

## 4 Product planning and clarification of the task

✓ Assignments are set not only by clients but increasingly, and especially in the case of original designs, they originate in the special planning departments of companies. In that case, the designers are bound by the planning ideas of others. Even then, however, the designer's special skills will prove most useful in the medium and long-term planning of products. The senior staff of the design department should therefore maintain close contacts not only with the production department, but also with the product planning department.

Planning can also be done by outside bodies, for instance by the authorities, by planning committees etc.

Before he takes the first step, by proceeding to the clarification of the task in hand, the designer should familiarise himself with the principles and procedures of product planning.

### ✓ 4.1 Product planning

#### ✓ 4.1.1 Task and procedures

Before a commercial product can be designed there has to be a *product idea*; that is, one that promises to lead to technically and economically viable applications.

According to Brankamp [4.2] and [4.17] *product planning* is the systematic search for, and selection and development of, promising product ideas. In many companies, accordingly, the product planning department is expected to follow the development of the product idea in the design and manufacturing departments and to watch over its market behaviour. In this book we shall only be dealing with product planning in the narrower sense. While it is often left to the managing director or other responsible individuals to develop and market the right product at the right time, it is now increasingly accepted that innovations should be systematically planned. A very important aspect of the systematic approach is that it provides a better prediction of the timing and costs of a particular project.

✓ The stimulus for a product plan can come from outside or from within the company. We accordingly distinguish between external and internal stimuli.

✓ External stimuli include:

- technical and economic obsolescence of the company's products, identified chiefly by a drop in turnover;

- the discovery of new research data, procedures or technologies;
- new market requirements;
- economic and political changes; and
- technical and economic superiority of competing products.

→ Internal stimuli include:

- excess capacity;
- drop in profitability;
- new discoveries by the company research department; and
- introduction of new production methods.

There have been numerous proposals for a systematic and organised approach to product planning [4.4, 4.6, 4.7, 4.14, 4.15] all of which involve the following steps:

- situation analysis and definition of company objectives;
- discovery of product ideas;
- product selection; and
- product definition.

These steps are compatible with the general systems approach (1.2.3).

#### 4.1.2 Situation analysis and definition of company objectives

Market analysis and clarification of company potential and objectives are among the most important first steps of successful product planning.

Market analysis is first of all applied to the turnover and profit situation. The timely detection of profit shortfalls and their correction are clearly of great importance. Next the analysis is extended to the following external aspects:

- socio-political and environmental requirements (including laws and regulations);
- limits of growth;
- overall market developments;
- economic conditions; and
- technological developments.

The accuracy of the analysis is impeded by:

- market fluctuations;
- decreasing life cycles of products; and
- uncertain forecasts.

An important aspect of product planning over and above the analysis of these external factors is the analysis of internal data, represented by the company's potential and its actual situation. The company potential characterises the overall capacity of an enterprise to meet a demand. Kehrman [4.6] and Kramer [4.9] have made a comprehensive survey of the types and areas of a company's potential (Figure 4.1).

Apart from data obtained from outside and inside the company, product planning also calls for a clear definition of the company's objectives. Such objectives may include:

- high market growth and a good share of the market;

- high flexibility in case of market fluctuations; and
- high rates of profit and good liquidity.

Market conditions, company objectives and company potential define the area in which the search for a new product can be usefully pursued. That area is

Area of potential Type of potential	Development	Procurement	Production	Distribution
Information	Experience – Development of functions and properties – Working principles – Organisational methods Trademark rights – Patents – Licences etc	Experience – Negotiation of delivery terms – Organisational methods Purchasing organisation Contacts with suppliers – Materials, bought-out parts Resources etc	Experience – Procedure – Preparation Materials Dimensions Precision – Organisational methods Organisational Structure etc	Experience – Publicity – Customer service – Organisational methods Sales organisation Customer relations – Sale negotiators – Final buyer etc
Facilities	Means of development – Experimental fields – Test equipment etc	Equipment Means of transport etc	Property, Buildings Infrastructure Means of production etc	Branches Equipment Means of transport etc
Personnel	Research staff Designers Draughtsmen etc	Staff – Inside staff – Outside staff etc	Professional staff Auxillary staff etc	Staff – Inside staff – Outside staff etc
Finance	Budget; long-term finance			

Figure 4.1. Types and areas of a company's potential, after [4.6]

also called a search field [4.2, 4.6]. In the final determination of a search field, it may be necessary to take several additional factors into account (see Figure 4.2). The boundaries of a search field depend strongly on the planning horizon—that is, on the time scale (short-term or long-term) set for product planning.

