing ensures that management accounting information is not merely a by-product of external financial accounting systems. While it provides a more accurate basis for calculating product costs, perhaps its greatest benefit is that it is a mechanism for managing costs. It is in this area of cost management and resource planning, rather than product costing, that ABC has the greatest potential.

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Marginal Costing

DEFINITION

Marginal or direct costing divides costs into fixed and variable costs. The latter tend to vary in total, in relation to output, and are regarded as marginal costs. Marginal costing first segregates fixed costs and then apportions the marginal costs to products or processes.

Marginal costing may be incorporated into the system of recording and collecting costs or it may be used as an analytical tool for studying and reporting on the effects of changes in volume and type of output. Where it is incorporated into the system of recording and collecting costs, stocks are valued at variable costs, while fixed costs are not charged to production but are instead written off to the profit-and-loss account in the year in which they are incurred.

Marginal costing is also sometimes called variable costing.

BACKGROUND TO MARGINAL COSTING

The background to the marginal costing concept is the marginal theory in economics which refers to the ambition of the entrepreneur to expand his or her business at the point where the additional cost of producing one more unit equals the additional revenue from selling it. The reason for this is that, as output increases, the pressures of demand and supply will cause prices and wages, and therefore costs, to increase. As more units are produced which need to be sold, prices will have to be reduced to ensure their disposal. This increase in cost and reduction in revenue will mean

Table 73.1 *Comparison of full and marginal costing*

		Full cost		Marginal cost	
	p	*p*	*p*	*p*	*p*
Sales price			50		50
Direct material costs		5		5	
Direct labour costs		3		3	
Direct expenses		2		2	
Prime cost		10		10	
Works expenses					
Fixed	8	12		4	
Variable	4	22			
Administration expenses					
Fixed	6				
Variable		6			
Cost of production		28			
Selling expenses					
Fixed	10				
Variable	6	16		6	
Total of above costs and expenses			44		20
Net profit			6		
Margin or total contribution					30
Contribution to fixed costs				24	
Contribution to profit				6	

highly competitive situation, it may well be wise to take an order which covers marginal costs and makes some contribution towards fixed costs, rather than lose the order and the contribution by insisting upon a price above full cost.

3. *Contribution analysis*. The analysis of the contribution per unit each product makes towards fixed or current period costs and profit leads to the preparation of statements showing the total contribution each product class has made towards the recovery of period costs. These statements may be further refined by deducting any discretionary or separable period costs (ie costs such as annual tooling and product advertising) which should be avoided if the product line were dropped.
4. *Sales mix decisions*. These can be made by analysing the respective contributions of each product line after charging separable period costs.
5. *Overcoming the volume variance problem*. The problems of volume variance in a standard absorption costing system are overcome. In absorption costing, the under- or over-absorbed fixed production

overhead is represented by the volume variance. In businesses with large variations in stock levels and a high ratio of fixed costs this approach can lead to serious distortions in the profit figures. It is perfectly possible in these circumstances for profits to decline when sales increase and vice versa, and it is hard to explain with absorption costing what is happening or why. Profit planning and control are therefore made more difficult. With the marginal costing approach, stocks are valued at variable cost and there is no volume variance. Consequently, the relationship between sales volume and contribution is much easier to explain and understand.

6. *Make-or-buy decisions*. These are best taken with full knowledge of the marginal or variable cost of making rather than buying a product. But it is also helpful to know through marginal costing what contribution to fixed costs will result from a 'make' decision.
7. *Limiting factor decisions*. Decisions on which orders to accept have often to be made when plant is being operated at capacity. The order to be accepted is the one that marginal costing shows will make the highest contribution per unit of the limiting factor. For example, if labour were the limiting factor, the product to be chosen for production would be the product which yields the largest contribution per unit of labour employed.
8. *Pricing decisions*. The marginal cost approach to pricing decisions recognizes that decision making is about choosing between competing alternatives, each with its own combination of income and costs. The relevant concepts to employ are therefore future incremental costs and revenues and opportunity costs, not full costs, which include historical or sunk costs. The marginal approach answers the question 'What will happen to profits if the selling prices of particular products are raised or lowered?' With marginal pricing, the company seeks to fix its prices so as to maximize its total contribution to fixed costs and profit. This is achieved by considering each product separately and fixing its price at a level which is calculated to maximize its total contribution.

ADVANTAGES AND DISADVANTAGES

Advantages

Marginal costing systems are simple to operate and do not involve the problems of overhead apportionments. Fluctuations in profits are easier to explain because they result from cost–volume interactions and not from changes in inventory. Marginal costing emphasizes the contribution made by sales to fixed cost recovery and profit and clarifies decision making in many key areas of management accounting where volume and product mix and pricing considerations are important.

Disadvantages

Marginal costing diverts attention from full costs, especially in the longer term. But in the long run it is important to have an understanding of the full cost of a product to the company, since the company must make sufficient contribution from all products to cover fixed costs and provide an adequate return on capital employed. In the short term, it may be desirable to price products below full cost as long as the price covers the variable cost and makes some contribution. But it is important to know what the implications of such decisions are on fixed-cost recovery at the time they are made. Marginal pricing can lead to danger if it is indulged in too readily and without proper foresight.

CONCLUSION

Marginal costing is an essential tool for cost–volume–profit analysis and planning. It is often operated as such in association with an absorption costing system which provides information on full costs for longer-term control and for the valuation of stocks in financial accounts.

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Variance Analysis

DEFINITION

Variance analysis identifies differences between actual and standard costs or between actual and budgeted overheads, sales and, ultimately, profits. The reasons for variances are then established to provide guidance for any corrective action required.

CLASSIFICATION OF VARIANCES

The classification of variance headings and the reasons why variances occur are shown in Figure 75.1.

