



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

07055



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

**FURNITURE AND JOINERY
INDUSTRIES
FOR
DEVELOPING COUNTRIES.**

**PART THREE:
MANAGEMENT CONSIDERATIONS**

The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

Material in this document may be freely quoted or reprinted, but acknowledgement is requested, together with a copy of the publication containing the quotation or reprint.

PREFACE

Two seminars on furniture and joinery industries have been organized by the United Nations Industrial Development Organization (UNIDO) in co-operation with the Government of Finland. The first was held in Lahti and Tuusula from 16 August to 11 September 1971, the second in Lahti from 6 to 26 August 1972. Their success was in no small measure due to the hospitality and understanding of the Finnish authorities and of the Finnish industry by granting participants these invaluable opportunities to avail themselves of their country's comprehensive expertise in the field of furniture design, production and marketing.

The aim of the seminars was to familiarize factory managers in developing countries with modern plant, equipment and production techniques to enable them to up-grade their own operations and to establish priorities for such improvement.

These seminars were attended by a total of 44 participants from 26 developing countries who were, for the most part, technical managers and production supervisors of woodworking plants.

This series is based on lectures delivered to either or both of the seminars. Many of them were complemented by illustrative material that did not lend itself to reproduction in the present form. The seminars consisted of these lectures, plus demonstrations, discussions and visits to medium-sized and small-scale furniture and joinery plants, plywood and lumber manufacturers and producers of upholstery foams, paints and woodworking machinery as well as vocational and technical training institutions.

Although these studies constitute a coherent whole, for convenience they have been grouped into three parts, bound separately, dealing respectively with inputs of materials, processing technologies and management matters.

The present publication is the third and last in the series and deals with management problems and responsibilities in the areas of quality control, production management, marketing and export trade, and occupational hazards and safety at work.

The first part of the series is made up of articles on the materials from which furniture and joinery products are constructed, among them solid wood,

composite boards of various kinds, upholstery materials, bonding agents and the hardware used in assembly and trimming.

The second part of the series deals with processing technology. It includes articles on such matters as furniture design, product development, plant layout, finishing operations and plant automation.

It is hoped that publication of the material issued in the course of the seminars will contribute towards increasing the awareness of the results that may be achieved when furniture and joinery enterprises are set up in developing countries following established, rational industrial procedures. It is also hoped that this material will be of use to teachers in training institutes in developing countries.

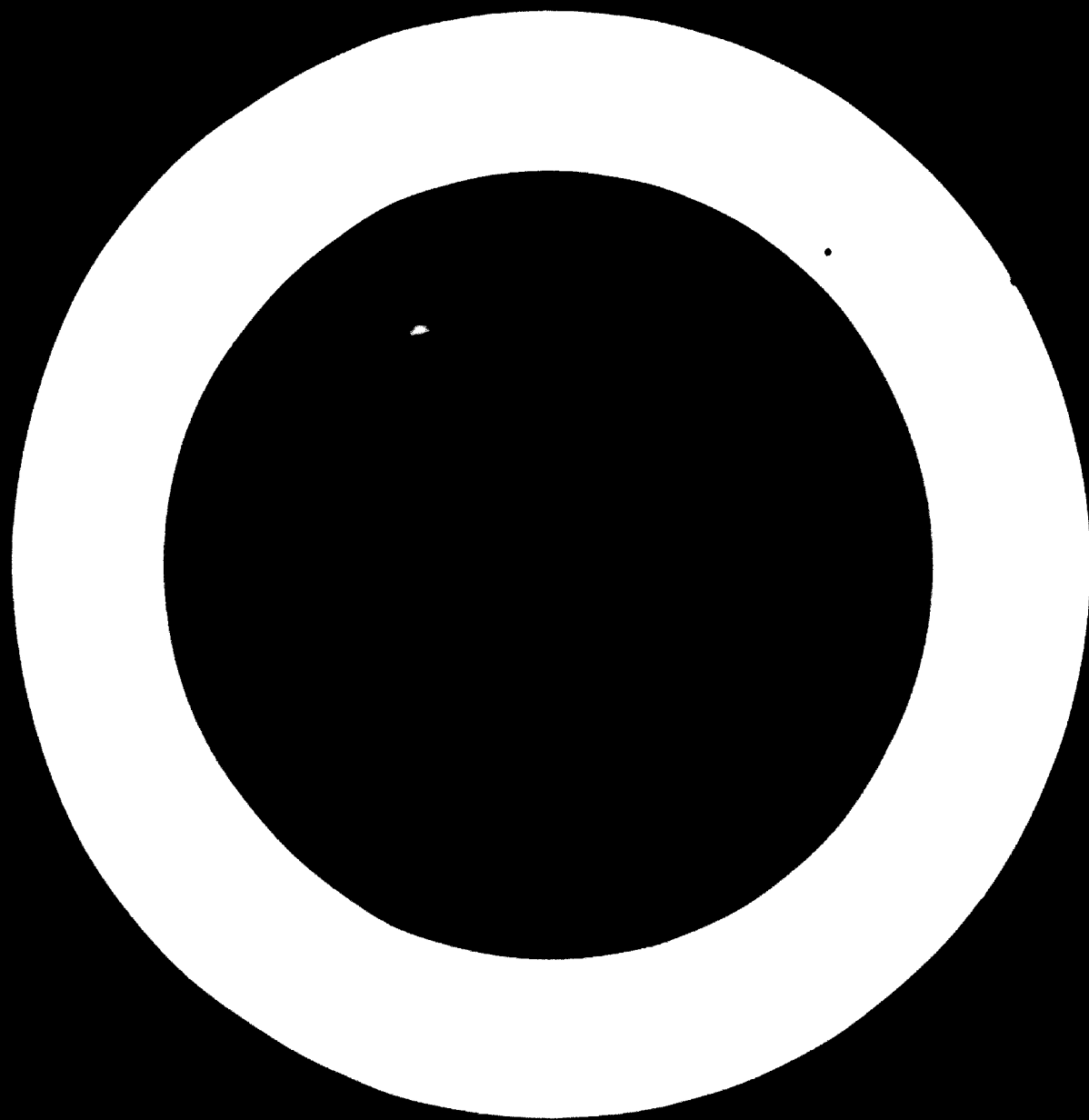
Readers should note that, in some instances, the examples cited and the descriptions given represent Finnish conditions that may not be wholly applicable to particular developing countries.

The views expressed are those of the individual authors and do not necessarily reflect the views of UNIDO.

CONTENTS

	Page
23. Quality control Jaakko Meriluoto	7
24. Production management Ervi Sirviö	11
25. Marketing and export trade Markku Harjula	27
26. Safety at work and occupational hazards Kai Lindberg	49

4663



23. QUALITY CONTROL*

The quality of a product determines its usefulness; certain levels of quality correspond to different uses. Quality generally has no absolute value; we can only consider average quality. Individual pieces are not equal, since their qualities differ. This variation usually results from factors connected with raw material and semi-manufactured articles, machines, tools and workers' ability. Variation is quite natural and cannot be avoided even in the most careful production.

The variable qualities of a product of the wood industry are, for instance:

Measures (length, thickness, breadth)

Condition of the wood (moisture content, number and size of knots, density etc.)

Quality of workmanship (evenness of surface, durability of glued joints, clearances etc.)

Such variations are more common in woodworking than in many other branches of industry, so quality control in the wood industry is relatively complicated and difficult. Since production processes in furniture and joinery are divided into many secondary stages, it is always possible that faults will multiply as the individual items move along the production chain. It is thus not enough to inspect finished products but to have quality control throughout all stages of production. It can be said, however, that it is most important to control production at the beginning of the process. If this is done, economic losses can be avoided because faults will not multiply themselves.

For example, let us consider faulty measurement of length in pre-cutting. The piece is dried, edged, surfaced and thickness-planed. If the piece is found to be too short in edge planing it is rejected, transferred to another part of the process or stored for future use. Such errors result in unnecessary

*Paper presented to the seminar by Jaakko Meriluoto, Lahti Technical Institute, Lahti, Finland. (Originally issued as document ID/WG.133/28.)

work, increase of raw material waste, need for more storage space, difficulties in planning of work or repairs of products, which leads to a decline of profits.

To summarize, uncontrolled quality gives rise to many difficulties. Among the most important of these is decreased product acceptability, which can lead to rejection of items by consumer and dealer alike, which in turn creates a disposal problem, decreased profitability and a decline in the morale of the work force.

The purposes of quality control are:

To narrow the ranges of acceptable product variation

To detect variations in excess of these ranges

To work out a system whereby the production process can be followed through its successive stages so as to prevent unfavourable factors from suddenly affecting it

The costs of quality control should, however, be proportional to other costs.

The nature of the production process usually determines the method of quality control. In unit production there are no large series; many different articles are produced randomly, often to order. In this case production volume (and the factory size) is often relatively small. The costs of quality control cannot be very high in this situation. Control by sample tests and measurements, normally by a foreman, is suitable for production on this scale. Nevertheless, control must be very strict despite its sporadic nature, and it must be repeated at each stage of the work. Simple visual examination, as a general procedure, belongs to this type of control. In addition, measurements must be carried out with appropriate instruments, such as the following:

A linear measure, for length, breadth, height and cross-measures (squareness)

A caliper gauge, for thickness and breadth

A set of gauges and a ruler, for the clearances of doors, drawers and the like, and for surface smoothness (a powerful light-source is also necessary)

Equipment to check the moisture content of the wood (by either the electrical or the weighing method)

A wet and dry thermometer and equilibrium curves to determine the humidity of the ambient air

Checking may be done at various times, but it must be done daily. If the foremen are to be responsible for quality control, each of them must be assigned his own, special, limited field. However, the best results are achieved when there is a special inspector to perform this task.

In any case records must be kept. The best way to ensure that this is done is to have a special tabular record for this purpose that makes it easy to control the situation. The notes thus make it possible to determine the circumstances of manufacture afterwards; this possibility is important especially if claims concerning performance are later made. The records of quality control can be compared with the reports that factories give on cost calculations and have a similar value to the factory management.

In serial production a relatively limited variety of articles is manufactured in large series. The production plant is usually larger than in the previous case and in addition is more automated.

Since unit costs in serial production can be kept relatively low, more money can be invested in quality. Because such factories are to some degree automated and the human labour specialized, and in some cases the whole production process without even a controlling eye, the importance of quality control becomes very great. In uncontrolled serial production there is a great danger that the volume of faulty products may become very large before it is noticed.

Serial production can be controlled by using the sample tests mentioned above for custom work, but statistical (mathematical) quality control must be considered more appropriate and effective. Only an expert or skilled craftsman should perform this work. The objects and the means of control are the same as in the previous situation. The difference lies in the fact that the schedule of specimen or sample measurements is regular, their number is rather large and the treatment of measurement results is mathematical (in the main by analysing the test figures). Space does not permit proper discussion here of statistical quality control, but there is a wealth of material on it in the literature. A few representative titles are included in the selected bibliography that follows.

Bibliography

- Arkin, H. and R. C. Colton. Tables for statisticians. New York, Barnes and Noble, 1957.
- Barnes, R. M. Motion and time study. New York, Wiley, 1949.
- Bowman, E. H. and R. B. Fetter. Analysis for production management. Homewood, Ill., Irwin, 1961.
- Cochran, W. G. and G. M. Cox. Experimental design. New York, Wiley, 1950.
- Duncan, A. J. Quality control and industrial statistics. Rev. ed. Homewood, Ill., Irwin, 1959.
- Fisher, E. A. The design of experiments. 7. ed. New York, Hafner, 1960.
- Grant, E. L. Principles of engineering economy. New York, Ronald, 1946.
- Grant, E. L. Statistical quality control. New York, McGraw-Hill, 1952.
- Snedecor, G. W. Statistical methods. 7. ed. Ames, Iowa, Iowa State University Press, 1956.
- Spiegel, M. T. Theory and problems of statistics. New York, Schaum, 1961.
- United Nations. United Nations Industrial Development Organisation. Information sources on industrial quality control. 1973. 58 p.
(UNIDO/LIB/SER.B/6)

24. PRODUCTION MANAGEMENT*

The function and objectives of production

Production is a transformation process whereby goods or services are brought into being. It is usually the most complicated function of an enterprise. The problems associated with it are not only technical; they are economic and organizational as well.

The basic function of production is to make and deliver goods of a desired kind, in the right amount and of the right quality at the right time, all at the lowest cost with a minimum of investment.

Quality is the key to the success of a manufacturing enterprise. The quality level must be such that product quality will not be too low to be competitive but not so high as to be too costly.

The second objective of production is to produce the right amount, but how much is that? The right amount for manufacturing may not be the right amount for sales. Top management must decide whether to sell what is produced or to produce what can be expected to sell.

The third consideration is timing. If production is too early, there may be excessive investment in inventory. On the other hand, if it is too late, there may be a permanent loss of sales and a disposal problem. It is thus often extremely difficult to produce the right amount at the right time.

The fourth aim is to minimize capital outlay. Production efficiency is generally measured in terms of productivity, which is simply output divided by capacity. Productivity can be raised either by increasing volume with the same basic capacity or by maintaining the same production with reduced capacity.

*Paper presented to the seminar by Ervi Sirviö, Oy Mec-Rastor Ab, Helsinki, Finland. (Originally issued as document ID/WG.133/24.)

The cost structure of the enterprise

To develop and rationalize production, the approximate cost structure of the enterprise must be known. In Finnish industries, the averages are as follows:

<u>Cost elements</u>	<u>Percentage</u>
Materials (in general purchases)	60
Wages	20
Capital costs, administrative cost etc.	20
	<u>100</u>

What is production management?

Production management can be defined as the principles and procedures, both technological and administrative, for planning and controlling production. Planning is the means used to achieve the four aims. It is an increasingly dynamic function, owing to the rapidity of change in the modern world. There is always a shortage of something: capital, capacity, time or know-how, so the best use must be made of the available resources. The planning procedures based on the objectives of production are shown in figure I. The normal sequence of the planning procedures for a customer order is shown in figure II.

Prerequisites for planning

Production is dependent on many other functions of the enterprise. Production management cannot be efficient if the prerequisites for planning are not met. A key element is keeping the product assortment within reasonable limits, since it can easily increase exponentially, thus making production more expensive and planning more difficult. Whoever suggests a new product should name two old ones to be dropped.

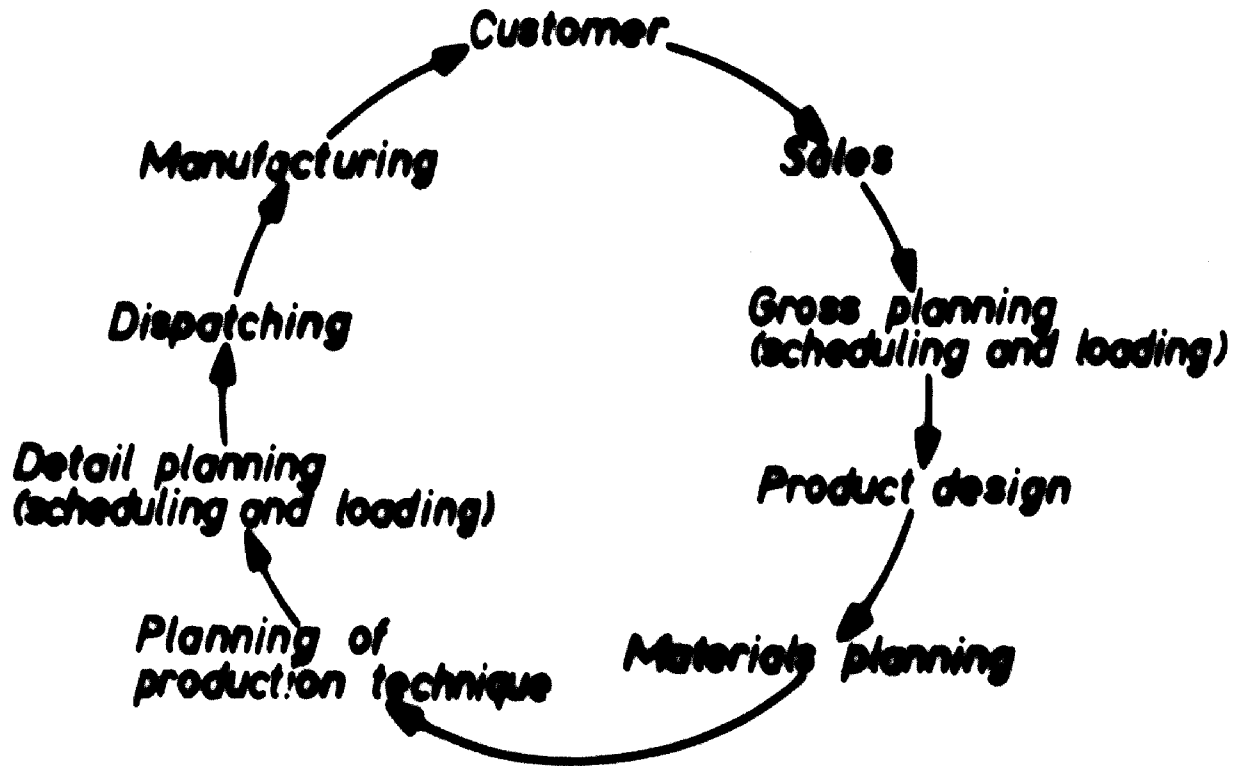
The product itself is the basic consideration; production can be rationalized no further than the product itself. The product must therefore be designed from the production standpoint. The process must begin at the drawing-board, which is where production cost is mainly determined.

