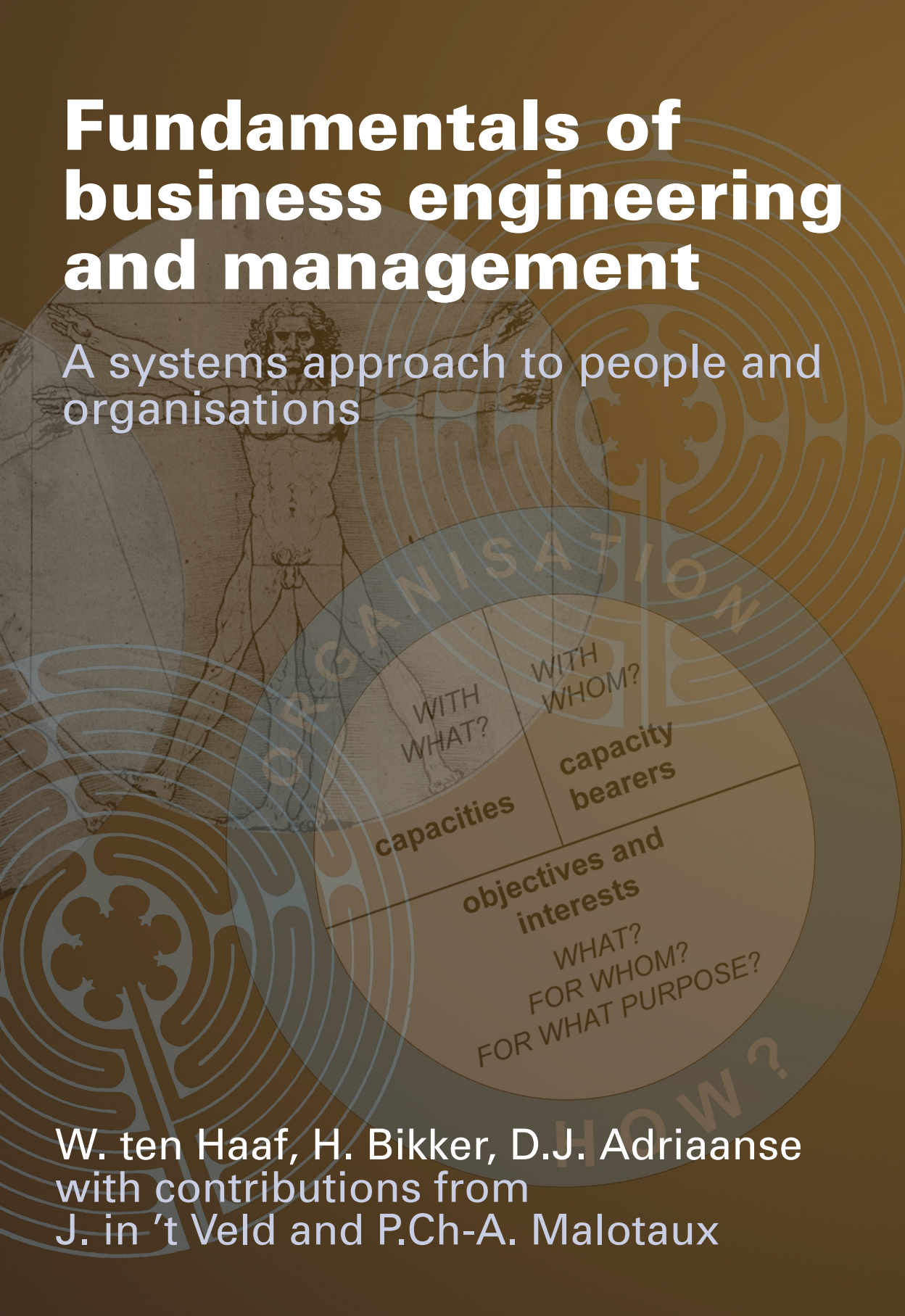
Fundamentals of business engineering and management

A systems approach to people and organisations



W. ten Haaf, H. Bikker, D.J. Adriaanse
with contributions from
J. in 't Veld and P.Ch-A. Malotaux

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Preface

Background details concerning the realisation of this book

In order to see this book in its true perspective one needs to briefly consider its underlying developmental history which takes us back to 1968. That was the year when two professors were simultaneously appointed to teach a subject known as "business management" at the University of Technology in Delft. They were the engineers P.C.A Malotaux and J in 't Veld who were respectively affiliated to the departments of Business Engineering and Management Studies (Malotaux) and Industrial Organisation (In 't Veld).
The common ground that they shared was this. They were required to teach students drawn from all the university's technological disciplines and faculties everything that they might need to know in their future (very divergent) areas of professional practice about Management Science.

Over the course of 30 years some 20 academic staff members (including technological business administrators, economists, sociologists, psychologists, mathematicians and engineers drawn from different disciplines) have been affiliated to these departments and have contributed both to the scientific developmental sides of these fields and to their operational applications. In extensive final dissertations resulting from fieldwork within all kinds of companies more than 450 students have implemented the theoretical concepts developed. On top of that sustained contact was, and still is, maintained with graduates in their various fields of work. Such interaction has, of course, been most instructive which has meant that in turn the theoretical concepts developed could be perpetually extended and adjusted as could the way in which they could be applied to resolve problem situations in a wide diversity of technological and other companies. After all, it was all about establishing practical, applicable knowledge!
The Dutch-language course readers were not only used at the university in Delft but they were also listed as obligatory reading by many colleges providing polytechnic level courses in engineering throughout the country.