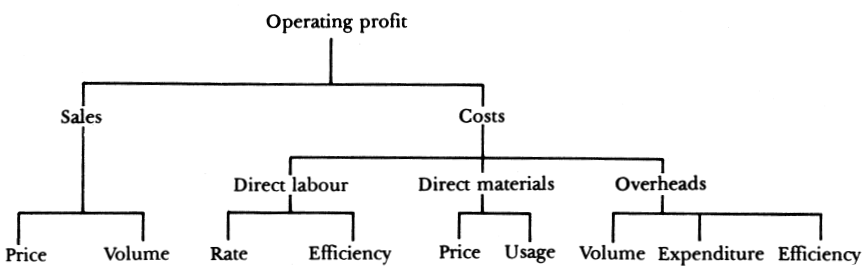

Figure 75.1 *Classification of variances*

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Cost–Volume–Profit Analysis

DEFINITION

Cost–volume–profit (CVP) analysis studies the relationships between expenses (costs), revenue (sales) and net income (net profit). The aim is to establish what will happen to financial results if a specified level of activity or volume fluctuates, ie the implications on profit levels of changes in costs, volume of sales or prices.

USES

CVP analysis is used to study the effects of changes in volume on variable costs, and the relationship between profit and volume (the profit–volume or P/V ratio). It answers the key question: 'What effect would increases or decreases in one or more of labour cost, material cost, fixed costs, volume of sales have on profits?' CVP analysis is used in profit planning and as a guide to making tactical decisions on sales effort and prices.

CONCEPTS AND TECHNIQUES

CVP analysis combines the following management accounting concepts and techniques:

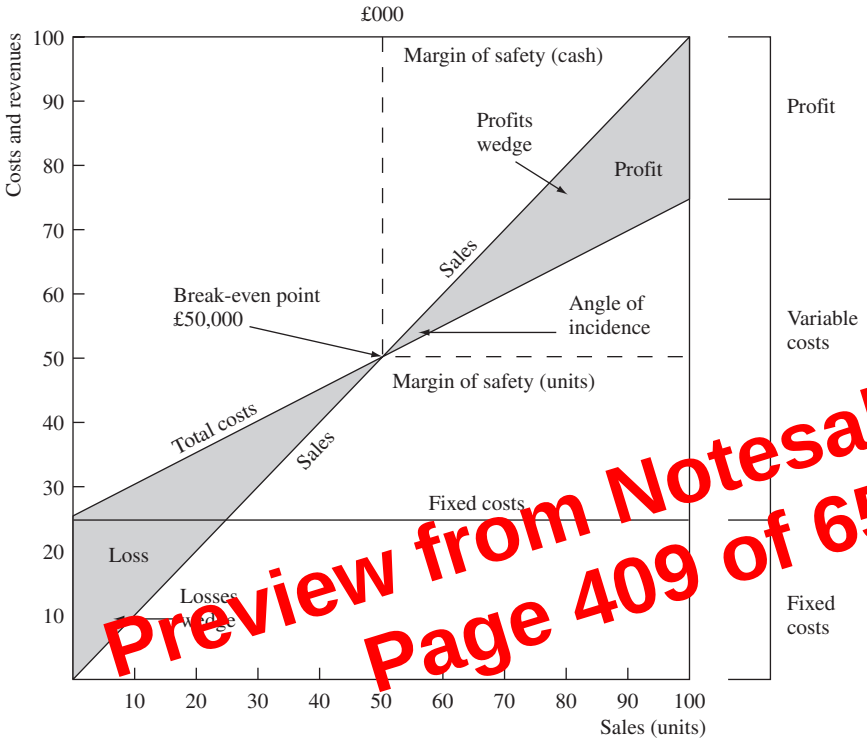

Figure 78.1 *A break-even chart*

An alternative method of drawing a break-even chart is shown in Figure 78.2. This clearly indicates the contribution to fixed costs and profits achieved above the break-even point. There are a number of assumptions built into break-even charts, which are often unrealistic. These can limit their usefulness. The main assumptions are:

1. the variable costs associated with producing the various levels of output are constant and can be represented by a straight line. This is linked to the assumption that volume is the only factor affecting variable costs and all other factors (eg wage levels and the cost of materials) remain unchanged;
2. the fixed costs remain constant over the range of output;
3. the selling price per unit is constant (ie no discounts), making sales revenue a straight line;
4. production and sales are equal and there are no significant changes in inventory levels; and
5. there is only one product or, if there is more than one product, a constant sales mix exists over the whole range.

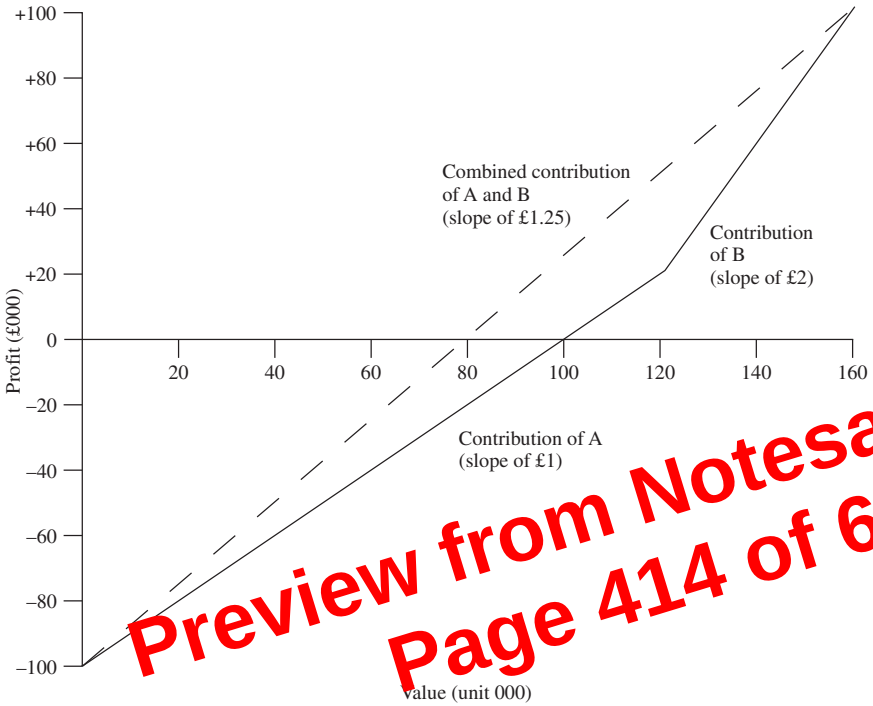

Figure 79.1 *Sales mix shown on a P/V chart*

If there are more constraints, *linear programming* techniques may have to be used.