Production planning can be no better than the sales programme, whose faithful servant it is. However, it can so serve only if sales programmes or forecasts that are as detailed as possible have been made up on a long-term

Figure I. Planning procedures based on the objectives of production

OBJECTIVE OF PRODUCTION	PROBLEM	PROCEDURE OF PLANNING
Quality	How to achieve ?	Production technique Processing, routing Methods planning Layout planning Tool design Work study Work measurement
Economy	Minimizing of costs; How to produce ? Where to produce?	
Amount	Lot size ?	Production planning Scheduling (gross, detail) Loading (gross, detail) Materials management (inventory control) Dispatching Control, reporting
Point of time	When ?	

Figure II. Planning procedures for a customer order



basis. For example, the order books of many enterprises often include some astonishing things. Even some of the larger ones still perform operations that they did many years ago when they began as small-scale handicraft operations. Such small, individual services to old clients are unprofitable in most cases and disturbing to production. To avoid this danger the product list and job policy should be examined from time to time, and management must decide whether it wants to remain a custom shop or grow into an industry.

The procedures of production management

The need for planning and the procedures for it vary in different industries. The situation is most complicated in job-shop production of custom-made products. In batch production of such things as consumer goods, competition is often severe. In this case work study and inventory control are very important. In mass production, as in process industries, the entire production process may have been planned in detail before erection of the plant, in which case no further large-scale planning is needed.

There are four main objectives of production planning:

To keep output capacity as high as possible. This means that promised times of delivery should be honoured and through-times kept as short as possible

To keep the inventories (stocks and jobs in process) as low as possible

To utilize the production capacity to the fullest possible extent and employment on an even level

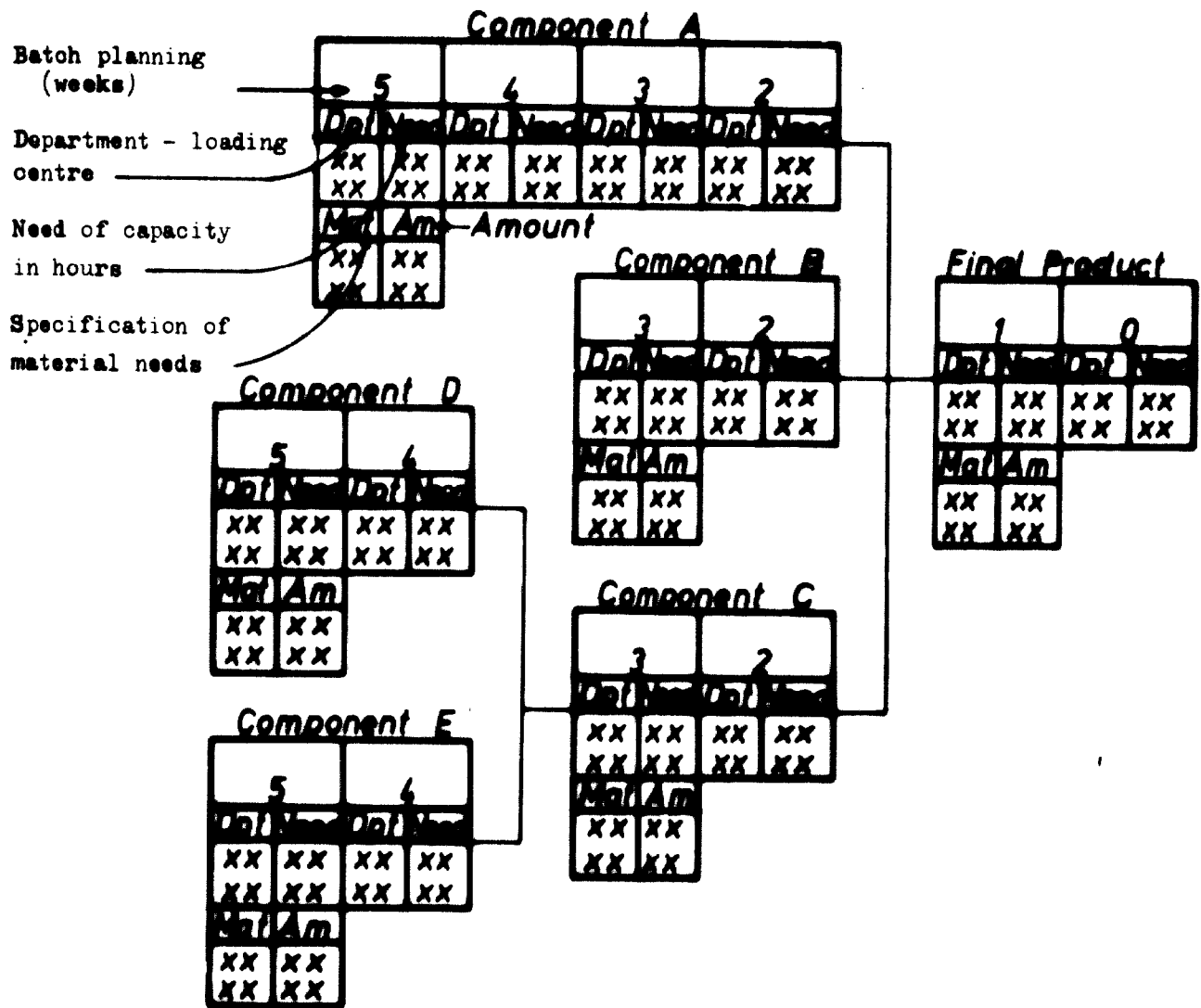
To inform the management, sales, purchasing and production supervisors regarding the delivery and capacity reservation (loading) situations so as to make it possible to correct and prompt decisions and arrangements

Gross planning is based on sales programmes or on customer orders. It must include all main phases up to the time of delivery. Rough capacity reservation (gross loading) is made at the same time.

Materials planning can be carried out when the preliminary or definite drawings become available. It is important to make the material orders or reservations as early as possible and to control the delivery times carefully.

Detail planning consists of scheduling and detail loading. It is often helpful to make planning models. Figure III presents a schematic model for product, including product structure, scheduling, capacity and material needs

Figure III. A schematic planning model of a product



per operation. Scheduling is always difficult in job shop production, since the waiting times make up about three quarters of the through time.

To plan loading properly, there must be accurate knowledge of the net available plant capacity. This can be obtained by subtracting all losses from the theoretical gross capacity, as shown in figure IV.^{1/} There is no general rough rule for this; each enterprise should make its own calculations.

If some products and parts can be produced repetitively, in batches, forced or cyclical schedules are possible. The production periods (cycles) will not depend on calendar time but on working hours. A new batch starts at the beginning of every cycle; an example is shown in figure V. Similar cyclical time-tables are used in many other areas such as traffic connexions and schools.

Dispatching is the stage at which the plans are implemented. Here the work flow to and within the plant must be regulated very carefully. If close contact between orders and manufacturing is maintained, it will be possible to maintain a smooth and rapid production flow. There is a broad and slow pattern when the production planning department dispatches all work orders to the shop foremen as soon as they are ready. The jobs are badly prepared, but the shop people are satisfied because they get plenty of work and they can determine the job sequence themselves. However, the shop will soon be full of uncompleted jobs and the assembly department short of some parts. The result will be long through-times and small output. There is a narrow and fast pattern when the production planning department dispatches work orders to the shop well prepared, in the proper sequence and only as much at a time as the shop can handle. The shop people are thus forced to do the jobs in the proper, planned sequence. The result will be short through-times and an even, broad output flow.

Generally speaking, it is useless to give an order if its performance is not checked; there must always be feedback from the shop. Figure VI shows control applied to the production of a single custom-made product. Control must exist on all levels. Figures VII and VIII show how the progress of a single order and of the whole production can be roughly controlled by curves.

^{1/} See also part two, figure II of article 16 (Pekka Paavola "Plant layout").

Figure IV. Graphic representation of the calculation of plant capacity

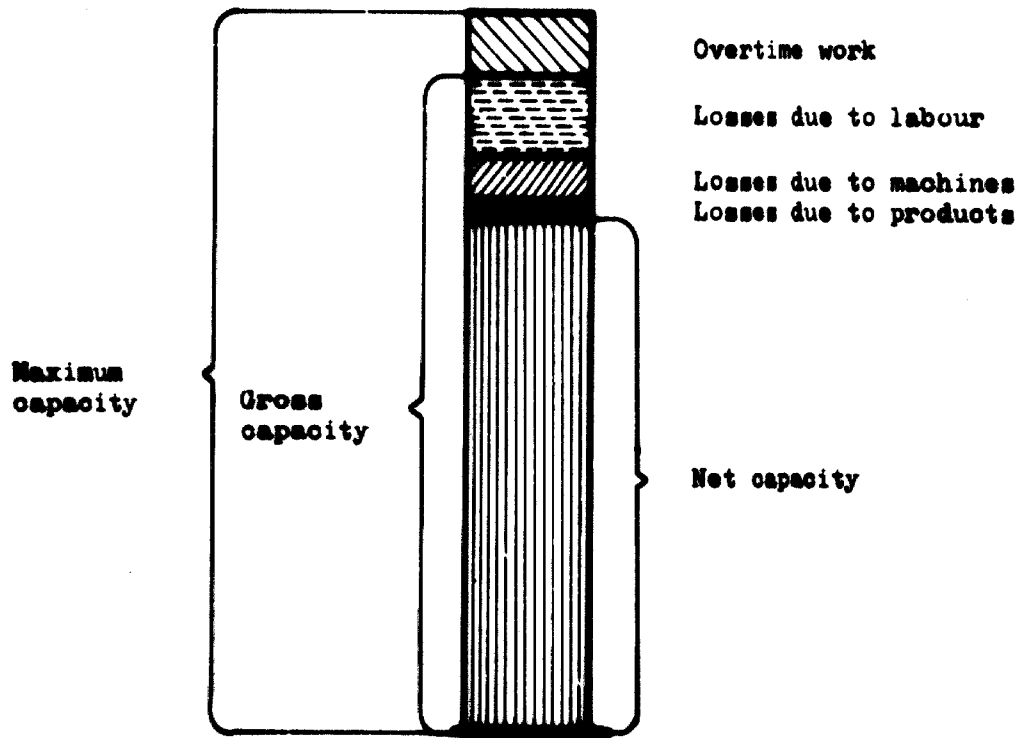


Figure V. A cyclical production schedule

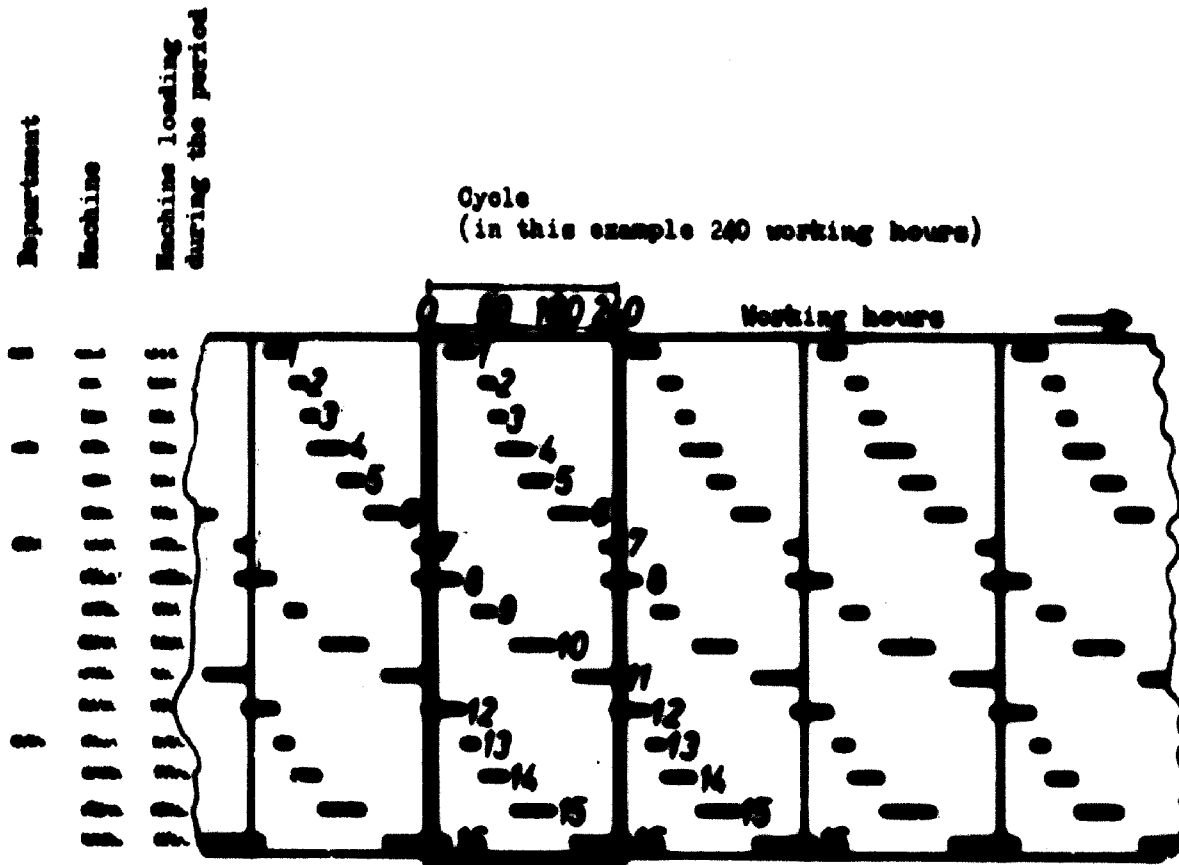


Figure 11. Diagram of the structure and function of an individual's memory system.