The same approach underlies the procedural plan shown in Figure 4.3.

### 4.1.3 Discovery of product ideas

The crux of product planning is the systematic search for new product ideas. Methods of discovering ideas are essentially methods for finding solutions as described in Chapter 5, and should be based on the general working method discussed in 2.2.1.

There are cases, however, in which these procedures alone do not lead to the discovery of concrete product ideas. Instead they throw up interesting questions for which solution ideas must first be elaborated.

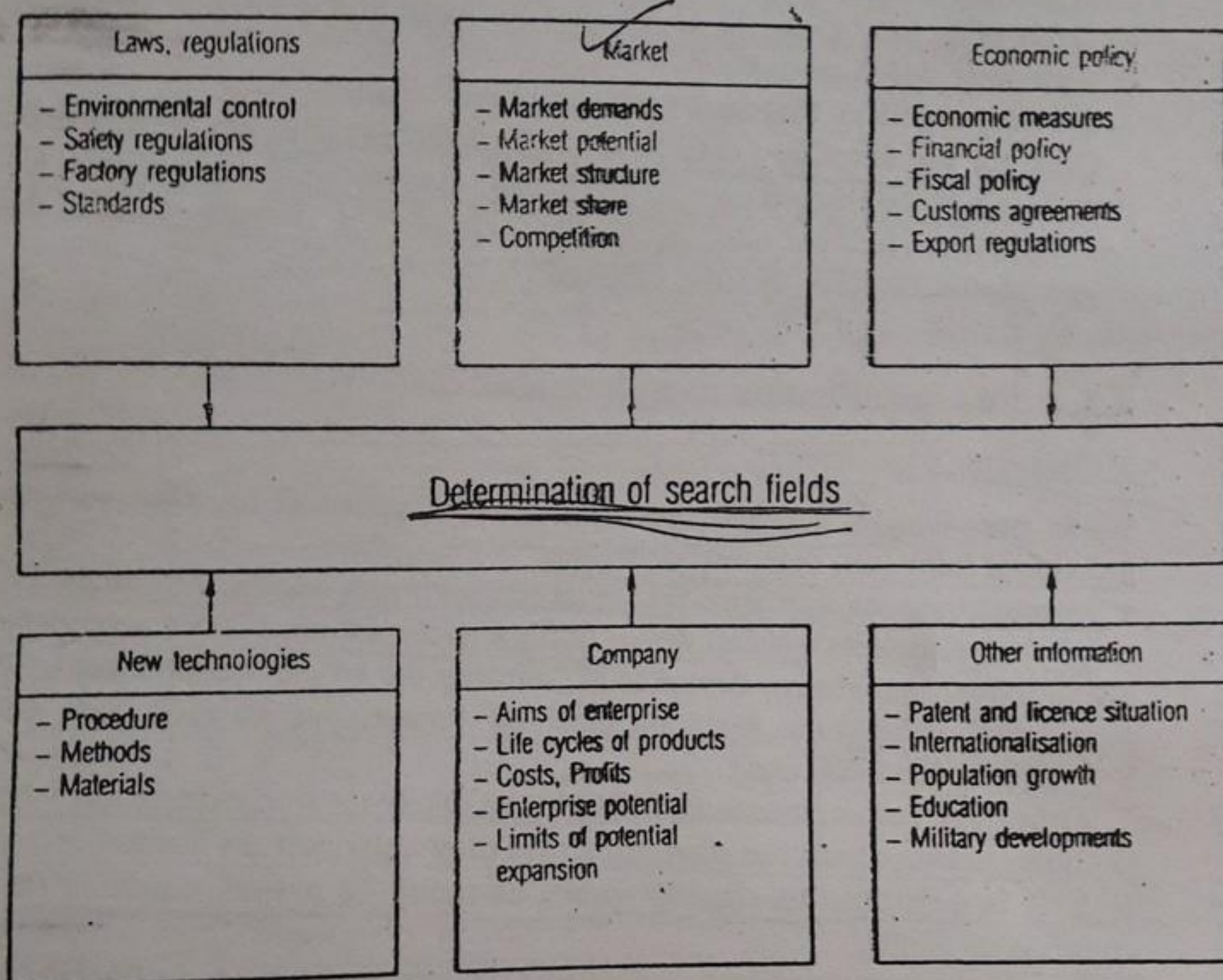


Figure 4.2. External and internal information for the determination of search fields, after [4.6]