BENEFITS

Sales mix analysis helps management to make decisions on changes in sales and production policies. These decisions are made on the basis of comparisons between the contribution to profit and fixed cost made by different combinations of products, especially when limited factors apply.

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Responsibility Accounting

DEFINITION

Responsibility accounting defines responsibility centres throughout the organization. The managers of each of these centres are held responsible for the costs and revenues assigned to them.

The three main areas of responsibility covered are:

1. *Cost centres*, where only costs are reported formally. They are the smallest segment of activity or area of responsibility for which costs are accumulated. Typically, cost centres are departments, but a department may contain several cost centres.
2. *Profit centres*, where costs and revenues are reported formally. They are usually segments of a business responsible for the sales and profits of a product line.
3. *Investment centres*, where there is a formal reporting of revenues, expenses and related investment. Their success is measured not only by their income but also by relating that income to their invested capital. Typically, a whole business or subsidiary can be treated as an investment centre.

BASE

Responsibility accounting is based on four principles.

CAPITAL BUDGETING PROGRAMME

A capital budgeting programme consists of the following stages:

1. *The search for investment opportunities*. To provide for profitable growth, management generates a constant flow of investment opportunities for appraisal.
2. *The identification of relevant alternatives*. There is rarely only one way of carrying out a project and relevant alternatives need to be evaluated to seek the best approach and to highlight opportunity costs.
3. *The determination of costs*. The emphasis is on relevant cost information, ie future incremented cash flows, not traditional historical cost accumulations. It is cash flows and net book values that are important in the long-term assessment.
4. *The determination of revenues*. Again these are forecast in the form of cash flows over a period of time. This requires estimates of the probabilities of different levels of revenue being attained, taking into account possible variations in the factors such as demand built into the forecast. *Risk analysis* techniques such as the calculation of expected values, utility theory, mean variance analysis, game theory, Monte Carlo simulations and decision trees are all used for this purpose.
5. *The screening and ranking of projects*. Alternative proposals are screened and ranked in accordance with the rates of return, generally at the net present values that it is believed they will generate. The payback period and the accounting rate of return from different projects may also be considered. Potential rates of return are compared with the company's policy on the minimum satisfactory rate of return it requires from an investment. This policy will be influenced by the target rates of return on shareholders' capital or on capital employed, and by the cost of obtaining capital.
6. *Capital expenditure control*. When the decision to incur capital expenditure has been made, a capital budget is set up for the project and procedures are introduced for the authorization of expenditure. Project control information is needed as part of the system of *project management*. This control data will show progress, expenditure to date against budget and total anticipated expenditure compared with the overall capital budget for the project.
7. *Rate of return control*. Information is generated which compares net cash flows with budget and enables corrective action to be taken when required.

BENEFITS

Risk analysis ensures that the factors influencing the likely outcomes of investments are identified and that the probabilities of their occurrence are fully explored. It provides guidance for decision making, but, because of the assumptions that have to be built into all estimates of probabilities, risk analysis can never completely supplant managerial judgement, that is to say, the gut feeling that an investment will or will not work.

FURTHER READING

Mott, G, *Investment Appraisal*, Pitman, London 1993.

objectives are achieved. This will mean that the outputs and potential benefits of the programme will need to be specified, at least in outline.
2. *Identify alternatives* – the means by which the objectives will be attained.
3. *Assess costs* – actual costs *and* opportunity costs for each alternative. Because the choice of an alternative implies that certain specific resources can no longer be used for other purposes, the true measure of their cost is the opportunities they preclude.
4. *Construct model* – a simplified representation of the real world which abstracts the features of the situation relevant to the question being studied. The means of representation may vary from a set of mathematical equations to a purely verbal description of the situation, in which judgement alone is used to predict the consequences of various choices. In cost-effectiveness analysis, as in any analysis of choice, the role of the model is to predict the costs that each alternative would incur and the extent to which each alternative would assist in attaining the objectives.
5. *Select criteria* – the rules or standards by which to rank the alternatives selected in order of desirability; the most promising is chosen. They provide a means for weighing cost against effectiveness.
6. *Conduct analysis* – the consequences of choosing an alternative as indicated by means of the model. These consequences show how effective each alternative is in the attainment of objectives (which means that a measure of effectiveness for each objective is required) and what the costs are. The criteria can then be used to arrange the alternatives in order of preference.
7. *Implement and review* – the selected policy or programme is implemented and its cost and effectiveness are measured against budgets and performance criteria. The review will then determine any changes needed to improve cost-effectiveness.

BENEFITS

Cost-effectiveness analysis can help a decision maker to understand the relevant alternatives and the key interactions by giving him or her an assessment of the costs, risks and possible pay-offs associated with each course of action.

FURTHER READING

Jones, R and Pendlebury, M, *Public Sector Accounting* (4th edition), Pitman, London 1996.

1. quality of corporate strategy;
2. execution of corporate strategy;
3. management credibility;
4. innovation;
5. research leadership;
6. ability to attract and retain talented people;
7. market share;
8. management expertise;
9. alignment of compensation with shareholders' interests;
10. quality of major business processes.

APPROACHES TO HUMAN CAPITAL MEASUREMENT

The points that should be borne in mind when measuring human capital are:

- Identify sources of value including the competencies and abilities that drive business performance.
- Analyse the relationships between people management practices and outcomes and organizational effectiveness.
- Remember that human capital measurement is concerned with the impact of people management practices on performance so that steps can be taken to do better. It is not just about measuring the efficiency of the HR department in terms of activity levels. It needs to be value focused rather than activity based. For example, it is not enough just to record the number of training days or the expenditure on training; it is necessary to assess the return on investment generated by that training.
- Keep measurements simple – concentrate on key areas of outcomes and behaviour.
- Only measure activities if it is clear that such measurements will inform decision making.
- Analyse and evaluate trends rather than simply record actuals – compare the present position with base line data.
- Focus on readily available and reliable quantified information; however, although quantification is desirable, it should not be based on huge, loose assumptions.
- Remember that measurement is a means to an end not an end in itself. Do not get so mesmerized by the process of collecting data as to forget that the data is there to be used to support decision making and generate action.