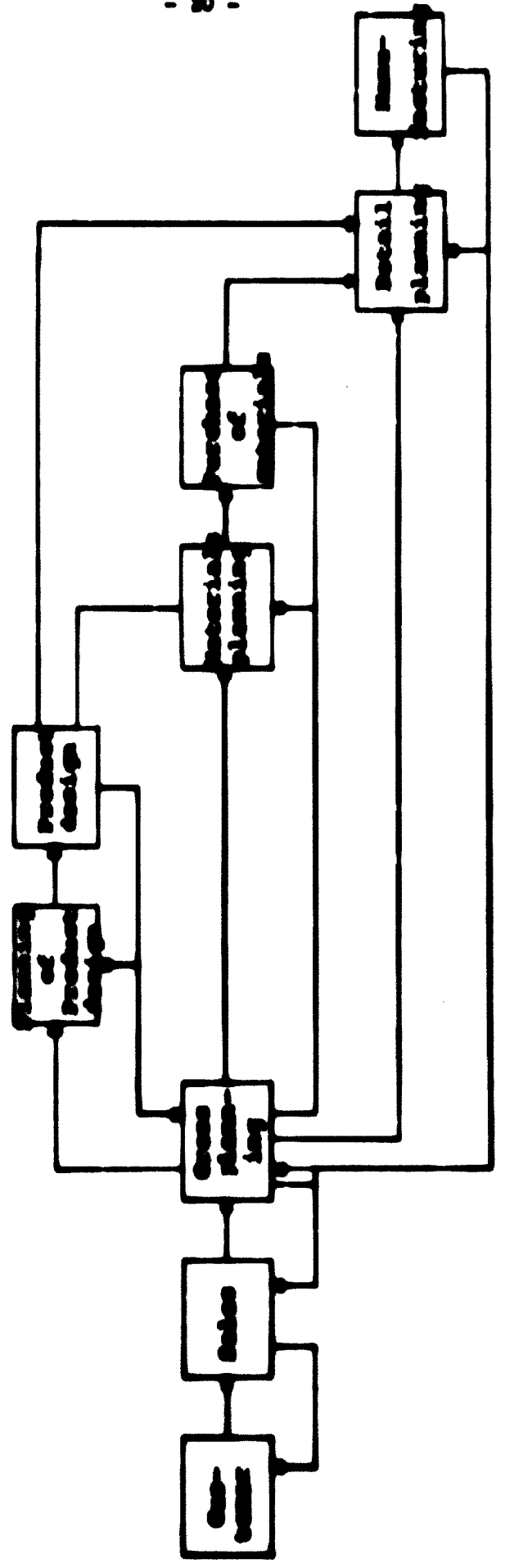


Figure VII. Control curve for an order

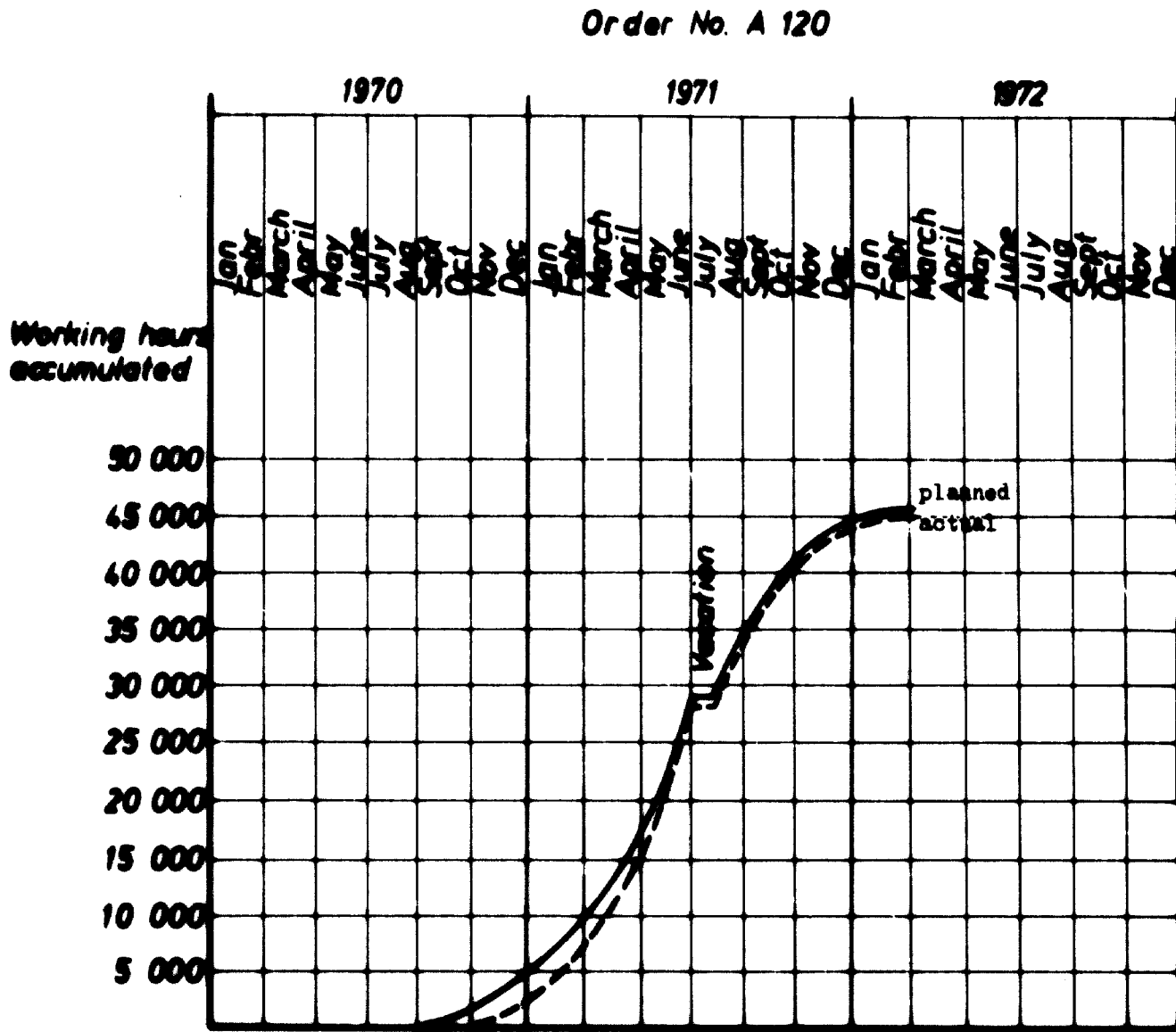
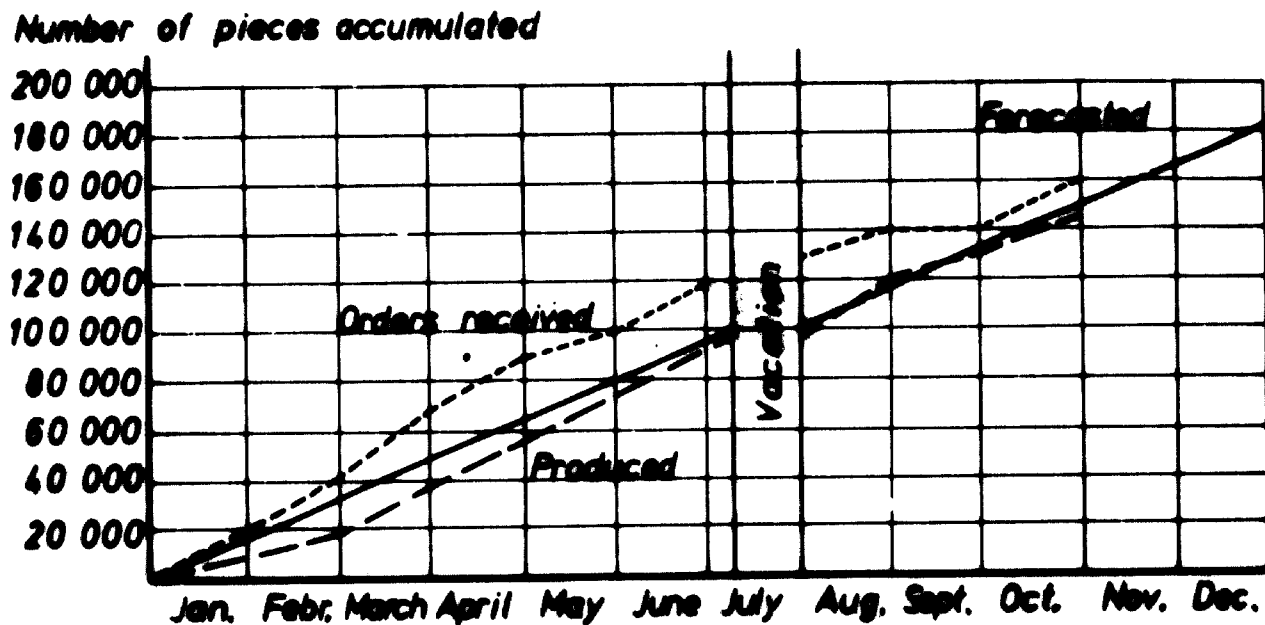


Figure VIII. Policy-up of forecasting, sales and production



Production technique

The development of production techniques in processing, methods planning, layout planning, tool design, work study and work measurement has been rather slow. Nevertheless, these techniques are being studied and practiced almost all over the world. Some extreme results of systematic development work are division of labour, assembly lines and thorough time-and-motion studies with predetermined time standards such as MTM (Methods-Time Measurement), WF (Work Factor system) and MTA (Motion-Time Analysis). It may be asked if the development of this form of work rationalization has gone too far. In industrialized countries there are some signs indicating that:

The average education level of young people is much higher than before

The labour supply is contracting

Young people tend to prefer to work in the service industries than on the assembly line

The turnover of labour is very high in many industries

Many labour unions demand regular monthly salaries instead of wages geared to incentives

Labour demands participation in management and more democracy in many work places

All these signs are challenges to production management.

It seems as if the pendulum of work rationalization has reached its extreme position and is swinging back. Job enlargement, job enrichment, participation, motivation, ergonomics and human engineering are not only slogans, but realities in ever more enterprises. Industrial engineering techniques are now needed more than ever; the only question is who will use them, and how.

Selectivity in production management

It is not always advisable to plan everything with the same accuracy; it is often worth while to remember Pareto's minority principle, according to which, in every group there is always a small part that contributes a disproportionately large part of the result. Some applications of this principle have been given such names as stratification, volume value, ABC-grouping, the 80/20-rule and the Lorenz diagram. It is thus possible to identify the most important elements from the total and to plan and control selectively and

save much work by giving less attention to the less important matters. It is often possible to achieve remarkable results by giving priority to selected products and orders. Figure IX shows an application of ABC-grouping in a manufacturing-for-stock system.

The development of production

The purpose of production planning is to reduce its total cost in terms of time and money. However, planning itself also involves such costs. The problem is thus to determine the point at which the investment in planning most effectively reduces production cost. This concept is presented in graphic form in figure X.

Production development does not occur automatically; purposeful and effectively guided work is needed to promote it. To begin, one must first determine the present level. It is advantageous to compare with that of a competitor. Also, good ideas often can be found in different but similar industries.

The second stage is to set objectives for development work. These should be at least approximately numerical and as realistic as possible. They can be either short term or long-range and perhaps divided into successive phases.

The third and final step is to determine how and when to reach the objectives. Subsequent development work should be carried out as projects with clear organizations and schedules. These projects will be investments, and it is important to calculate and follow-up the pay-off time. Figure XI shows a general schedule for a development project of a production-planning system.

Figure IX. ABC grouping in a manufacturing-for-stock order

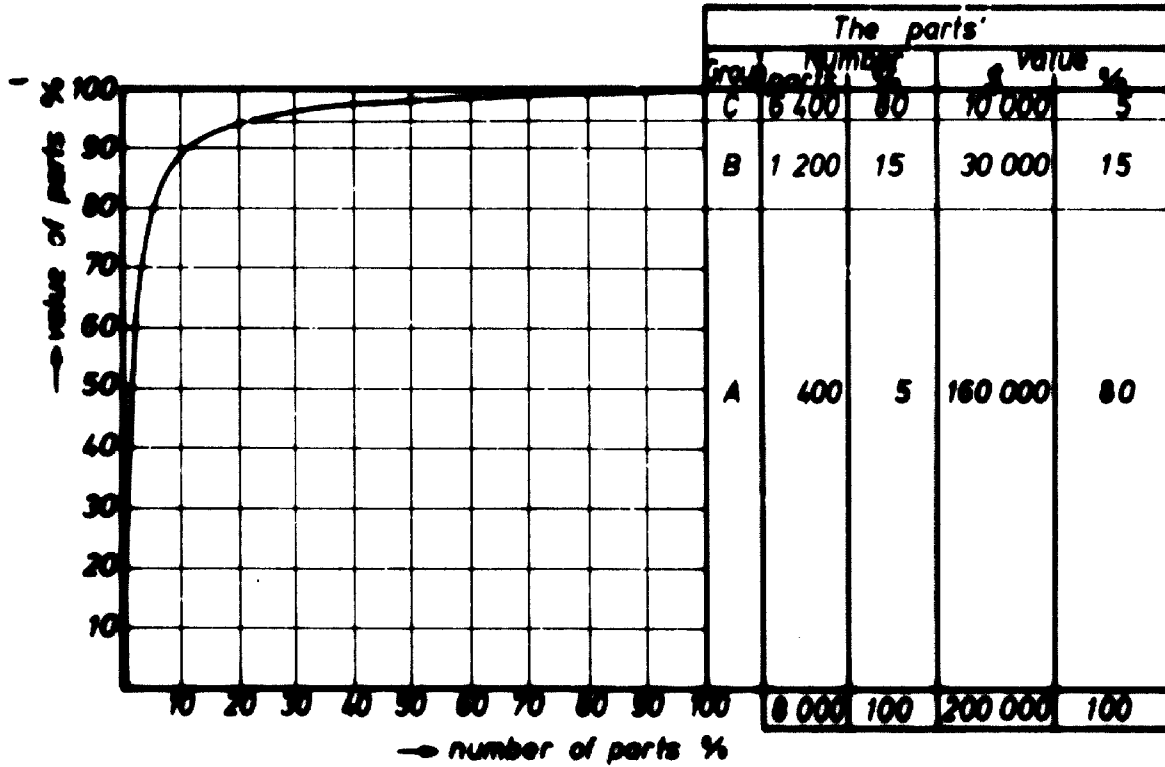


Figure X. Schematic presentation of the optimisation of planning and manufacturing costs