#### 4.1.4 Product selection

The selection of promising product ideas is of great importance because of the expense of subsequent developments. Such selection cannot, of course, be more than rough and ready at this stage, when still relatively little is known about the implementation of the product idea or the properties of the product to be developed from it. Here, too, it may be advisable to make a feasibility study before beginning the search for a concrete solution.

With a great many product ideas it is advisable to make a selection for the purpose of identifying those product ideas that seem to fit in best with the company's or other general objectives. This step should be followed by a further evaluation (see 5.8) based on the technical and economic criteria listed in [4.1. 4.9].

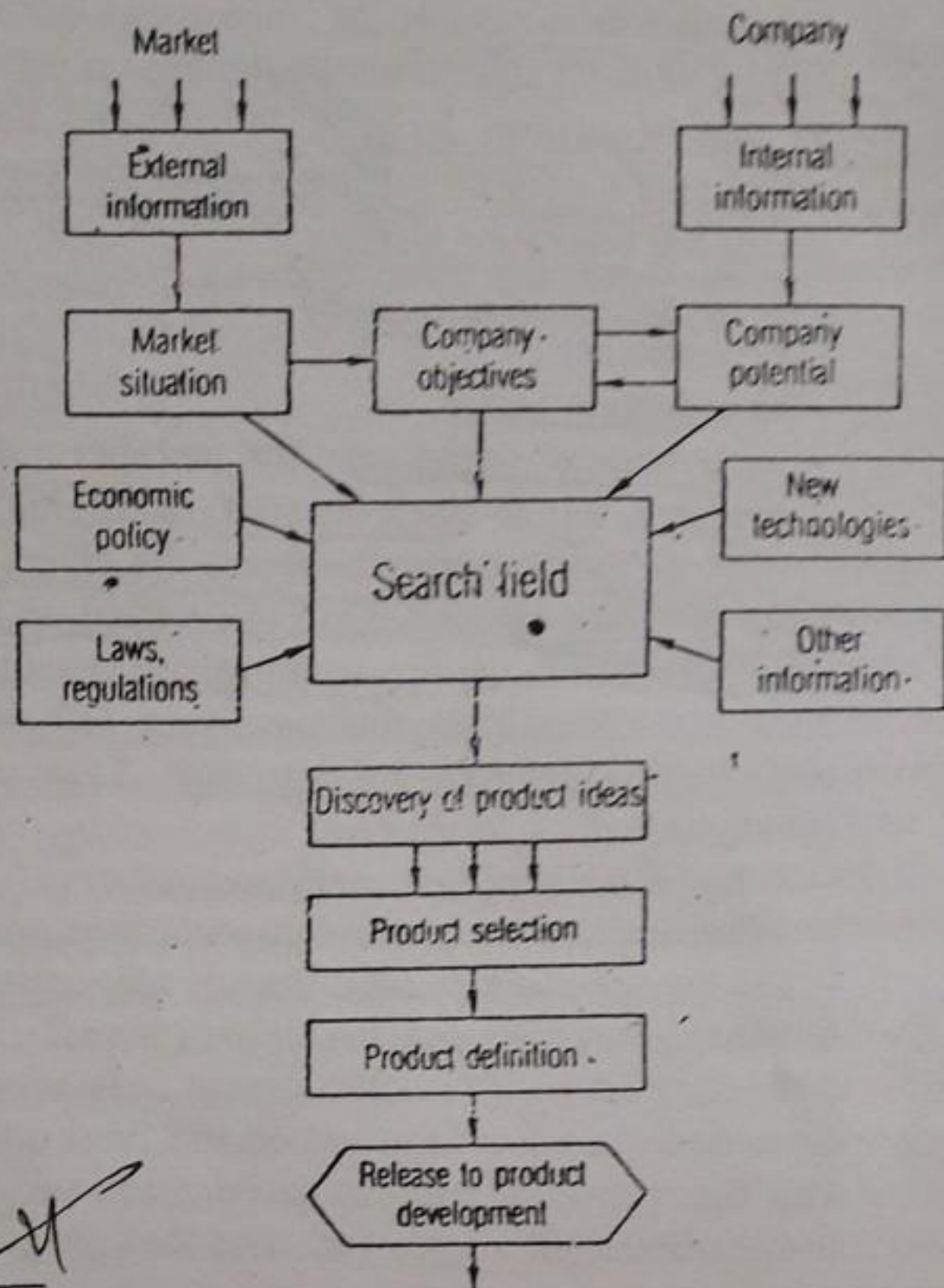


Figure 4.3. Product planning

### 4.1.5 Product definition

The last step of product planning, namely 'product definition', involves the specification of the most important features and requirements of the final product. Such definitions or proposals are usually submitted to the company board before they are acted upon. They are best presented in the form of a simplified specification or requirements list (see 4.2) which must later be completed and elaborated by the design department.

## 4.2 Clarification of the task

### 4.2.1 The importance of task clarification

The designer's work starts with a particular problem. Every task involves certain constraints that may change with time but must be fully understood if the optimum solution is to be found. From the very outset, therefore, the task must be defined as fully and clearly as possible so that amplifications and corrections

during its subsequent elaboration can be confined to the most essential. To that end, and also as a basis for subsequent decisions, a specification (requirements list) [4.10, 4.11] should always be drawn up and consulted. It is indispensable in the case of original designs.

The task is generally presented to the design or development department in one of the following forms:

- as a development order (from outside or from the product planning department);
- as a definite order; or
- as a request based on; for instance, suggestions and criticism by sales, research, test or assembly staff, or originating in the design department itself.

Without close contact between the client or proposer on the one hand and those in charge of the design department on the other, no optimum solution can be expected because the problem, as presented to the design department, often does not contain all the necessary information. A phase of further data collection must then be initiated. This phase must answer the following questions:

- What is the problem really about? ✓
- What implicit wishes and expectations are involved? ✓
- Do the specified constraints actually exist? and ✓
- What paths are open for development? ✓

Fixed solution ideas or concrete indications implicit in the task formulation often have an adverse effect on the final outcome. Only the required function with the appropriate inputs and outputs and the task-specific constraints should be specified right at the start. For that purpose the following questions must be asked:

- What objectives is the intended solution expected to satisfy? ✓
- What properties must it have? and
- What properties must it not have? ✓

Any general requirements not specified by the product planning department must be assessed in terms of information collected by the design department. To that end, the following factors should be examined:

### 1. Possible company shortcomings

- Evaluation of enquiries to the sales department. This evaluation clarifies the customer's requirements. It is important to evaluate enquiries rather than firm orders, which already represent the selection of a specific product.
- Customers' complaints.
- Assembly and test reports.

### 2. State of technology

- Competitors' programmes.
- Accounts of similar solutions in textbooks, technical journals and manuals.
- Study of patents.

## 4.2 Clarification of the task

### 3. Standards and guidelines

- International recommendations.
- National standards.
- Expert advice.

### 4. Future developments

- Allowing for changes in requirements and fashion.
- Observing new projects so as to determine the trends of technical and economic developments.
- Developing ideas that best meet customers' wishes.

Once all the necessary data have been collected, it is advisable to combine them into a system based on the established steps of the design process. For that purpose a general specification should be drawn up, namely, a more detailed requirements list than the one supplied by the customer.

## 4.2.2 The specification (requirements list)

### Contents

When preparing a detailed specification it is essential to state whether the individual items are demands or wishes.

Demands are requirements that must be met under all circumstances, in other words, requirements without whose fulfilment the solution is not acceptable (for instance such qualitative demands as 'suitable for tropical conditions', 'splash-proof' etc). Minimum demands must be formulated as such (for example  $P > 20 \text{ kW}$ ;  $L < 400 \text{ mm}$ ).

Wishes are requirements that should be taken into consideration whenever possible, perhaps with the stipulation that they only warrant limited increases in cost. It is advisable to classify wishes as being of major, medium or minor importance [4.13].