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1 *Watson Wyatt Human Capital Index*, Watson Wyatt, London 2002.
2 Nalbantian, R, Guzzo, R A, Kieffer, D and Doherty, J, *Play to Your Strengths: Managing your internal labour markets for lasting competitive advantage,* McGraw-Hill, New York 2004.
3 Mayo, A, *The Human Value of the Enterprise: Valuing people as assets,* Nicholas Brealey, London 2001.

1. ratio-trend analysis;
2. work study;
3. econometric models.

Ratio-trend analysis

Ratio-trend analysis is carried out by studying past ratios between, say, the number of direct and indirect workers in a manufacturing plant, and forecasting future ratios, having made some allowance for changes in organization or methods. Activity level forecasts are then used to determine direct labour requirements, and the forecast ratio of indirects to directs is used to calculate the number of indirect workers needed.

Work study

Work study techniques can be used when it is possible to apply work measurement to calculate how long operations should take and the amount of labour required. The starting point in a manufacturing company is the production budget prepared in terms of volumes of saleable products for the company as a whole, or volumes of output for individual departments. The budget of productive hours are then compiled by the use of standard hours for direct labour, if standard labour times have been established by work measurement. The standard hours per unit of output are then multiplied by the planned volume of units to be produced to give the total planned hours for the period. This is divided by the number of operators required. Allowance may have to be made for absenteeism and forecast levels of idle time. The following is a highly simplified example of this procedure:

1. Planned output for year: 20,000 units.
2. Standard hours per unit: 5 hours.
3. Planned hours for year: 100,000 hours.
4. Productive hours per worker/year (allowing normal overtime, absenteeism and downtime): 2,000 hours.
5. Number of direct workers required: 100,000 ÷ 2,000 = 50.

Work study techniques for direct workers can be combined with ratio-trend analysis to calculate the number of indirect workers needed. Clerical staff requirements may also be estimated by these methods if clerical work measurement techniques are used.

Econometric models

To build an econometric model for human resource planning purposes it is necessary to analyse past statistical data and to describe the relationship

- *Competency requirements* – the specific technical competencies attached to the role; what the role holder is expected to know and to be able to do.

For job evaluation purposes, the role will also be analysed in terms of the factors used in the job evaluation scheme.

METHODOLOGY

The essence of role analysis is the application of systematic methods to the collection of information required to produce a role profile under the headings set out above. The steps required to collect this information are:

1. Obtain documents such as the organization structure, existing job descriptions (treat these with caution, they are likely to be out of date), and procedure or training manuals which give information about the job.
2. Ask managers for fundamental information concerning the overall purpose of the role, the key result areas and the technical competencies required.
3. Ask the role holders similar questions about their roles.

The methods that can be used are interviews, questionnaires or observation.

Interviews

To obtain the full flavour of a role, it is best to interview role holders and check the findings with their managers or team leaders. The aim of the interview is to obtain all the relevant facts about the role to provide the information required for a role profile. It is helpful to use a check list when conducting the interview. Elaborate check lists are not necessary; they only confuse people. The basic questions to be answered are:

1. What is the title of your role?
2. To whom are you responsible?
3. Who is responsible to you? (An organization chart is helpful.)
4. What is the main purpose of your role? ie in overall terms, what are you expected to do?
5. What are the key activities you have to carry out in your role? Try to group them under no more than 10 headings.
6. What are the results you are expected to achieve in each of those key activities?
7. What are you expected to know to be able to carry out your role?
8. What skills should you have to carry out your role?

TYPES OF JOB EVALUATION

Job evaluation schemes are usually grouped into two basic types:

1. *Non-analytical*, based on whole-job comparisons. The main non-analytical schemes are job ranking and job classification.
2. *Analytical*, based on factor comparisons. The basic scheme is points rating, although there are a number of proprietary brands, of which the best known is the Hay/MSL scheme.

Job ranking

The simplest form of job evaluation is job ranking. This is a non-analytical approach which aims to judge each job as a whole and to determine its relative value in a hierarchy by ranking one job against another. The rank order is established by considering the worth of each job to the organization. A grading structure has then to be developed and the jobs are slotted into the grades.

Job classification

Job classification is based on an initial definition of the number and characteristics of the grades into which the jobs will be placed. The grade definitions attempt to take into account discernible differences in skill and responsibility and may refer to specific criteria, such as level of decision, knowledge, equipment used and education or training required to do the work. Jobs are allotted to grades by comparing the whole-job description with the grade definition.

Points rating

Points rating schemes use factor comparison techniques. The factors selected are those considered to be most relevant in assessing the comparative value of jobs. Typical factors include resources controlled, decisions, complexity, and knowledge and skills.

Each factor is given a range of points so that a maximum number of points is available. The relative importance or 'weighting' of a factor is determined by the maximum number of points allotted to it. In each factor, the total range of points is divided into degrees according to the level at which the factor is present in the jobs. The characteristics of each degree in terms of, say, level of complexity, are defined as yardsticks for comparison purposes.

Jobs are evaluated by studying job descriptions containing analyses of the degree to which the factor is present in the job and comparing them with the factor level definition. The jobs are graded for each factor and the

points for each grading are added to produce a total score. This score can then be related to the scores of other jobs to indicate the rank order. For example, an evaluation of two jobs using a four factor scheme could produce the results shown in Table 98.1.