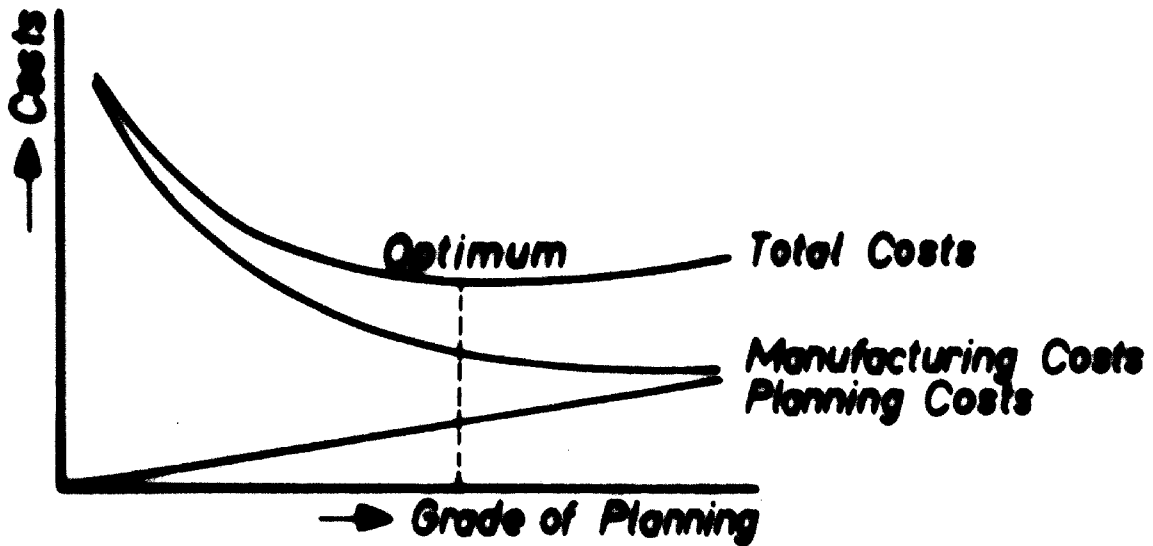
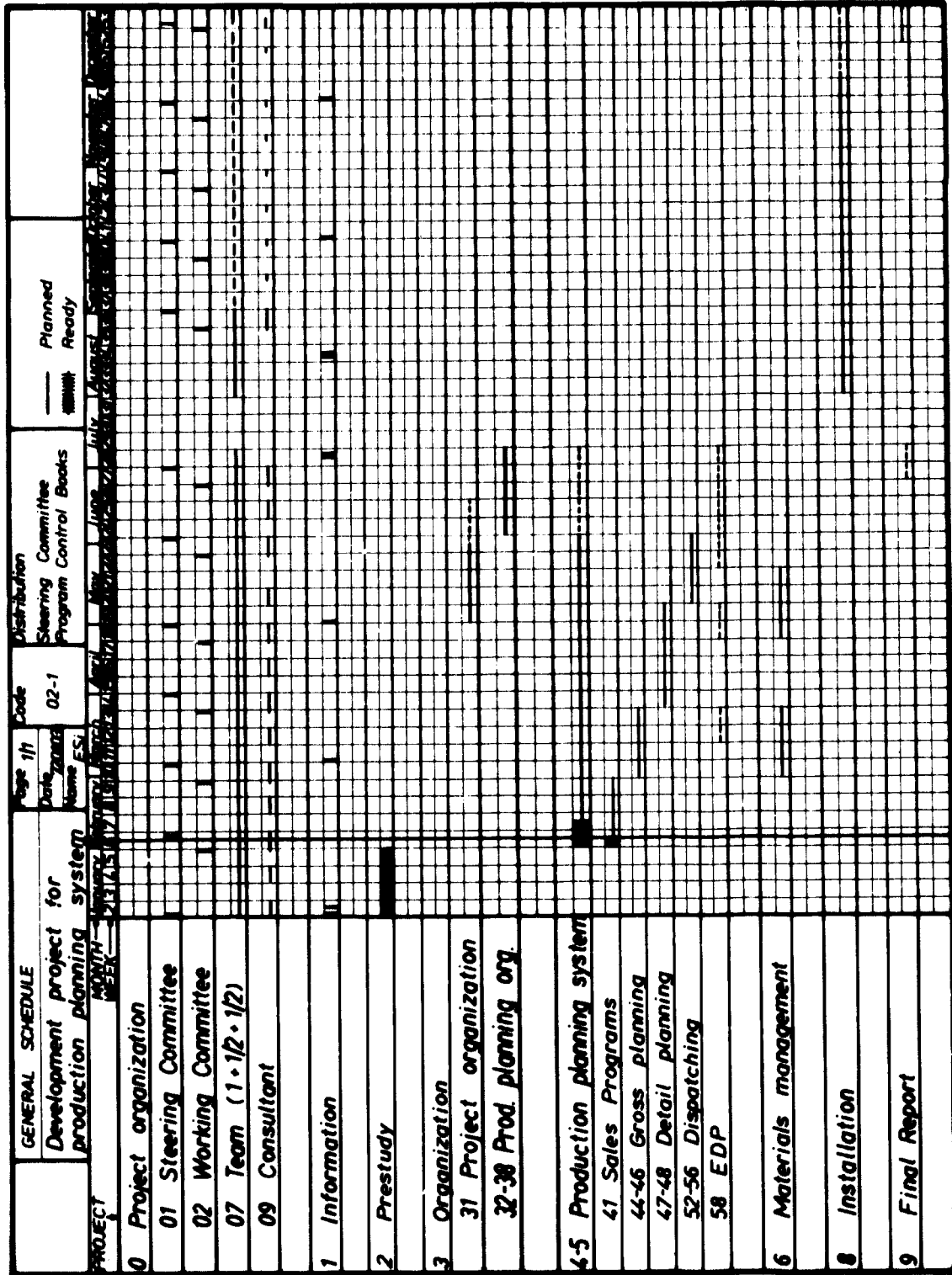


Figure XI. The general schedule for a development project of a production-planning system



25. MARKETING AND EXPORT TRADE*

Basic concepts and considerations in marketing

The two basic functions of any business enterprise have often been defined as making and selling, or, in other words, production and marketing. By the same token, the effectiveness of a firm depends on its ability to compete through creativity, on one hand, and on its skill in marketing a product or service on the other. These prerequisites should be understood as complementary to each other and not as supplementary.

Marketing consists of activities in the creation of markets and the satisfaction of customers through the distribution of goods and services. It includes the business activities that are required to develop and transfer a flow of goods and services from production to consumption. The American Marketing Association has defined marketing as "the performance of business activities that direct the flow of goods and services from producer to consumer or user". As an alternative to this condensed definition, marketing could be defined on the basis of the crucial functions involved, in which case it might read as follows: "Marketing is the performance of all business activities required to develop, promote and distribute products and services to satisfy the existing and potential demand of customers." However, no matter which of the numerous definitions of marketing is used, the main elements still are the creation or identification of customer wants and the distribution of goods and services to satisfy these wants.

Let us now consider the marketing concept in the light of specific marketing functions or activities. At this point it must be emphasized that, although modern marketing techniques have been developed in the industrially advanced countries and are based on their competitive conditions, modern marketing will become more important and applicable also in the developing countries for the following reasons: in the first place, in many developing countries, the competition within industries is getting keener, and at the same time different kinds of consumer goods compete for a limited purchasing

*Paper presented to the seminar by Markku Harjula, Helsinki School of Economics, Helsinki, Finland. (Originally issued as document (ID/WG.105/48.)

power. Secondly, domestic firms must compete against foreign companies that operate or sell in the developing countries and which use modern marketing methods. Thirdly, although economic development increases business opportunities, many marketers believe that, conversely, marketing can make an essential contribution to economic development, and that therefore marketing orientation, planning and implementation should be given sufficient weight.

Marketing activities

Marketing functions or activities have been classified under various headings in different contexts. Since it is thus largely a matter of choice, the following presentation of marketing activities is based on the structural classification of Creating a market, published by the International Labour Office.^{1/} Some of the most common divergences in the definitions are dealt with at the end of this presentation.

Market research

Market or marketing research is the systematic collection and analysis of marketing information. It includes various types of research, among them market analysis, which is a study of the size, location and characteristics of markets, sales analysis, which is largely an analysis of sales data, and consumer research, which is concerned with consumer attitudes, motives and preferences.

Before starting the production of a new item, management should obtain information on the potential market, its size and location, competitors, expected market share and sales volume, customers' needs and preferences and so on. The same requirements also apply to existing products if the sales volume or market share is to be increased. Some of the basic market information may be obtained from statistics, previous studies, publications, journals and similar sources. The data on customers, their wishes and preferences, and on competition may, to some extent, be gathered through the company's own salesmen and retailers. Consumer surveys, such as personal interviews, mail questionnaires and motivational research are more difficult to conduct without expert help. Instead, product tests in which new items

^{1/} This work was distributed to the participants in the seminar (see the bibliography at the end of this article).

are given to selected customers, or test marketing, where a new product is actually offered for sale in certain locations only, may be applicable for studying the customer. It must be emphasized that the use of outside market research experts, if at all possible, normally gives the best results but is very costly in the first place, and even then many problems cannot be re-searched and must be resolved by subjective judgement.

Product planning

Product planning is the process of developing new products and modifying or abandoning existing ones so as to meet customer needs and to utilize fully the capabilities of the enterprise. The ultimate aim of product planning is to develop a product that sells, and therefore it requires the participation of marketing in addition to research and engineering. In fact, in marketing-minded companies, product planning is largely based on an analysis of market requirements and future opportunities. An evaluation of the effects of technology and technological change on market needs and competitive conditions is also necessary. Especially in the case of small companies and markets, new-product development is mainly dependent on the suitability of the company's existing technical and marketing experience.

Product modification is any physical alteration of an existing product or its packaging. It may become necessary because of new technological developments, competitive conditions, changes in customers' needs and preferences and so on. The most important product-modification strategies are quality improvement through better materials and engineering; feature improvement, aiming at increased user benefits, real or imaginary; and style improvement, aiming at better aesthetic appeal.

Compared to new-product development and product modification, the importance of product elimination is often neglected. For this reason, many marginal or losing products may consume considerable resources that could be employed productively elsewhere; such a situation reduces the profitability of the enterprise and its ability to take the advantage of new opportunities. In order to avoid losses or financial setbacks, the enterprise should have a periodic product-review system, especially for products that yield less than average.

In regard to product planning there are two basic marketing strategies: product differentiation and market segmentation. Product differentiation is a method of control over the demand for a product by advertising or promoting real or imaginary differences between it and those of competitors. It is basically a strategy to establish the market position of a firm and counter-balance existing or potential price competition; in fact, the prices of differentiated products tend to exceed the average level. Market segmentation, on the other hand, is based on considering a heterogeneous market as a number of smaller homogeneous markets in response to differing product preferences among important market segments. Also, market segmentation often relies on substantial use of advertising and sales promotion in order to inform market segments of the availability of products meeting their special needs. Successful marketing generally requires careful application of both product strategies.

Pricing

Pricing is the process of determining the price of a product on the basis of the type of the product, customer demand, costs, competition and the company objectives. In most cases the starting point in developing a price is the character of the product, that is, its physical and market qualities, its production aspects, its degree of differentiation and whether it is new or established. In the case of durable consumer goods, there is normally some leeway for price differentials between competing products. For so-called "shopping goods", this depends largely on the use of brands, special features, styling and the like, whereas specialty goods permit considerable variations in pricing. As noted above, differentiated products may generally command somewhat higher prices. Product differentiation gives the best results when the company's product has a distinctive advantage over the competing ones, but even if this is not the case, differentiation can be developed in other aspects of sale, such as delivery terms, service and credit conditions.

The pricing of a new product depends on whether it is completely new or similar to existing products. In the latter case the price is determined by the price range of the existing substitutes, but in the former situation there are basically two better-known pricing approaches: market-skimming and market penetration. The first of these refers to setting a high price accompanied by considerable promotional expenditures during the early phases of market

development, followed by lower prices during later phases; the other consists of setting a relatively low price in order to stimulate the growth of the market and to capture a large share of it in the early stages.

In practice, there are basically three different pricing policies: cost-oriented, demand-oriented and competition-oriented. In cost-oriented pricing, the enterprise sets its prices largely or wholly on the basis of its costs. The most common methods are mark-up or cost-plus pricing, where the price is determined by adding some fixed percentage to the unit cost, and target pricing, in which the price is determined on the basis of a specified target rate of return on the investment required for the product. Demand-oriented pricing is based on the differences in the intensity of demand, in other words, a high price is charged when or where demand is intense, and a low one when or where demand is weak, even though unit costs may be the same in both cases. A common form of demand-oriented pricing is price discrimination, in which a particular product is sold at two or more prices. Price discrimination may take various forms, depending on whether its basis is the customer, the product version, the place or the time. Competition-oriented pricing is a policy of setting prices chiefly on the basis of what the competitors charge and not on the basis of either costs or demand. The most common type is the so-called going-rate or imitative pricing, where an enterprise tries to keep its price at the average level of the industry. Especially in fairly homogeneous product markets or in cases where there are close substitutes, an enterprise should take the competitive prices as a starting point for its price decisions, and costs should be regarded as setting the lower limits to prices. Even in the case of product differentiation, the presumably higher price must be set in some realistic and feasible relation to the competitive non-differentiated products.

If a firm wishes to change its established price, it must consider carefully its customers' and competitors' possible reactions. The probable reaction of customers can be expressed in terms of price elasticity of demand, whereas competitors' reactions depend very much on the market structure and the degree of product homogeneity. If, on the other hand, a price change is initiated by a competitor, an enterprise must try to understand the competitor's intent and the likely duration of the change. In general, price as a competitive weapon may be rather dangerous to its user unless the firm has a

distinct cost advantage. In many cases, when faced with competition, other marketing techniques, such as product differentiation, advertising, sales promotion, improved distribution and the like, may be more appropriate.

Advertising

Advertising may be defined as any paid form of impersonal presentation and promotion of ideas, goods or services by an identified sponsor through mass media such as newspapers and magazines, radio and television, motion pictures, posters, signs and billboards, direct mail, catalogues, leaflets and so on. The purpose of advertising is to induce potential buyers to respond more favourably to the offering of the enterprise. This is attempted by providing information to customers, by arousing their interest, by trying to influence their desires and buying decisions, and by giving real or emotional reasons to prefer the particular product of an enterprise. These tactics, in turn, usually involve finding various points of advantage to distinguish the product from competitive ones. When successful, such efforts partially protect the product from direct price competition. An important factor in this respect is a brand or trade-mark. By means of advertising and other promotional methods, a company should try to create brand preference and brand loyalty that can refer to the name of the company and not merely to the product.

The most important elements in planning an advertising programme are the size of the advertising budget, selection of media, message design, timing of advertisement and measurement of effectiveness. The size of the advertising budget is commonly determined in many ways: according to what the company can afford, as a regular percentage of the company's sales, to correspond to competitors' expenditures, or by defining the cost of accomplishing specified communication goals, which actually amounts to estimating marginal revenues and costs of specified advertising projects. The selection of media must be based on the following factors: their availability, their geographical range, the media habits of the target audience or population segment, the nature of the product and the cost of different media. The effectiveness of advertising depends largely on the development of good message content and presentation, which are the elements of message design. These aspects are influenced by local characteristics, and they should therefore be preceded by marketing

research covering the buying process and buyer motives, attitudes and behaviour. The timing of advertising should be determined on the basis of the nature of the product, target customers, competition, distribution channels and other marketing factors. As a few examples, when introducing a new product, a company may try to create brand preference by advertising heavily in the initial phase and to a lesser extent later on, or in the case of some special product, instead of repetition, it may be necessary to try to reach most of the people known to be interested, in which case the advertising effort would be fairly evenly distributed over a period of time. One of the most difficult tasks related to advertising is the measurement of its effectiveness. Nevertheless, a continuous effort should be made to evaluate the likely communication effect, that is, the effect of advertising on buyers' knowledge, feelings and decisions, and the likely sales effect; in other words, the effect of individual advertisements on sales.

Sales promotion

Sales promotion consists of those marketing activities, other than personal selling, advertising and publicity, that stimulate consumer purchasing and dealer effectiveness. Some of the most common techniques are displays, shows and exhibitions, demonstrations, samples, premiums, contents, manuals and other promotional literature and special customer service. In contrast to advertising, sales promotion involves non-repetitive, one-time communications efforts, and it is mostly accomplished by bringing the selling message to the actual point of sale. Sales promotion is basically a direct method of influencing the customers and can therefore stimulate demand more quickly than can advertising. Furthermore, it can be applied more easily to particular market segments or areas.

The satisfactory selection of various methods of sales promotion requires continuous study of the market and the competitive situation. As there are no fixed rules, the company should experiment with different methods and use them in various combinations. The extent to which sales promotion is necessary depends on the company's other promotional efforts, advertising, personal selling and publicity. By its nature, sales promotion is a fairly close substitute for advertising, and therefore any factors that restrict the use of advertising normally increase the relative importance of sales promotion.

As stated above in the definition, sales promotion also refers to stimulating dealer effectiveness. This can also be achieved partly by applying some of the aforementioned general techniques to the dealers but also through financial inducements, such as allowances and extensions of credit, training and consultation, good co-operation and personal relationships, and so on.

Distribution

Distribution is the marketing activity that covers all aspects of the movement and flow of goods and services from the producer to the consumer or user. By the same token, a channel of distribution is the set of marketing intermediaries, agents and wholesale and retail dealers through which the goods and services are marketed.

A manufacturer can develop his own marketing channels by owning and operating the intermediate and retail facilities, by selecting firms already operating in the distributive structure, or by using a combination of both of these methods. The selection of a marketing channel or a combination of them depends mainly on the following factors: customer characteristics (their number, geographical distribution, purchasing patterns and susceptibility to different selling methods), the nature of the product (bulk, degree of standardization, service requirements and unit value), the characteristics of intermediaries (the strengths and weaknesses of different types of middlemen in handling various tasks), the structure of channels used by competitors (either as a target or as an example to be avoided) and the characteristics of the enterprise itself (its size, financial strength, product line, past channel experience and over-all marketing policies).

The basic options of distribution channels available to a manufacturer are shown in figure I, in which option A is the case of direct selling, which can be done through the manufacturer's own retail outlets, door-to-door salesmen or through direct contacts to large customers, such as government, institutions and the like. Option B is common when a producer can sell in quantity to such retailers as department stores, chain stores or mail-order houses. Option C is a channel typically followed by manufacturers of mass consumption goods, and option D is an example of a channel where the service of a middleman, such as a sales agent, is used for the initial dispersion of goods.