The distinction between demands and wishes is also important at the evaluation stage, since selection (see 5.6) depends on the fulfilment of demands, while evaluation (see 5.8) bears on only such variants as already meet the demands.

Even before a certain solution is adopted, a list of demands and wishes should be drawn up and the quantitative and qualitative aspects tabulated. Only then will the resulting information be adequate:

Quantity: All data involving numbers and magnitudes, such as number of items required, maximum weight, power output, throughput, volume flow rate etc.

Quality: All data involving permissible variations or special requirements such as waterproof, corrosion proof, shock proof etc.

Requirements should, if possible, be quantified and, in any case, defined in the clearest possible terms. Special indications of important influences, intentions or procedures may also be included in the specification, which is thus an

internal digest of all the demands and wishes expressed in the language of the various departments involved in the design process. As a result, the specification not only reflects the initial position but, since it is continually reviewed, also serves as an up-to-date working document. In addition it is a record that can, if necessary, be presented to the board and the sales department so that they may make their objections known before the actual work is started.

### Format

For a recommended layout of a specification, see Figure 4.4.

The format of the specification should be agreed with the company's standards office so that it can be used, elaborated and adopted in as many departments as possible. Figure 4.4 is thus no more than a suggestion that can, of course, be modified at will.

User		Specification for Project, product		Issued on:
Changes	D W	Requirements	Identification Classification Page	
Date of change	Specify whether item is D or W	Objective or property with quantitative and qualitative data  if necessary split into sub-systems (functions or assemblies) or base on checklist headings		Responsible  Design group responsible
Replaces		issue of		

Figure 4.4. Layout of a specification

It may prove useful to draw up the specification in order of sub-systems (functions or assemblies) where such can be identified, or else by checklist headings (see 4.2.2.3). With established solutions, in which the assemblies to be developed or improved are already determined, the specification must be arranged in accordance with these—special design groups are usually put in charge of the development of each assembly. With motor cars, for instance, the specification can be subdivided into engine, transmission and bodywork development.

In the case of essential and also of less obvious requirements it is extremely useful to record the *source* of specific demands or wishes. It is then possible to go back to the proposer and to enquire into his actual motives. This is particularly important when the question arises of whether or not the demands can be changed in the light of subsequent developments.

Such *changes* in, and *additions* to, the original task as might result from a better understanding of solution possibilities or from possible changes in

emphasis must always be entered in the specification, which will then reflect the progress of the project at any one time.

*Responsibility* for this work is vested in the chief designer. The updated specification should be circulated among all departments concerned with the development of the product (management, sales, accounts, research etc). The specification can only be changed or extended by decision of those in charge of the overall project.

### 3 Listing the requirements

As a rule designers have some difficulty in drawing up their first specification. Experience, however, will greatly facilitate the compilation of subsequent ones.

It is useful to head all specifications with a description of the overall task and some characteristic data, for example 'Induction motor, rating 63 kW, 4-pole'. This helps to convey some idea of the nature and scope of the problem.

Further data are collected with the help of a *checklist* reflecting the general and specific objectives and constraints. By applying this checklist to the task in hand and then asking what questions he needs to have answered, the designer may elicit a most beneficial association of ideas.

Franke [4.3] has drawn up a very detailed checklist, based on a search matrix. Checklists and questionnaires are particularly useful if they cover no more than a limited field, if they do not date too quickly, and if they can be taken in at a glance. In this book we shall deliberately refrain from presenting detailed questionnaires—it is our considered opinion that easily memorised checklists with regular headings will help the designer to hit upon the essential questions automatically, and without laborious aids.

The first step in the clarification of the task is the elucidation of the necessary functions and task-specific constraints. This is done by reference to the following headings: geometry—kinematics—forces—energy—material—signals. The combination of the relevant concepts produces a welcome redundancy and hence an important check that nothing essential has been forgotten.

The remaining general or task-specific constraints come under the heading listed in 2.1.6 and must be taken into account time and again.

Once the data have been gathered, they must be combined in a sensible way. To that end, numbering of individual items may prove useful.

In the light of the arguments advanced in this chapter, the following general method of compiling specifications can now be recommended:

#### 1. Compile the requirements

- Pay attention to the main headings of the checklist (Figure 4.5) and determine the quantitative and the qualitative data.
- Ask:
  - What objectives must the solution satisfy?
  - What properties must it have?
  - What properties must it not have?
- Compile further information.