Table 98.1 *An example of points rating*

Factor	Job A		Job B	
	Level	*Points*	*Level*	*Points*
Resources	4	20	5	25
Decisions	4	60	4	60
Complexity	5	25	3	15
Knowledge and skills	3	15	3	15
		120		115

JOB EVALUATION PROGRAMME

A job evaluation programme consists of the eight stages shown in Figure 98.1:

Stage 1 is the preliminary stage in which information is obtained about present arrangements; decisions are made on the need for a new scheme or to revise an existing scheme; and a choice is made of the type of scheme to be used.

Stage 2 is the planning stage when the programme is drawn up; the staff affected are informed; arrangements are made as required for setting up working parties; and the representative sample of benchmark jobs to be analysed is selected.

Stage 3 is the analysis stage when information is collected about the sample of benchmark jobs as a basis for the internal and external evaluation.

Stage 4 is the internal evaluation stage when the jobs are ranked by means of the chosen evaluation scheme and graded, usually on a provisional basis pending the collection of market rate data, except where a job classification scheme is used to slot jobs into an existing job grade structure.

Stage 5 is the external evaluation stage when information is obtained on market rates.

Stage 6 is the stage in which the salary structure is designed.

2. *Specialized surveys*, which consist of three types:
   - analyses of members' salaries conducted by professional institutions;
   - local or national surveys of particular industrial groups produced by employers or trade associations;
   - local or national market studies carried out on a 'one off' basis by consultants either for a single employee or for a group of organizations.
3. *Company surveys*, which cover selected benchmark jobs which are special to the industry or are not dealt with adequately by other surveys. Surveys are either conducted by a single company approaching others on a reciprocal basis, or they are carried out by a group of independent companies acting as a 'salary survey club'. The data from a company survey can be presented in the form illustrated in Figure 99.1.

The translation of salary market data into an acceptable company salary structure is a process based on judgement and compromise. The aim is to extract a derived market rate based on effective estimates of the reliability of the data, and to strike a reasonable balance between the competing merits of the different sources used. However 'scientific' the approach, this is essentially an intuitive process. Once all the available data have been collected and presented in the most accessible manner possible (ie job by job for all the areas the structure is to cover), a proposed scale midpoint has to be established for each level based on the place in the market the company wishes to occupy, ie its 'market posture'. The establishment of this midpoint will be based not only on assessment of current and updated

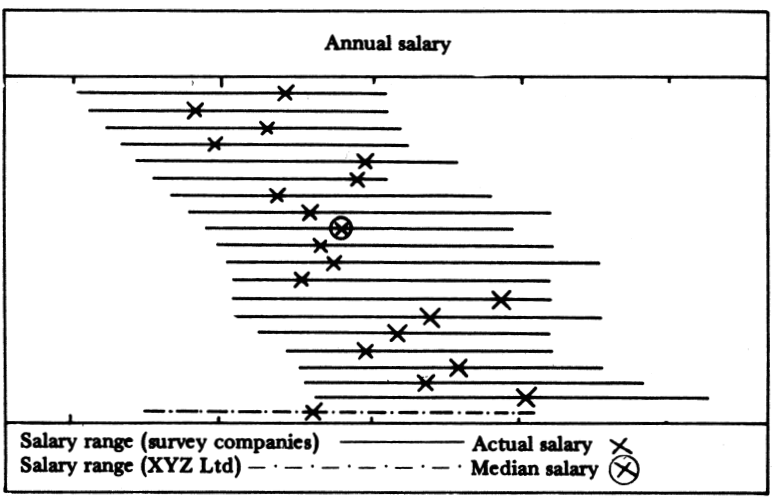

Figure 99.1 *Salary survey data presented graphically*

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generally keeping pace with the market or whether any particular groups of staff are out of line. The best way to summarize and compare the data is to chart (as shown in Figure 101.1):

1. the salary practice line (the average of actual salaries paid in each grade);
2. the salary policy line (the line joining together the target salaries for each grade – usually the midpoint salary); and
3. the median and/or upper-quartile market rate trend lines.

Monitoring internal relativities

Internal relativities are monitored by carrying out periodical studies of the differentials that exist vertically within departments or between categories of staff. For example, if there is an established hierarchy in departments of say, departmental manager, section heads, senior and junior clerks, the average salaries at each level are analysed periodically to reveal any changes in differentials between levels. There is nothing sacrosanct about the pattern of differentials. Structural adjustments within the company and alterations in market rates can justify changes. But it is desirable to know what is happening so that action can be taken, if required and if feasible, to restore the proper relationships.

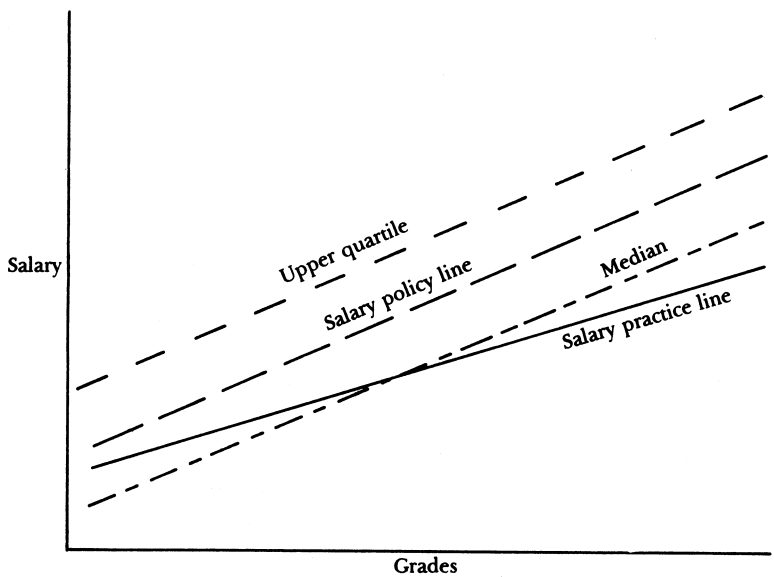

Figure 101.1 *Analysis of salary structure policy and practice in relation to market rates*

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Contingent Pay

DEFINITION

Contingent pay is the term used to describe schemes for providing financial rewards that are related to individual performance, competence, contribution or skill.