In practice, however, the selection of alternative channels is more complicated. In fact, a manufacturer often uses different channels, at different times, for different products, in different markets. The problem of selecting the most satisfactory channel of distribution for a product is complex, and each situation must be analysed individually. After examining in detail the major feasible channel alternatives, each of them must be evaluated according to economic, control and adaptive criteria, of which the first refers to sales, costs and profits, the second to possible sources of channel conflict, and the third to the firm's flexibility with regard to new competitive and distributive challenges. After determining its basic channel structure, the enterprise must find or select intermediaries with which to work. It must also motivate channel members by special incentives and supervision in addition to normal trade relations. Furthermore, it must periodically evaluate the performance of individual intermediaries against their own past sales, other intermediaries' sales, and possibly, sales quotas.

In addition to effective channels, a very important role in distribution is played by physical distribution, which covers the actual movement of the goods. The functions involved in physical distribution include transportation, warehousing, order handling and inventory control, which can be an efficient instrument in the demand-stimulation process. A company may be able to promote sales by offering more than competitors by means of service or by cutting prices through reduced physical distribution costs. Since physical distribution activities are highly interrelated, the choice of the appropriate system must be preceded by the analysis of the total distribution costs associated with different proposed systems. The optimal physical distribution strategy must therefore minimize the cost but also provide a given level of customer service.

Although the managerial functions of marketing include the administration of marketing programmes and control of marketing management, let this enumeration of marketing activities be ended by a brief consideration of the other two major promotional elements in marketing that have not been included in the aforementioned conceptual framework, namely, personal selling and publicity.

Personal selling

This can be defined as oral presentation in conversation with one or more prospective purchasers for the purpose of making sales. Basically, the selling process consists of making the customer aware of the product, developing customer comprehension of the offer, convincing the customer that the product can satisfy his needs, and persuading the customer to make the actual purchase.

Because salesmen may be very important in the creation of sales and are capable of performing different activities, the company should decide exactly what it is trying to accomplish through direct selling. From the strategic point of view, the company must determine the size and the organization of its sales force, which is in practice often done on the basis of the estimated territorial productivity or feasible work-load of salesmen, and the carefully planned organizational lines by territories, products or customers. The managerial tasks of personal selling are the recruiting and selecting of salesmen, their training, motivation and stimulation, supervision, monetary compensation and periodic evaluation of their performance.

Publicity

Publicity can be defined as impersonal stimulation of demand for a product or service by securing favourable information in communications media about the company or product as part of news or entertainment content and without payment by the sponsor. In practice, publicity may take the form of news releases, published articles, general booklets, pamphlets and so on. The significance of publicity comes from the fact that people tend to be relatively more influenced by a news item or other official-looking information than by direct advertising. For this reason publicity is used to some extent by many companies to supplement their advertising and selling efforts.

Management in marketing

Principles

The first and most vital principle of marketing management is customer or market orientation, or in other words, the fact that the customer is the key to the firm's survival and growth. Secondly, there must be a total company philosophy, real commitment and active attitude towards marketing.

Thirdly, the marketing function must be integrated, that is, all decisions of the enterprise, including those concerning organization, production, communications, finance and distribution, must take into account all marketing elements and all factors influencing the marketing effort. Finally, the marketing effort must be planned and evaluated continuously.

The main tasks of marketing management consist of assessing marketing opportunities, planning and programming marketing efforts, organizing marketing activity and controlling marketing effort, which is dealt with below.

Assessing marketing opportunity

This function involves identifying the company's mission and goals and analysing profit potentials in order to determine the markets where the company may try to achieve its objectives. In practice, it is essentially a problem of identifying the existing and potential customers. The process of assessing marketing opportunity should be continuous so as to facilitate dynamic marketing and production operations, identification of new challenges and problems facing the company and taking advantage of changing market opportunities.

The assessment of marketing opportunity, which should be the determining factor in company activities, must be based on the analysis of the firm's present market position, resources, characteristics and capabilities.

Planning and programming marketing effort

The planning of marketing calls for the establishment of objectives, the formulation of strategies and the development of concrete programmes, and must basically consist of the anticipation of possible problems and the consideration of alternative solutions to them.

The main components of the marketing planning process can be classified under four consecutive phases. In the first, the situation analysis and identification of problems and opportunities, covers the firm's actual business, product lines, markets, organization, channels of distribution, competition, technological change and profits. The second phase, the determination of specific goals or objectives, concentrates on the firm's desired business, product and marketing mix, market share and profits or return on investment. The third, the development of marketing strategies, refers to the generation of many different types of strategies, on one hand, and to the selection of more promising ones on the other. A marketing strategy is composed of two

parts: definition of market targets, including the types of customers the firm wants to reach, and the composition of a marketing mix that is the combination of manpower and other resources and inputs needed in marketing programmes to fulfil objectives and plans, in other words, such elements as product planning, pricing, branding, advertising, sales promotion, personal selling, physical handling, channels of distribution and servicing. The last phase in the marketing planning process is the evaluation and adjustment of plans, which calls for the establishment of objective performance standards, which in turn determine the necessary control activities and the need for any adjustments.

The programming of marketing effort consists of two major functions, the development of operational action schedules for each element in the plan and the establishment of the necessary functional procedures. It should be noted in this connexion that marketing planning and programming, if carried out in detail, will also provide a built-in control device.

Organizing for marketing activity

In principle, the framework for organization and planning is provided by the goals and objectives of the enterprise. Traditionally, organization was dominated by production or financial orientations, as shown in figure II.

As the marketing concept developed, sales were gradually removed from the jurisdiction of the production manager and raised to approximately the same level. In order to avoid conflicts that tend to occur between the logic of customer satisfaction and that of cost minimization in such a case, marketing-minded companies have applied the modern marketing concept by centralizing the responsibility for the total marketing task under one executive who establishes, co-ordinates and integrates all factors necessary to achieve marketing goals, as indicated in figure III.

Although there are differing opinions, from a market-oriented company's point of view, it is obvious that the marketing executive must be at a high level in the organization so that he can participate in all areas of business policy related to the marketing objectives of the firm.

Figure I. Distribution channels available to a manufacturer

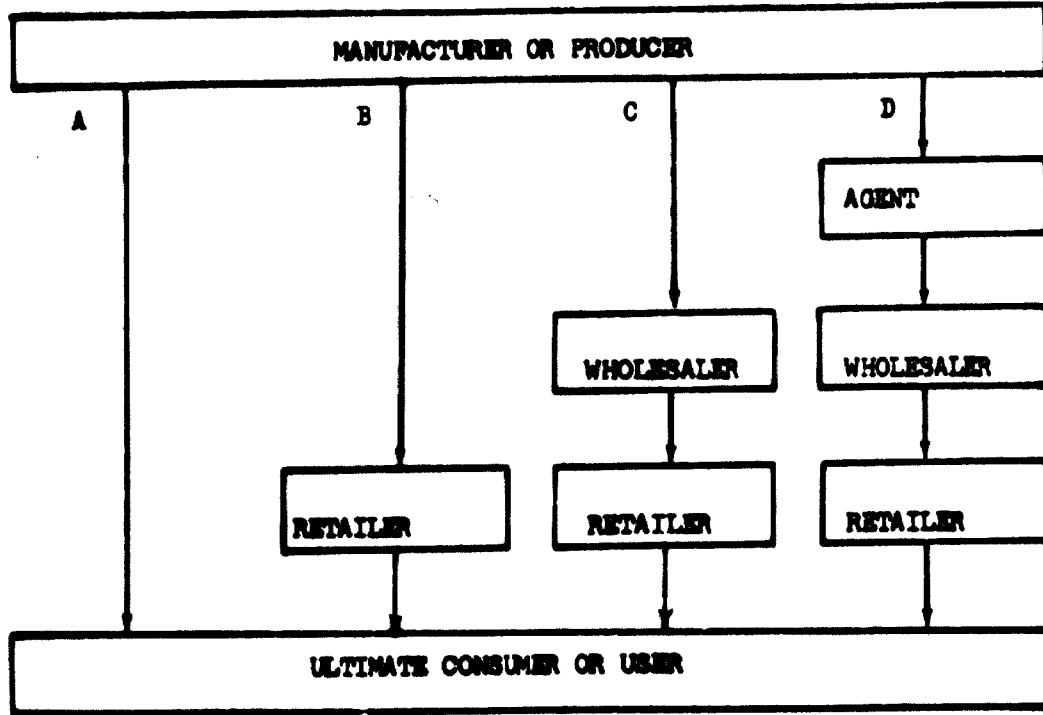


Figure II. Model of traditional organisation of a manufacturing company

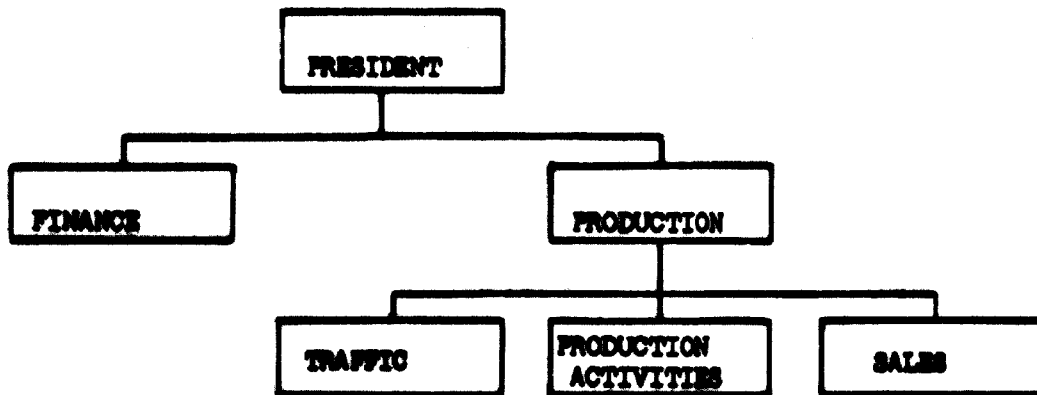
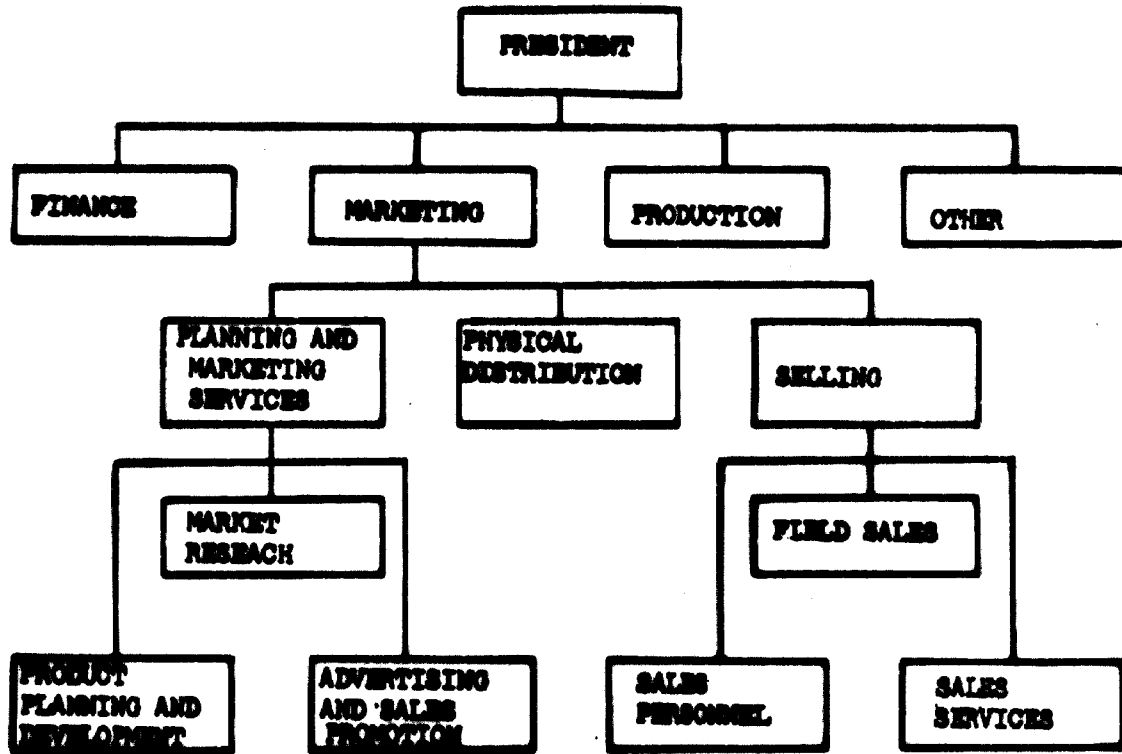


Figure III. Model of the organisation of a marketing-oriented company



Controlling the marketing effort

In practice, an enterprise can apply many different types of controls in order to keep marketing effort keyed to areas of profitable opportunity. Their basic forms are managerial controls, financial and cost controls and leadership controls, of which the first is based on clear-cut plans or standards of performance and operational procedures and policies established by the management. Financial and cost controls in marketing often consist of distribution cost accounting and cost analysis by function and product, whereas the most commonly used methods of forecasts and quotas essentially involve both managerial and fiscal control. Leadership control, through which the two other controls are integrated, is exercised through the organization and motivation of individuals and groups. The objective of this type of control is to motivate the individuals to achieve and exceed pre-determined organizational and individual goals.

All effective control systems must include four common elements, of which the first consists of the definition of goals and standards, which should be understood and accepted by the persons involved and stated numerically if possible and feasible. The establishment of numerical standards usually implies a range of tolerable deviations. The second element consists of the development of a programme for achieving these goals, which is a detailed plan on how available resources should be used over a specified period. The third element consists of the measurement of actual results; the actual performance should be checked against desired performance on the basis of various types of information, both external and internal and, depending on the specific circumstances, the comparisons may be made either continuously, as through daily field reports, or intermittently, as through quarterly reports. The fourth element in a control system consists of making adjustments in the goals, programmes or both, if the goals are not being achieved.

Fundamentals of export trade

At the level of the national economy, there are many basic reasons for export trade; some typical examples are abundance of natural resources, the necessity of paying for imports, balance of payments problems, national

welfare and profits from exports. From the viewpoint of the individual enterprise, however, considerations regarding the export trade are essentially different and are enumerated hereunder.

Advantages of export trade

For a new or potential exporter, the advantages may be direct or indirect. In the former case, they consist in the creation of a larger market, increased and even mass production, specialization and concentration in production, more rapid inventory turnover and more sales revenue, better chances for balancing seasonal differentials, and possibilities for limiting risks caused by changes in local demand. There may well be indirect advantages. For example, increased exports may bring about changes in the technical and managerial structure of the enterprise through competition, contacts and so on; an active export company must follow technical development and tendencies in foreign countries that will make it more competitive domestically. Also, export trade often tends to improve co-operation among domestic companies in the form of rationalization, specialization and the like. Importantly, also, a well-known and successful exporter has a better image in the home market and may gain better access to more long-term credits, both domestic and foreign.

Study of export potential

The first step in studying export potential is to determine the position of the enterprise in the home market, the general trends within the industry and the present exports, if any. The position of the enterprise must be analysed, based on such factors as its existing market share, trends of development, and financial position and availability of adequate financial resources. The second step is the study of production, that is, of the suitability of products for export, possible patents or other protections, production capacity and planning capacity for technical modifications.

The next factor is pricing. In general, the price of a product is fixed by the price level of the existing competitors or substitutes, and the cost price must be calculated for comparison with this figure. In export pricing, however, there are some special features that should be taken into account. In the case of export products, the domestic sales tax is normally deductible as well as taxes and duties paid on imported raw materials and

accessories. All domestic selling expenses should also be deducted from export prices. In practice, one of the most common methods of determining the lowest acceptable export price is the so-called break-even analysis, in which the price must cover at least all variable costs and then, if possible, make some unit contribution to fixed costs. Important factors in export trade are the specific costs caused by exporting, which may consist of such necessities as market research, advertising, product modification, better packaging, staff travel and so on. These costs often cannot be assigned to any particular sale and should therefore be spread over a period of time.