C A E E

Main headings	Examples
Geometry	<u>Size, height, breadth, length, diameter, space requirement, number, arrangement, connection, extension.</u>
Kinematics	<u>Type of motion, direction of motion, velocity, acceleration.</u>
Forces	<u>Direction of force, magnitude of force, frequency, weight, load, deformation, stiffness, elasticity, inertia forces, resonance.</u>
Energy	<u>Output, efficiency, loss, friction, ventilation, state, pressure, temperature, heating, cooling, supply, storage, capacity, conversion.</u>
Material	<u>Flow and transport of materials.</u> <u>Physical and chemical properties of the initial and final product, auxiliary materials, prescribed materials (food regulations etc).</u>
Signals	<u>Inputs and outputs, form, display, control equipment.</u>
Safety	<u>Direct protection systems, operational and environmental safety.</u>
Ergonomics	<u>Man-machine relationship, type of operation, operating height, clearness of layout, sitting comfort, lighting, shape compatibility.</u>
Production	<u>Factory limitations, maximum possible dimensions, preferred production methods, means of production, achievable quality and tolerances, wastage.</u>
Quality control	<u>Possibilities of testing and measuring, application of special regulations and standards.</u>
Assembly	<u>Special regulations, installation, siting, foundations.</u>
Transport	<u>Limitations due to lifting gear, clearance, means of transport (height and weight), nature and conditions of despatch.</u>
Operation	<u>Quietness, wear, special uses, marketing area, destination (for example, sulphurous atmosphere, tropical conditions).</u>
Maintenance	<u>Servicing intervals (if any), inspection, exchange and repair, painting, cleaning.</u>
Costs	<u>Maximum permissible manufacturing costs, cost of tools, investment and depreciation.</u>
Schedules	<u>End date of development, project planning and control, delivery date.</u>

Figure 4.5. Checklist for drawing up a specification

- Specify demands and wishes clearly.
- If possible, rank wishes as being of major, medium or minor importance.
- 2. Arrange the requirements in clear order, as follows:
  - First define the main objective and the main characteristics;
  - then split into identifiable sub-systems, functions, assemblies etc, or in accordance with the main headings of the checklist.
- 3. Enter the specification on standard forms and circulate among interested departments, licensees, directors etc.
- 4. Examine objections and amendments and, if necessary, incorporate them in the specification.

Once the task has been adequately clarified and the relevant departments are satisfied that the listed requirements are technically and economically attainable, the way is clear for the conceptual design phase. *Chapter 5*

VEPAG PACKING CO.		Specification		Issued: Nov. 1971	
		for Sub-task: assemble cartons		Page: 1	
Changes	D W	Requirements			Resp.
15/12/ 1970	W	Assemble and glue 15 cartons/min			Smith's group
		Size of bought-out sections			
		Alternatives 500 x 500 mm 400 x 400 mm 450 x 450 mm (only 10%)			
		Probable tolerance: ± 1 mm			
	W	Cardboard sections fed in manually. But allow for automatic feed-in in due course. (Project conference minutes 16/70)			
		Assembled cartons placed on conveyor belt lying on their base. Height of conveyor belt above floor level: 300 mm			
		Cartons capable of being removed in any of three directions.			
		Available air pressure: 6 bar			
	W	Counter required for counting the assembled cartons			
		Machine quickly moveable without further adjustment			
21/1/71	W	Glueing: On leaving the machine the glue must have set and the cartons must be capable of bearing the full load.			
		Working principle must allow increase in output to 30 cartons/min with automatic feed mechanism			
		Maximum production costs DM 15000 (Project conference minutes 20/70)			
		Schedule: End of development 31/3/1971 Planned delivery date 1/7/1971			
29/1/71		Hot-melt glueing machine with setting time 1s (Project conference minutes 2/71, Point 2)			
8/2/71		Glueing equipment purchased from outside. Additional cost DM. 6000			
8/2/71		Operation can only be started with 2-hand control (industrial safety)			
8/2/71		Provide emergency stop			
		Replaces issue 31			

Figure 4.6. Part of specification for a carton assembly machine (Demands D have not been indicated).