TYPES OF SCHEME

Performance-related pay

Individuals receive financial rewards in the form of increases to basic pay or cash bonuses which are linked to an assessment of performance, usually in relation to agreed objectives. Scope is provided for consolidated pay progression within pay brackets attached to grades in a grade and pay structure (see Chapter 99). Such increases are permanent – they are seldom if ever withdrawn. (See also Chapter 103.)

Competence-related pay

People receive financial rewards in the shape of increases to their base pay by reference to the level of competence they demonstrate in carrying out their roles. It is a method of paying people for the ability to perform now and in the future.

Workers are paid at their basic piecework rate for the time allowed, but if they complete the job in less time, they gain the advantage of the time saved, as they are still paid for the original time allowed. Thus, an operator who completes a job timed at 60 hours in 40 hours would receive a bonus of 50 per cent of his or her piecework rate, namely: $(60 - 40/40) \times 100$.

Piece rates may be determined by work study using the technique known as effort rating to determine standard times for jobs. In situations where work is not repetitive, especially in the engineering industry, times may be determined on a much less analytical basis by rate-fixers using their judgement. This often involves prolonged haggles with operators.

DIFFERENTIAL PIECEWORK SYSTEMS

Straight piecework systems result in a constant wage cost per unit of output, and management objections to this feature led to the development of differential systems where the wage cost per unit is adjusted in relation to output. The most familiar applications of this approach have been the premium bonus systems such as the Halsey/Weir or Rowan schemes. Both these systems are based on a standard time allowance and not a money piece rate, and the bonus depends on the time saved. Unlike straight piecework, the wages cost per unit of production falls as output increases, but the hourly rate of workers' earnings still increases, although not in proportion to the increased output. For obvious reasons, these systems are viewed with suspicion by unions and workers, and many variations to the basic approach have been developed, some of which involve sharing the increments of higher productivity between employers and workers.

MEASURED DAY WORK

In measured day work the pay of the employee is fixed on the understanding that he or she will maintain a specific level of performance, but the pay does not fluctuate in the short term with his or her performance. The arrangement relies on work measurement to define the required level of performance and to monitor the actual level. Fundamental to measured day work is the concept of an incentive level of performance, and this distinguishes it clearly from time rate systems. Measured day work guarantees the incentive payment in advance, thereby putting employees under an obligation to perform at the effort level required. Payments by results, on the other hand, allows employees discretion as to their effort level but relates their pay directly to the output they have achieved. Between these two systems are a variety of alternatives that seek to marry the different characteristics of payment by results and measured day

2. *Presentation*. This consists of a combination of telling and showing (demonstration).
3. *Practice*. The learner imitates the instructor and constantly repeats the operation under guidance. The aims are to reach the target level of performance for each element of the total task and to achieve the smooth combination of these elements into a whole job pattern.
4. *Follow-up*. The trainer follows up and helps the trainee as required.

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Decision Theory

DEFINITION

Decision theory deals with the process of making decisions, especially in conditions of uncertainty, when a number of alternative courses of action may have to be evaluated before the final decision is made. Decision theory analyses types of decisions, sets out ground rules for making decisions and develops decision making methods using various kinds of models or procedures.

TYPES OF DECISION

Decisions can be classified according to their purpose, their structure, their complexity, the degree of dependence and influence on other decisions, the extent to which conditions of uncertainty exist, the circumstances in which the decisions are made and the timescale available. Features contained in any of these categories may be present in a single decision.

Purpose

Decisions may be either:

- strategic – long term, dealing with wide issues affecting the whole or a major part of an organization; or
- tactical – shorter term, dealing with operational issues which, although they may affect the whole organization, are more likely to make an impact upon a particular function or department.

- decision trees;
- algorithms;
- subjective probability;
- Bayesian analysis.

These are considered below.

Other techniques designed to assist in decision taking, described elsewhere in the handbook, are:

- linear programming (Chapter 114);
- modelling (Chapter 112);
- simulation (Monte Carlo and deterministic) (Chapter 113).

Means–ends analysis

Means–ends analysis as described by Cooke and Slack[1] is a method of clarifying a chain of objectives and thus identifying a series of decision points. The concept is based on the fact that what is an objective to one decision maker will be a means of achieving a higher objective to a higher (hierarchically) decision maker. In other words, one person's means is another person's end.

Means–ends analysis is carried out by charting a means–ends chain as illustrated in Figure 111.1.

Decision matrix

A decision matrix, as described by Cooke and Slack,[1] is a method of modelling relatively straightforward decisions under uncertainty in such a way as to make explicit the options open to the decision taker, the factors or 'states of nature' relevant to the decision, and the probable outcomes from a combination of each option with each factor as shown on the matrix. The form in which a decision matrix is constructed is shown in Figure 111.2.

Decision trees

Decisions are often made in conditions where there are a number of alternative courses of action and when the outcomes of these actions are uncertain. Furthermore, earlier actions may affect subsequent actions and these likely effects need to be considered at the earlier stage.

Decision trees are a means of setting out problems of this kind, which are characterized by the interaction between uncertainty and a series of 'either/or' decisions. They display the anatomy of sequential decision points, the implications of which lead to branches on the tree. Thus the

Endogenous variables are the outputs of the system which are generated from the interaction of the system's inputs or exogenous factors and the structure of the decision itself.

5. Identify the parameters or constants which will be fed into the model and will not vary over the period of time studied or the range of options considered. The rate of interest, for example, may be taken as a constant.
6. Analyse the interactions to determine the influence of one factor on another and therefore the cause-and-effect relationship. From this analysis may be derived a cause–effect model of the situation which can be used as the basis for a mathematical model. An example of a cause-effect model is shown in Figure 112.1.
7. Build a mathematical model containing a set of symbols which describe decision variables and the relationships between them. Computers are used when the model becomes too complex to be used manually. Special modelling systems exist which compile the models directly into computer-readable statements.