The last step in studying export potential is to determine the range and scope of the different tools of marketing available to the company. Basically, they are the same as those considered above in the discussion of marketing activities, but in export trade they must be adjusted to local conditions in foreign countries, which will increase costs substantially. Also, the competition is most likely to be keener, and for these reasons the potential exporter should co-operate closely with domestic or foreign representatives and preferably with other exporters. When planning to export, a firm must bear in mind that export trade is a long-term activity, that will take years to learn, and that profits will often not be made immediately. On the other hand, the exporter is required to comply with agreements and commitments in every detail and to have knowledge of export trade, terms and procedures.

The export process

Occasionally a firm may receive inquiries from foreign representatives or importers leading to actual sales later on. More often, however, the export process must be initiated by action of the potential exporter. One way to do this is to carry out market research, which also clarifies available distribution channels and their costs. Such studies are, however, often very costly, and the findings may be speculative and useful for but a short period, so that this activity can normally be engaged in only by larger enterprises. Another way of gaining a foothold in foreign markets is to take part in trade fairs and exhibitions, which can serve both as a means of establishing contacts and as actual selling situations. Even this type of participation is rather costly and can best be accomplished through co-operation among many smaller firms.

From the point of view of a small enterprise, the best way of initiating the export process may be to get in touch with either importers or their intermediaries, directly by letter or through their sales representative. The choice of the appropriate channels will depend on the specific circumstances, such as the type of the product, the size of the enterprise, local (foreign) purchasing habits and the price of the product.

The channels of distribution in export trade can basically be divided into two groups; those in the home country and those abroad. In the former case the principal intermediaries are export agents and export firms, although occasionally some of their tasks are also handled by wholesalers and department stores. The main difference between an export agent and export firm is that the former sells for and on the account of the manufacturer, while the latter buys the product and sells it on its own account and also assumes all of the risks.

In foreign countries, the distribution channels consist typically of export agents (normally located in third countries), import agents, import firms, wholesale firms, department stores, retail stores and brokers, which are generally sales organizations. Sometimes it may be possible to sell directly to industries and institutions, occasionally even through a local manufacturer if the products complement each other. Owing to the high costs involved, the establishment of a sales organization is usually realistic only for large enterprises with very profitable products or many small companies working in close co-operation.

In the field of export trade there are often many types of supporting activities at different levels that are of vital importance for relatively small exporters. If governmental export organizations or even financial support exist, then these should be utilized. On the other hand, there may be foreign trade associations and industrial federations that can furnish valuable information or support. The export activities may, to some extent, be promoted through chambers of commerce and local banks that carry on international operations and through the official commercial representatives and trade attachés of the foreign countries. Unfortunately, these institutions may be limited in number.

There are, however some important possibilities that can be utilized by individual exporters, and these are export and sales associations and export groups and pools, which are based on voluntary co-operation. Such associations may be formed either to cover a product range or a region, and their main activity is often concentrated on promotional aspects, such as establishing business connexions and arranging exhibitions and joint advertising, but they can also engage in market research and even selling. Export groups and pools, on the other hand are based on smaller groups in which small manufacturers of different but supplementary products obtain marketing information as a joint effort, using the same channels of distribution and hiring joint personnel. In the light of the prevailing keen competition in the international markets, some forms of co-operation between small enterprises are necessary for increased exports, or even for any exports at all.

Essential information

The basic export trade information of any exporter should consist of a reasonably thorough knowledge of terms of delivery and terms of payment. If an export agent or firm is being used, normally the company does not have to apply these terms in practice. In other cases, however, it must be familiar with delivery clauses, such as f.a.s., f.o.b. and c.i.f. and with their effects on pricing and actual export measures, and with methods of payment, which include letter of credit, documents against cash or acceptance, and prepayment. Even though the exporter does not handle these functions, it would be useful for him to have some idea of foreign currency controls and rates of exchange as well as of various shipping documents, such as bills of lading, insurance certificates, commercial invoices, consular invoices and certificates of origin.

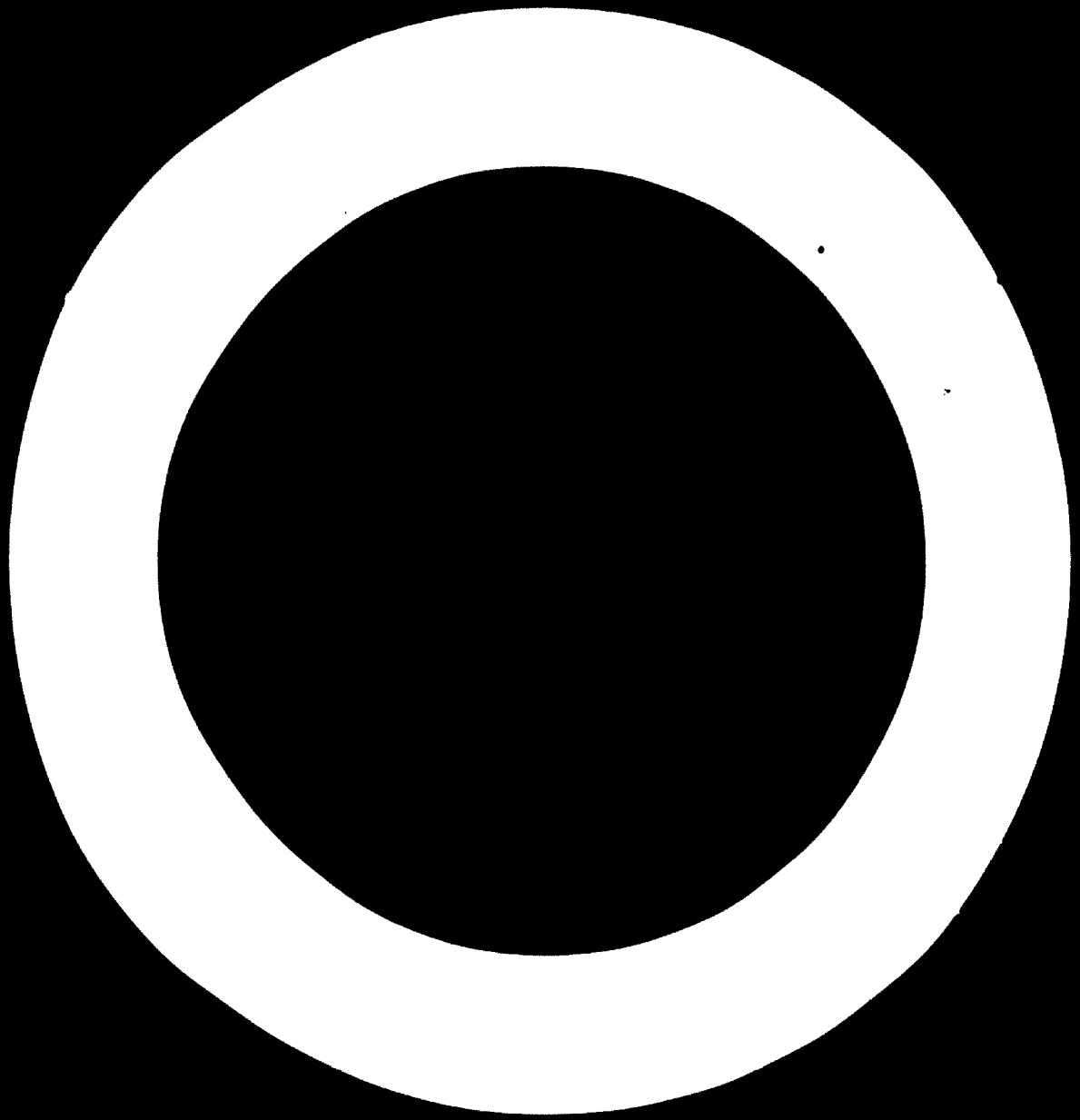
One task of increasing significance in the export trade is to obtain credit information before selecting a partner in a foreign country. This information is normally provided by local banks that carry on international operations. An exporter should also become familiar with the existing foreign trade agreements with the countries to which he envisages exporting, as well as with potential regulations concerning patents and trade-mark registrations. Last but not least, an exporter should know how to find business contacts

abroad. One possibility of doing this is through the supporting organisations mentioned above, but there are also many other sources of this type of information, such as special international publications and reference books for different lines of business, foreign trade directions and local professional journals.

Finally, it should be emphasized that export trade is a very difficult and demanding activity and one that must be based on effective domestic operations. On the other hand, once a firm is in a position to being exporting, it may, in the long run, find it very interesting, challenging and profitable.

Bibliography

- Alderson, Wroe. Marketing behavior and executive action. Homewood, Ill., Richard D. Irwin, Inc., 1957.
- Bowman, E. H. and R. B. Fetter. Analysis for production management. Homewood, Ill., Richard D. Irwin, Inc., 1957.
- Boyd, Harper W. and Ralph Westfall. Marketing research. Homewood, Ill., Richard D. Irwin, Inc., 1964.
- Export and import procedures. New York, Morgan Guaranty Trust Company, 1968.
- Fayerweather, John. International marketing. Englewood Cliffs, New Jersey, Prentice-Hall, 1965.
- Gatz, Werner. Export promotion for developing countries. Bremen, Bremen Economic Research Institute, 1969.
- Getting started in export trade. Geneva, International Trade Centre UNCTAD/GATT, 1970.
- Hess, John M. and Philip R. Cateora. International marketing. Homewood, Ill., Richard D. Irwin, Inc., 1966.
- Holloway, Robert J. and Robert S. Hancock. Marketing in a changing environment. New York, John Wiley and Sons, Inc., 1968.
- International Labour Organisation. Creating a market. Geneva, International Labour Organisation, 1969.
- Kelley, Eugene J., Marketing: strategy and functions. Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1965.
- Kotler, Philip. Marketing management. Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1967.
- Laso, Hector and Arnold Corbin. Management in marketing. New York, McGraw-Hill, 1961.
- Stanton, William J. Fundamentals of marketing. New York, McGraw-Hill, 1964.
- Stern, Mark E. Marketing planning. New York, McGraw-Hill, 1966.



26. SAFETY AT WORK AND OCCUPATIONAL HAZARDS*

Safety promotion at industrial plants

In industry, occupational hazards are of two kinds: accidents and occupational diseases. An occupational accident is an injury that has occurred at work within a relatively short time; occupational diseases are illnesses caused by physical or chemical factors of occupational origin, such as noise, dust or chemicals. Among the consequences of accidents and occupational diseases are:

Death

Temporary or permanent, partial or complete, loss of working ability of the injured person

Suffering and economic losses to the injured person and his family

Direct and indirect impairment of the operation of the enterprise

In most countries the employer is legally bound to maintain certain minimum conditions so as to prevent accidents and occupational diseases. A well-managed enterprise will not only fulfil these minimum requirements but will also try, by all available means, to make working conditions as safe as possible. Such voluntary accident prevention is becoming increasingly common as ever more industries come to understand that the prevention of accidents is not only economically profitable but a moral obligation of the employer. It is thus usual to speak of three motives of voluntary safety promotion, namely, moral, legal and economic.

The degree of safety at work depends not only on management but also on supervisors at all levels and on the workers themselves. While an industrial enterprise with a small staff does not need a special safety organization, every foreman must, in addition to his other duties, concern himself with safety at work. Furthermore, wide co-operation is a condition of effective safety promotion. It is of particular importance that the workers take part in this operation. The establishment of safety committees that include representatives of management, supervisors and workers can make such co-operation

*Paper presented to the seminar by Kai Lindberg, Institute of Occupational Health Accident Prevention Department, Helsinki, Finland. (Originally issued as document ID/WG.133/26.)

systematic. The tasks of such a safety committee would be to receive and transmit information about safety matters and to issue pertinent statements. The safety committee should have no executive power, nor should it be given the responsibility for safety at work. Such committees have proved useful in industrial plants of all sizes.

The internal safety activities of an industrial establishment must cover a large field of operations. Only some of the most important of these functions can be dealt with here; they are (a) statistics and internal accident reports, (b) safety inspections and (c) training and safety propaganda.

Reports and statistics

The internal accident report, which the foreman makes after each accident, serves three purposes: it forces him to be aware of every accident that occurs within his jurisdiction, ensures that the management of the department and the factory is informed about all accidents and provides a reliable basis for statistics on accidents. These statistics are an important guide to the necessary safety measures, and they show trends in the frequency and severity of accidents.

Inspections

In addition to the safety inspections of the governmental authorities, insurance companies and other external agencies, every industrial establishment should organize its own internal inspection programme, directed toward eliminating occupational hazards. A written report of every inspection should be submitted to management.

Training and propaganda

There is a wide variety of methods of conducting an efficient safety training programme and promoting safety consciousness; among them are safety meetings, exhibitions, films and rescue displays. These activities are often concentrated into safety campaigns or safety weeks. Safety competitions have also proved helpful in promoting interest in accident prevention. Safety posters and pamphlets are commonly used even in the smallest workshops to provide information on safe working methods or merely to promote safety consciousness.

Prevention of occupational hazards in the furniture
and joinery industries

In Finland, accident frequency (per million working hours) in various occupational groups is highest in stevedoring (205.0), followed by construction work (109.4), mechanical workshops (102.0), sawmills (95.8), underground work in mines (94.1) and joinery with machines (89.6); accident frequency in joinery without machines is much lower (58.8). It thus seems justifiable to suggest that the joinery industries show more interest in accident prevention and especially in providing safer working conditions.

It is the considered opinion of the writer that the guarding of machines and the competence of their operators are the most important factors in the curtailment of major hazards in the joinery industries, but the prevention of hazards caused by dust, paint and lacquer must also be given due attention.

Machines

When assessing the hazards presented by machines and the technical safety measures needed to minimize them, consideration must be given to the differences in prudence, professional skill, intelligence, training and attentiveness among the people working at a given machine or in its vicinity. Shortcomings in these qualities are conducive to accidents, which are often attributed to the so-called human factor. Nevertheless, many accidents are attributable to the dangerous characteristics of the machines.

Technical safety devices for machines are intended to minimize human error (it can never be avoided completely) leading to accidents. Consequently, the design, construction and installation of every machine (and every part of a machine) must be such as to permit working at or near it with minimal risk of accident and disease. The less skilled the workers, the more important this requirement will be. In small plants in which the workers vary widely in training and professional skill, the machines must be especially safe.

As already noted, woodworking machinery is inherently dangerous; it should be operated only by skilled and experienced workers. In Finland, persons under the age of 18 years are not permitted to operate it.

In the accompanying table, accidents in the joinery industries are classified according to their causes. These data reveal that, on the average, each

worker is absent from work 2.7 workdays a year because of an industrial accident. Of these 2.7 lost days, 1.1 are attributable to circular saws, planers and spindle moulders; 0.4 days to other woodworking machines and 1.2 days to other reasons. It is apparent that special attention must be paid to woodworking machines of these three kinds.

Accidents and their consequences in the
Finnish woodworking industry

Causes of accident	Accidents		Days lost		Number of cases with permanent partial disability	Number of days lost per accident
	Num-ber	Per-centage	Num-ber	Per-centage		
Circular saws	121	15.0	2,316	14.3	3	19.2
Planers	103	12.8	2,252	13.8	3	21.8
Spindle moulders	64	8.0	2,044	12.6	4	32.0
Total	288	35.8	6,612	40.7	10	23.0
Other woodworking machines	126	15.7	2,276	14.0	2	18.1
Total: all wood-working machines	414	51.5	8,888	54.7	12	21.4
Others	390	48.5	7,400	45.3	8	19.0
Total: all accidents	804	100	16,288	100	20	20.2

Source: Keskinäinen yhtiön Teollisuusvakuutus (Industrial Mutual Insurance Company), Helsinki, Finland.

General. In all woodworking machines, the power transmissions must be completely protected, and each machine must have its own safety switch, which cuts off the current when the voltage drops sharply. This switch must be constructed so that the machine does not start again when the power supply is restored. Most woodworking machines must also be equipped with a brake to stop the blade or other moving parts quickly when the power is cut off.

Circular saws. Accidents caused by circular saws are of two kinds according to the ways in which they happen; touching the saw-blade and kick-backs. In most cases accidents of both types can be prevented by technical measures, although correct working methods are also important.