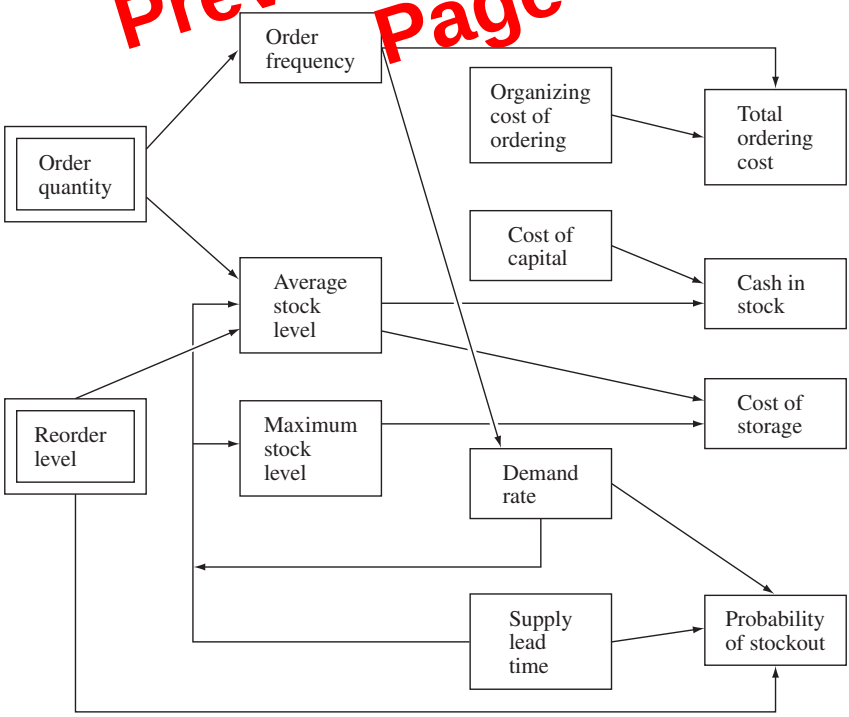

Figure 112.1 *A cause–effect model of a stock control process.* From *Making Management Decisions,* S Cooke and N Slack, Prentice-Hall International, London 1984

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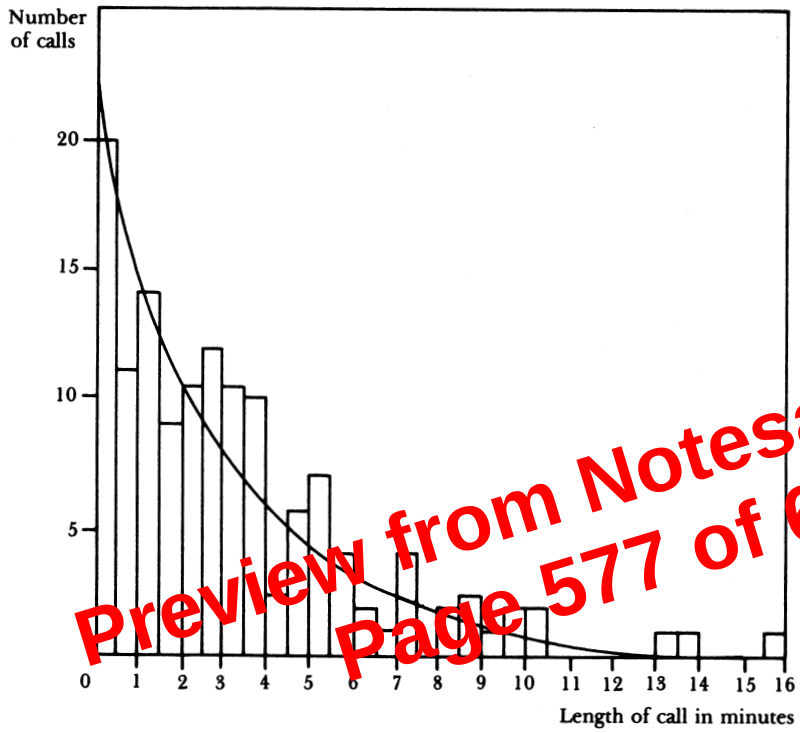

Figure 115.1 *Histogram showing number of calls of a given length at half-minute intervals. The curve shows the expected number of calls of a given length from a negative exponential distribution with mean call length of 3.322 minutes.*
From 'Manning the telephone enquiry building at West Midlands Gas' L B Sparrow in *Operational Research for Managers* ed S G Littlechild, Phillip Allan, Deddington 1977

BENEFITS

By employing the mathematics of queuing theory, the probable efficiency of a system can be assessed in terms of its service levels and productive capacity and plans can be made to eliminate undue and over-costly delays and bottlenecks.

There is a limit, however, to the extent to which queuing theory can deal with highly complex problems in dynamic situations with many variables. In these circumstances simulation techniques may be used as described in Chapter 113.

Littlechild has explained succinctly that:[1]

> The difference between simulation and queuing theory is that the former involves the repeated trial of a particular system, under different patterns of customer arrivals or service performance, until

environmental conditions so that certain essential parameters remain constant. The homeostatic mechanism is one that itself responds to the error-actuated feedback instead of relying on an outside agent.

The Black Box

In cybernetics, a Black Box is a system too complex to understand fully in the existing state of knowledge. In macro terms, the economic system of a country is a Black Box. In micro terms, in a complex department run by a number of interacting human beings, it may never be possible to find out exactly how inputs to the department are transformed into outputs. But it may not matter too much. The most important task in any manufacturing or processing system is to transform inputs into outputs as economically as possible. If this is achieved satisfactorily, it may be a futile exercise to try to find out precisely what is going on.

The Black Box principle states that the behaviour of a complex system is discovered merely by studying the relationship between the input and output, and not by considering what happens inside the box.

APPLICATIONS

Cybernetics can be applied to the design of manufacturing processes. Comprehensive feedback mechanisms can be built into the system. Some of these can automatically initiate corrections on the principle of homeostasis. Others use a systematic procedure for producing control information for process operators who have clearly defined rules on what action they take in response either to the information or to their observations in order to restore the system to normal.