Accidents caused by touching the saw blade most often occur when the sawyer's hand slips into the blade, either when he holds his hands too close to it while sawing or when he removes waste from the side of the blade or from beneath it; he can also fall on the blade if he trips or stumbles near it. These kinds of accidents can usually be prevented by guarding the blade both above and below the sawing level. The part of the blade below the sawing level can usually be guarded with no inconvenience. The under-guard is usually a fixed enclosure, but it should be constructed so that it can be easily removed, either partly or entirely, when changing the blade. The upper side of the guard should preferably be hinged so that the blade can be changed without removing the whole enclosure (figure I and figure II).

Kick-backs are a constant danger in the use of circular saws. They may cause serious accidents, so attention must be taken to prevent them. They are caused by internal tensions released from the wood during sawing, so that the kerf pinches the turning blade, causing the material to rise to the top of the saw-blade and be flung backwards with great force. This happens so quickly that the sawyer has no time to parry the kick-back. (The same thing happens if a board falls on the blade.) To prevent such accidents, every saw that is used for rip sawing should be equipped with a spreader or at least with double anti-kick-back fingers. A substantial upper guard that is placed low enough is also effective.

Spreader must be made of steel, be just thick enough to fill up the kerf and wide enough to be stable. The shape of the leading edge of the spreader knife should follow the shape of the saw-blade. The spreader knife should be easily adjustable both vertically and horizontally so that the distance between the knife and the blade will be no more than 3 mm and so that it will extend vertically no more than 5 mm under the top of the biggest blade (figure III).

A rip saw should have an upper guard to prevent touching of the blade, the falling of boards onto it and also kick-backs. The upper teeth of the blade must be inside the guard during sawing. The guard must be longer than the diameter of the biggest blade.

In small rip saws that have no feed rolls, the upper guard and the spreader together must cover the whole upper and rear part of the blade. The upper guard must be easily adjustable according to the height of the object

Figure I. Guards of a rip saw with feed rolls

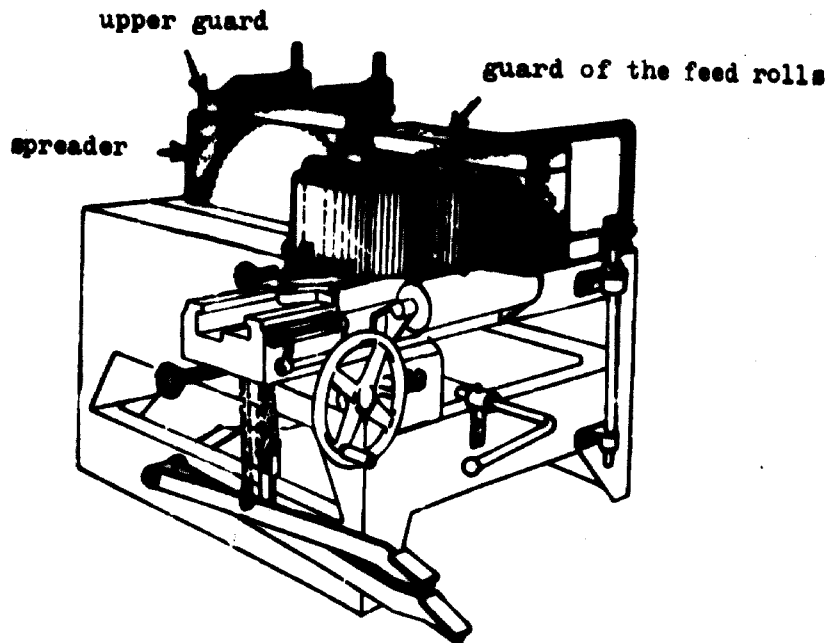


Figure II. Guards of a small rip saw

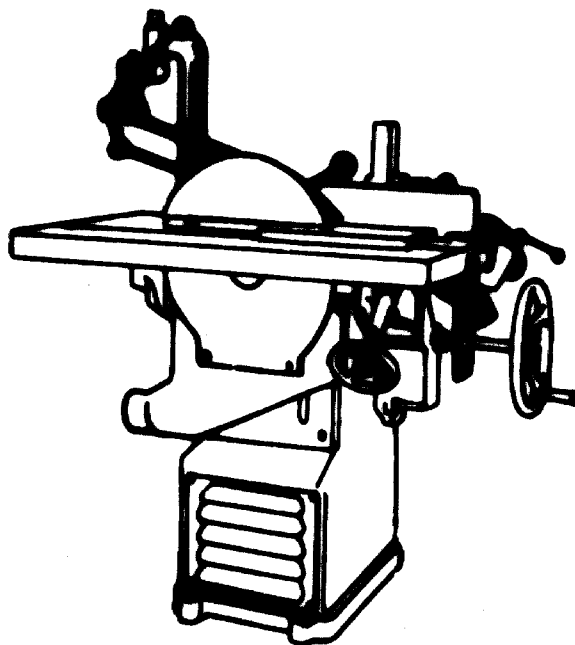
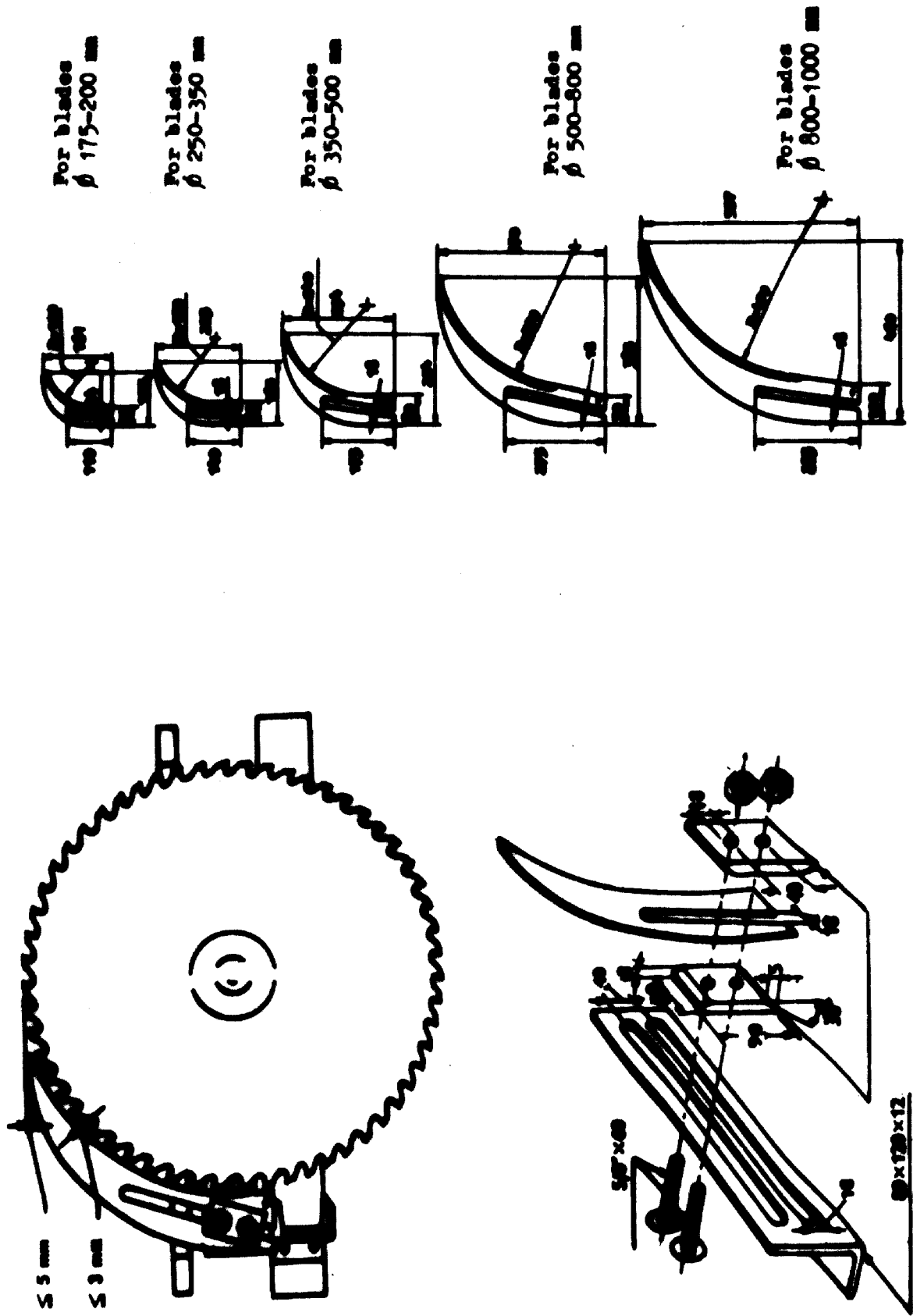


Figure III. Spreaders for rip saws of various sizes



worked on or it must follow the object during the sawing (figure II and figure IV). If the saw is equipped with feed rolls, they must be guarded from the front, sides and top. There must be a safety bar in front of the rolls with which they can be stopped (figure I).

The blade of a balanced cross-cut saw cutting from underneath must not be one that can be lifted with the foot. The handle for lifting the blade should be situated so that the sawyer need not stand in front of the blade where his hand can touch it. In its lowest position the blade must be completely covered with a closed encasement. The balanced cross-cut saw lifted from underneath should be so balanced that, when the operator releases the handle, the blade will drop inside the protective encasement without bouncing.

A cross-cut saw that cuts from above must have a guard that encloses the upper part of the blade. Attached to the front of this guard there must be an additional one that rises and falls by itself according to the thickness of the board to be cut (figure V).

Band saws. Saws of this kind can be considered safer than circular saws because they present no danger of kick-back. The most important risks when using them are: touching the blade or power transmissions with the hand or some other part of the body and dangers caused by the breaking of the band blade. All moving parts of a band saw should be completely guarded. Disc wheels are usually considered safer than spoke wheels, since spokes can easily cause accidents when pieces of wood or clothing get caught in them. Whichever type of wheel is used, it should be completely enclosed so that the protective casing will also prevent a broken saw-blade from causing any accidents (figure VI).

The blade should be completely covered except at the actual cutting point. The return side of the blade must be completely encased over its entire length. On the sawing side, the blade must be guarded from the upper wheel to the blade-guide with a guard that covers at least the front and outer sides of the blade. This guard should be adjustable so that, regardless of the height of the blade-guide, the guard will always cover all of the distance between the wheel and the blade-guide. The guard can be attached to the saw guide so that it automatically follows the guide.

Planers. Accidents occurring during planing are usually caused by a knot or some other hard spot in the wood that prevents the work-piece from

Figure IV. A Swiss-made (SUVA) upper guard for a small
rip saw. This device can be locked into the desired
position

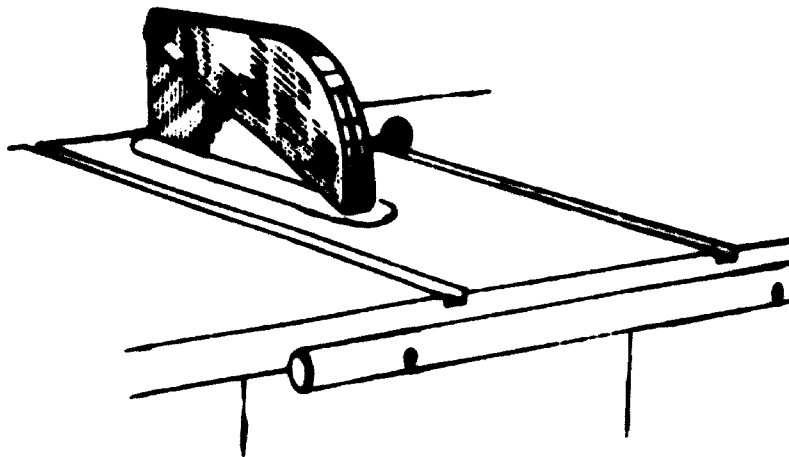


Figure 7. Three types of upper guards for overhead saws

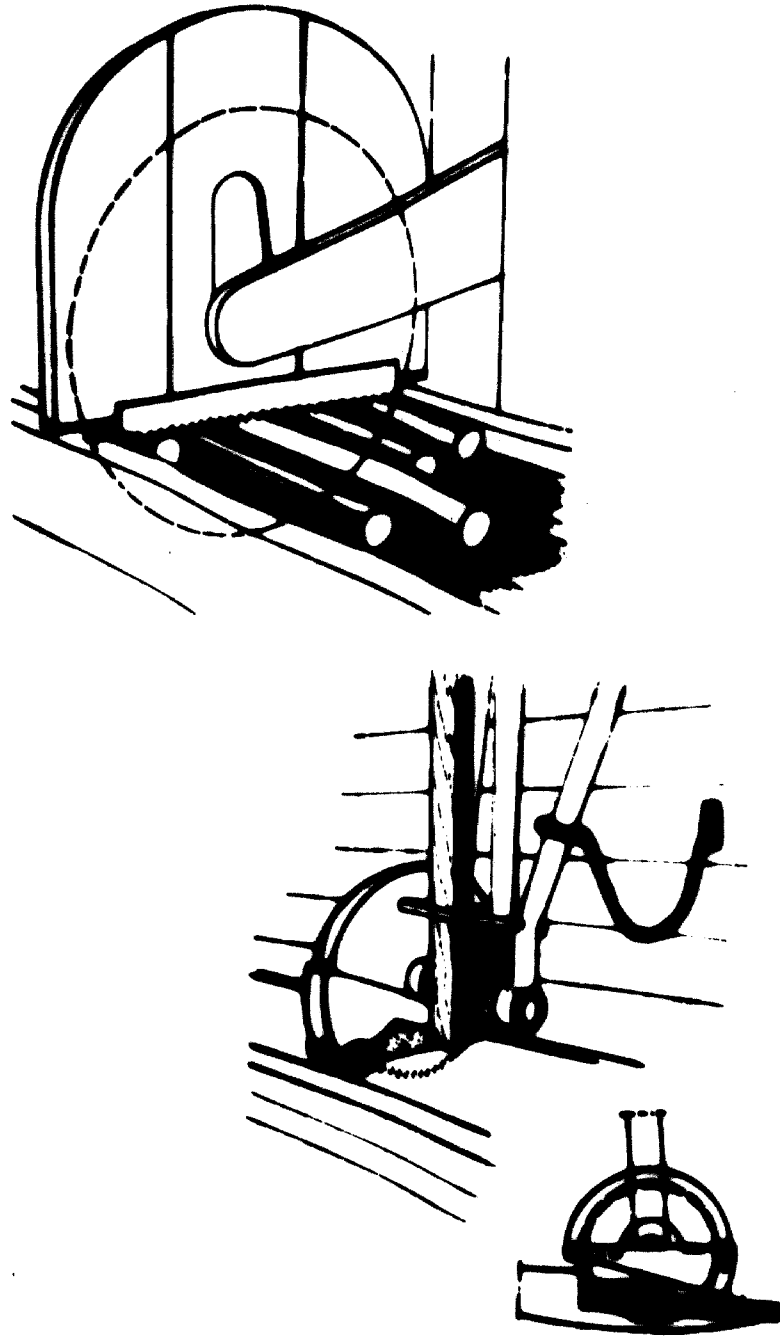
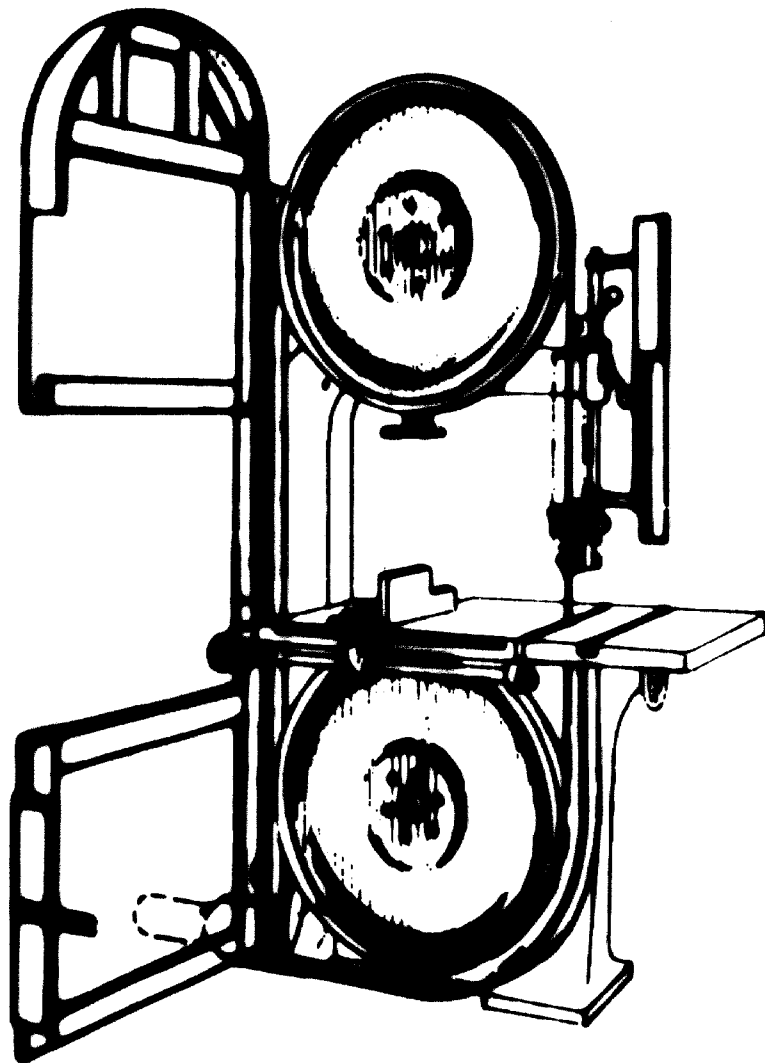


FIGURE VI. Guards for a hand-saw



moving on smoothly. When resistance increases too rapidly, the operator cannot react quickly enough but his hand gives way, causing the work-piece to bounce back and his hand to slip to the cutter. Accidents are also caused by incorrect holding of the work-piece. If the operator's grip is weak or unsteady, the slightest shock will be sufficient to cause his hand to slip to the cutter. Also, if the operator's hands are placed so that they almost touch the surface of the table, this will naturally lead to the cutting off of his fingertips as soon as they reach the cutter.