Cybernetics applied to management ensures that feedback on performance is available so that corrections can be made. It is the basic principle behind budgetary control and management by objectives, but cybernetics aims to introduce much more comprehensive information systems which will enable corrections to be made more swiftly and without having any drastic effect.

The Black Box principle can be used to control systems that are highly complex. An example given by Duckworth, Gear and Lockett[2] is of a production controller with the problem of scheduling a tool room. The operations in the tool room were so complex that three or four clerks would be required to record all the necessary information. But on the basis of an analysis of inputs and outputs it was established that an input of 40 jobs per week would keep the tool room fully occupied and ensure an output of 40 jobs per week. Without worrying too much about what precisely was happening inside the tool room, it was possible to schedule

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Network Analysis

DEFINITION

Network analysis is a technique for planning and controlling complex projects and for scheduling the resources required on such projects. It achieves this aim by analysing the component parts of a project and assessing the sequential relationships between each event. The results of this analysis are represented diagrammatically as a network of interrelated activities.

BASIC TECHNIQUE

Networks are built up from the following basic elements:

1. *Events* – stages reached in a project at which all preceding activities have been completed and from which succeeding activities start.
2. *Nodes* – circles used to represent an event, ie the start or completion of a task, at a point in time.
3. *Activities* – arrows which link up events and indicate the time or resources which will be used in completing the task.

The basic sequence shown in a network is illustrated in Figure 118.1, where the two circles represent project events and the arrow joining them denotes the activity which must take place in order to progress from the first event to the second.

Part 7

Efficiency and Effectiveness

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Identify performance measures

The third step is to determine how performance in each of the categories will be measured. In some areas such as finance and customer service it may be quite easy to determine quantitative measures such as sales or levels of service as assessed by surveys, questionnaires and mystery shopping. The measures for the process and change in perspectives may, however, have to focus on the achievement of development programmes to meet defined specifications and to deliver expected results.

Communicate

This fourth step is to communicate to all employees what the balanced scorecard is, why it is important, how it will work, the part they will be expected to play and how they and the organization will benefit from it.

Operationalize

The fifth step is to operationalize the system. This means developing policies, procedures and processes that ensure that it is applied at all levels in the organization – strategically at the top, tactically in the middle – and as a matter of continuing importance so far as working practices are concerned to all employees.

Operationalization might include the definition of performance requirements in terms of targets and the introduction of new processes, the communication of these requirements, and the development and application of processes for measuring outcomes and taking corrective action when required. At an individual level, performance management processes may be based on the four elements of the scorecard. Objectives and standards of performance and competencies that are aligned to corporate objectives would be agreed for each element and performance reviews would assess progress and lead to agreed improvement and personal development plans.

Train

The sixth step is to provide training for everyone in the organization on the operation of the balanced scorecard and on what, on their different levels, they are expected to do about managing and implementing the process.

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Benchmarking

DEFINITION

Benchmarking involves identifying best practices in other organizations, comparing them with existing practices within the benchmarker's own organization, and taking action to improve those practices in the light of information on best practices elsewhere, comparing and measuring the performance of the benchmarker's own organization in particular respects with the performance in those areas of other organizations.

AIM

The aim of benchmarking is to improve the performance of the organization by incorporating appropriate best practice into existing procedures and practices, and by identifying areas where performance is inadequate compared with other organizations so that corrective action can be taken.

METHODOLOGY

The process of benchmarking involves:

- identifying the aspects of policy, procedure and practice for which information from other organizations is required;
- identifying the critical performance areas or factors within the organization for which comparative data are required;

effectively and it will fail if it does not take account of the people implications, including the opinions and feelings of those concerned.

FURTHER READING

Hammer, P, *Beyond Re-engineering*, HarperCollins, Oxford 1997.
Hammer, P and Champy, J, *Re-engineering the Corporation*, Harper Business, Oxford 1993.

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Ratio Analysis

DEFINITION

Ratio analysis studies and compares financial ratios which identify relationships between quantifiable aspects of a company's activities. The object is to reveal factors and trends affecting performance so that action can be taken.

TYPES OF RATIOS

Ratios cover the following areas:

1. profitability;
2. performance;
3. cost;
4. liquidity;
5. capital structure;
6. financial risk;
7. efficiency – debtors, creditors, inventory;
8. productivity.

PROFITABILITY

The profitability ratios are as follows:

BENEFITS

The analysis of management ratios clarifies trends and weaknesses in performance as a guide to action as long as proper comparisons are made and the reasons for adverse trends or deviations from the norm are investigated thoroughly.

FURTHER READING

Pendlebury, M and Groves, R, *Company Accounts* (2nd edition), Unwin Hyman, London 1990.

might well be the case that 20 per cent of the products account for 80 per cent of the turnover or total contribution. This is known as the 80/20 rule.

2. *Trend analysis*. The relative performance of the items generating less income are scrutinized to check recent trends in turnover.
3. *Action plan*. Any lower-income items for which sales are static or declining are examined in more detail to see if their contribution can be increased by such actions as reducing variable costs and/or increasing the selling price.
4. *Final decision*. The final decision on whether or not to phase out a product for which the action plan has not improved its performance will be affected by two considerations. The first will be the opportunity costs of concentrating on other, more profitable, products, ie what would be gained by transferring production to them. The second will be the economies that would result from discontinuing the product. If, in the short term, they are less than the contribution made by the product it might be worth retaining it until it can be replaced by an improved version.

Component variety reduction

Component variety reduction examines every component in the final production to find out if there is any scope for standardization, amalgamation or eliminating unnecessary items. If a new component becomes necessary, an effective coding system for existing components will indicate if one is already available. Rather than making the component, it might be more economical to buy it from an outside supplier.

BENEFITS

1. Production runs will be longer and ancillary time for setting up and breaking down will be reduced.
2. Inventory levels will be reduced.
3. Planning and production control will be simplified.
4. Potential savings will be achieved in plant and equipment requirements.
5. Activity can be concentrated more in development and design, marketing and sales, and after-sales service.