For safety, it is important that planers be fitted with rounded cutters with shavings-crushing gullets as narrow as possible (figure VII). It should also have an easy-to-use cutter guard. For safety, the best kind of guard conceals the cutter slit also when in use, with the hand gliding over the guard during the planing process. This prevents fingers from slipping to the cutter as a result of a kick-back, as well as accidents caused by incorrect placement of the fingers on the work-piece. Figure VIII shows a good example of this type of safety guard.

Not as effective as those described above, but still good and perhaps easier to use are so-called boomerang guards. In these, the guard always conceals the cutter slit except at the moment of planing when the work-piece pushes the guard aside. Even then, only a part of the cutter, no bigger than the width of the piece to be planed, remains uncovered. The guard is pressed against the guide by a counterweight or spring. Furthermore, planers must always be fitted with a brake that limits the rotating time to 10 to 20 seconds after the power is switched off and also with a back guard that covers the part of the cutter behind the guide.

The mechanical feeding device has proved to be by far the best guard in use in planers as well as other woodworking machines. It gives complete protection to the cutter and has no characteristics that impede work.

Spindle moulders. These are the most dangerous machines in joinery. Accidents with them are usually caused either by a kick-back or by slippage of the fingers of the operator. Because these machines are used in many different ways, it is impossible to devise a general-purpose guard; consequently, a separate protective device must be designed for each use. Figures IX and X show an example of a Swiss-made guard that is practical and versatile

Figure VII. A rounded cutter, with knives. The dimensions A, B and C should be as small as possible. While they should not exceed 10.3 mm, 3 mm and 4 mm, respectively, the absolute maxima are 13 mm, 4 mm and 6 mm.

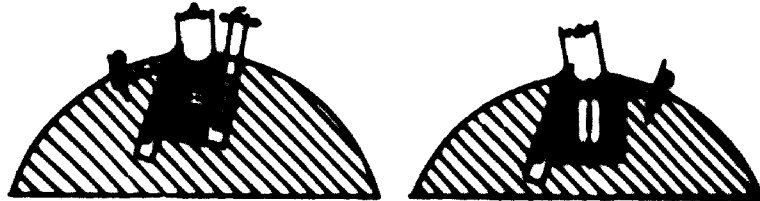
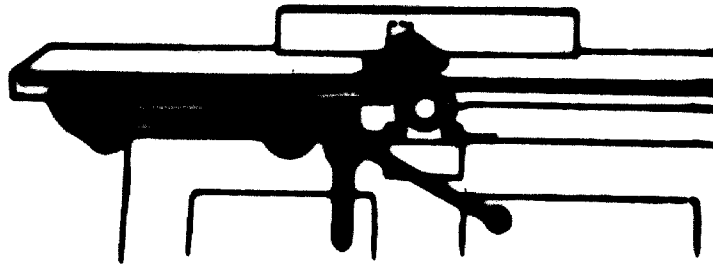


Figure VIII. A Swiss-made guard for a planer

(a) Working end



(b) Guard for the rear portion of the cutter

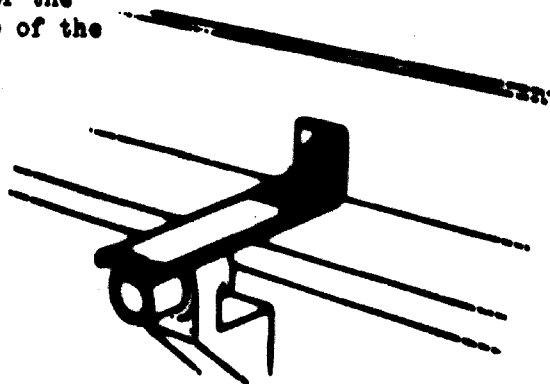


Figure II. A Swiss-made guard and exhaust hood for a spindle moulder

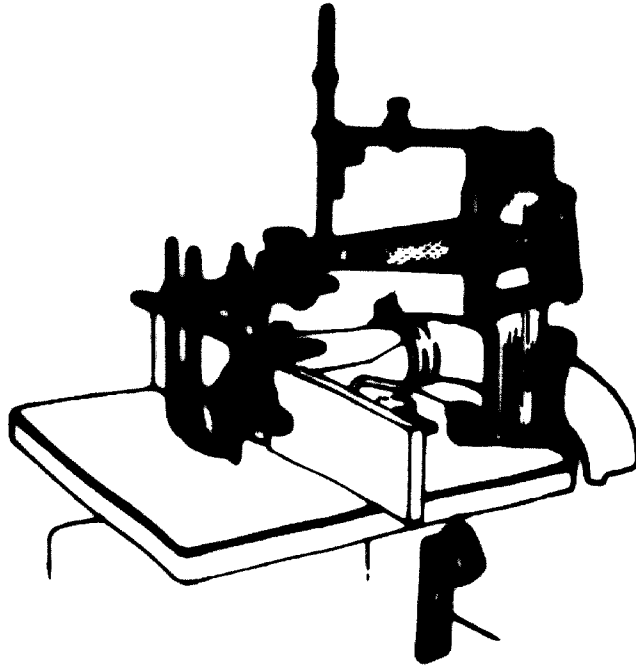
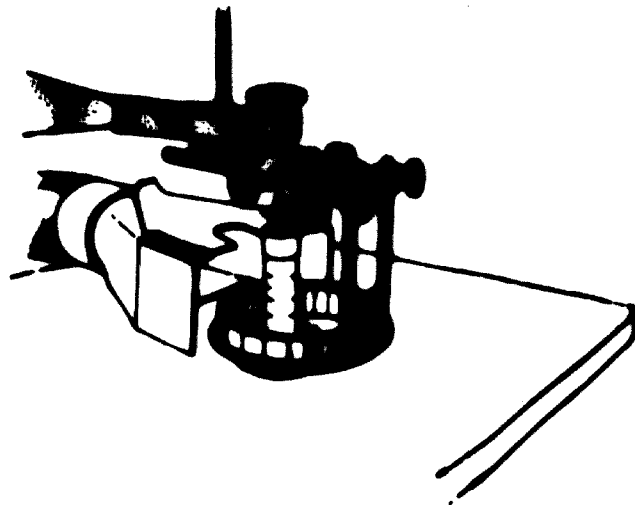


Figure I. A circular guard for a spindle moulder



and that can be applied to almost all uses of the spindle moulder. It does have the disadvantage that the guard requires a separate adjustment for each desired protective position for each working phase; it is for this reason that this otherwise excellent guard has not become popular in Finland. The mechanical feeding device has proved the best and most practical protective device for spindle moulders as it has for other woodworking machinery.

Dust

The dust produced by woodworking machines should be removed not only because of the danger of explosion and fire that it presents, but also because the dust of some tropical wood species (for example, teak and mahogany) can cause illnesses such as allergic nasal catarrh, asthma and dermatitis. To remove the dust, each saw must be equipped with a fixed exhaust-hood connected to an exhaust system. In many cases the exhaust-hood can be built together with guards, for example, the under-guard of a rip saw. The exhaust system must include a dust precipitator located outside the plant.

Paints and lacquers^{1/}

The solvents used in many paints and lacquers may cause contact dermatitis and poisoning when inhaled in appreciable amounts. Also, many so-called two-component lacquers and glues contain strong chemicals that can cause dermatitis. Consequently, contact with these materials must be avoided, and special attention must be paid to cleanliness and hygiene at work. Solvents should not be used for washing the hands.

The solvents used in most paints and lacquers are also highly combustible. To prevent poisoning and the danger of fire, the shops where paints and lacquers are used must be well ventilated.

No matter how good the ventilation may be, benzol (crude benzene) must never be used as a solvent in painting, lacquering or cleaning because it is highly poisonous. Also, some other solvents, notably toluene, may contain benzol in dangerous amounts. The purchasing agent should therefore demand a guarantee that the benzol content of any solvent will not exceed a specified limit. An acceptable maximum would be 3 per cent benzol.

Painting and any other work that entails the handling of materials dangerous to health should be done in a painting booth with a sufficient volume of

^{1/} See also part two, article 19 (P. Å. Biström "The surface finishing of wood and wooden products").

air exhausted to make the velocity of the air in the front opening of the booth at least 0.5 m/sec.

Conclusions

Despite the necessity of the technical safety measures discussed above, it is obvious that accidents cannot be prevented entirely. Unsafe behaviour and dangerous working methods must be eliminated and improved. Dangerous acts may be caused by carelessness, foolhardiness, lack of skill or experience or even by stupidity. On the other hand, the lack of specific instructions or insufficient training are often reasons for improper working methods. Training and guidance are needed for the prevention of accidents.

Whether it is a question of either technical measures or training, the final responsibility for accident prevention lies with management. This responsibility, which does not depend on the size of the enterprise, is discussed very clearly in a booklet published by the Central Federation of the Finnish Employers:

- "The management of an industrial enterprise is responsible for the promotion of safety. But in addition to the so-called formal responsibility, a positive attitude of the management is of utmost importance when preventing occupational hazards. Such an attitude is always needed, regardless of the size of the enterprise or of other factors. Anyhow it is important to point out that a positive attitude is something much more than simply realizing a legal or economical responsibility. A positive attitude means, inter alia that:
- the management of an enterprise completely realizes the importance of safety promotion both in general and especially regarding their own plant
 - the management publicizes their positive attitude
 - the management makes efforts to obtain a close co-operation of foremen and workers in safety problems."

The following studies on various uses of wood have been prepared by the United Nations Industrial Development Organisation:

- ID/10 Production Techniques for the Use of Wood in Housing under Conditions Prevailing in Developing Countries, Report of Study Group, Vienna, 17-21 November 1969
(United Nations publication, Sales No.: 70.II.B.32)
- ID/61 Production of Prefabricated Wooden Houses, by Keijo N. E. Tiisanen
(United Nations publication, Sales No.: 71.II.B.13)
- ID/72 Wood as a Packaging Material in the Developing Countries, by B. Hoohart
(United Nations publication, Sales No.: 72.II.B.12)
- ID/79 Production of Panels from Agricultural Residues, Report of Expert Working Group Meeting, Vienna, 14-18 December 1970
(United Nations publication, Sales No.: 72.II.B.4)

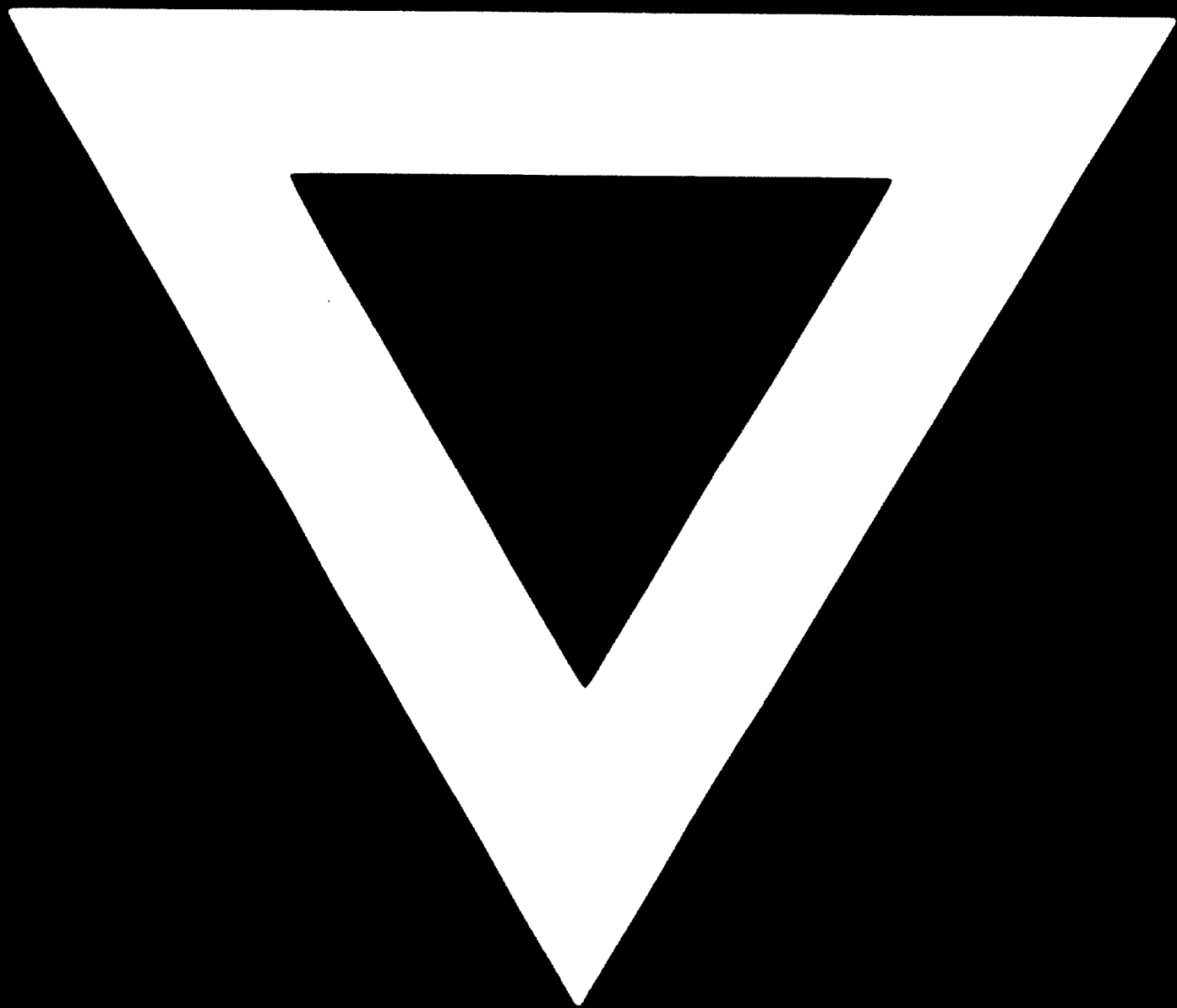
UNIDO/LIB SER.D/4

Guides to Information Sources No. 4: Information Sources on the Furniture and Joinery Industry

- ID/108 Furniture and Joinery Industries for Developing Countries:
Part one: Raw material inputs
Part two: Processing technology



C - 280



77 .07.14