In 1993 Professor Malotaux and Professor In 't Veld retired but the co-operation between the "Business Engineering and Management" and the "Industrial Organisation" departments was perpetuated in the fields of education, research and theory development.
In the late nineties the authors selected certain of the existing and relevant key topics for inclusion in the present book. All these topic areas were partially revised, some of them were even rewritten and a number of totally new topics were added.
The focus throughout has been upon what technologists and colleagues drawn from other disciplines need to know in their everyday practice about business management insight and problem analytical and problem resolving oriented approaches.
The target group in question is a varied one comprising, above all else, technologists drawn from all kinds of disciplines who may be employed in all types of companies in all kinds of functional capacities. Moreover, in practice, also managers with other scientific backgrounds but with an affinity to a systematic approach to management problems, have proved to be interested. This book aims to provide such people with the fundamental insight they need into how, in broad outline, companies are structured and how they operate. It will also help them to learn how to recognise, analyse and tackle business functioning problems.

The business management approach adopted in this book may be described in the following way:

1. As being directed towards processes and the relevant accompanying functions
2. As dealing with the application of the Systems and model approach
3. As being interdisciplinary

1. Directed towards processes and the relevant accompanying functions
Companies are purposeful organisations set up in order to make "something" happen. To that end people undertake activities within processes and which are organised in such a way that the goal in question can be achieved. If those processes do not proceed well or if they are not properly organised or attuned to each other then something will be wrong. In such cases one must try, preferably in a systematic way, to establish what constitute the missing links and to find ways of improving matters.
In this respect a company is primarily viewed as an organised collection of functions that have to be fulfilled in which the onus is upon activities or processes. The way in which they are equipped and mutually structured is, in each case, the basic angle of approach.

2. The application of the systems and model approach
The Systems and model approach is what is implemented as a "method" and as a "language" because of the opportunities it provides to examine organisations in a systematic way with the help of unequivocally defined concepts. This approach opens up the way to keeping attention directed towards the organisation in its environment while at the same time looking from that standpoint at the various parts of the organisation. It also enables one to study organisations from the angle of different

professional disciplines and approaches. Together with the fundamental process approach the systems approach forms what amounts to a universally applicable set of instruments for analysing organisations and for getting to the bottom of problems in the functioning of business processes and, of course, to dealing with such issues.
Even though the methodology – especially in technologically oriented businesses – tends to be developed and applied it has emerged that it is just as applicable to the service providing sector for organisations such as hospitals, transport companies, trading organisations and so on. If one thinks about it this is logical because all organisations are under pressure to operate in a "goal-oriented" and "business-like" fashion.

3. Interdisciplinary

Though the process approach is often chosen as the main analysis mode, the view of people and organisations adhered to certainly may not be termed monodisciplinary in a technological or economic sense. Organisations are co-operations of people set up for people. If one only looks at the technological functioning of processes or at economic profit one will generally find that little can be resolved. Organisational phenomena emerge from the field of tension between what is technologically possible, economically profitable and socially and psychologically acceptable. This demands an approach that needs to be realised in an integrated way and from different perspectives. It is an approach that may be briefly characterised in the following way: "as paying attention to the organisation and to its environment, the basic conviction being that in all cases it is all about activity for people and with people". With the systems approach it is always possible to integrally introduce many different disciplines and specialist fields.

The desire voiced at the outset of the development of the business management approach reflected in this book to the effect that the approach should remain applicable to all kinds of organisations brought with it, and still brings with it:

- the need for a certain distancing from various concrete kinds of companies by turning them into abstractions
- a need to focus upon the general constants which may be said to lead to the fundamentals of business management

This book is therefore no manual. The aim is rather to help the reader to develop his insight and understanding. It should be emphasised that the many examples provided throughout the book constitute guidelines for independent analysis and for the finding of solutions to problem situations in all kinds of business processes.

Many business management books are more oriented towards specific business management issues and/or are written from the particular perspective of a given specialist field. In the realm of economics, for instance, much has been written about the establishing of business strategies and policies but there attention is rarely paid to the business processes that have to be specifically realised through such policies. The psychologists highlight the human factors while in sociology it is themes such as interest groups and power issues that are central. The approach presented here, known

as the Delft School approach, takes as its point of the departure the company itself and all the processes within the company and related to it. From that point of view it may be said that all disciplines have something important to offer that cannot only be acknowledged but which in fact must be acknowledged. The approach presented here provides the space for this. In other words, it is not so much a question of "instead of" or "in addition to" but rather of "in conjunction with".

When it came to the notion of developing an English edition of this book it was really the following considerations that were uppermost in the minds of the authors:

1. The "Delft School" ideology characterised by its process orientation, systems approach and interdisciplinary traits is really little known outside of the Netherlands. From their participation in various congresses the authors had gradually become aware that in the areas of systematics and applications there was much external interest for "their school". Publication thus offered the perfect platform for internationally launching the mental legacy of Malotaux and In 't Veld.
2. The internationalisation of the student population at the University of Technology in Delft is gradually making it imperative for the university to provide many of its courses in English.

Acknowledgements

It is due to the co-operation of many individuals that this book has finally been able to materialise. Content-wise it was Malotaux and In 't Veld who really developed the basic philosophy underlying the Delft School in close co-operation with their various staff members, the authors of this book included, over the course of a 20-year period. Students, post-graduates and student assistants stimulated them to innovate change and to modernise through the application of methods, and the provision of criticism and praise. Translating the book into English proved to be no sinecure. Mrs Diane Butterman enthusiastically took responsibility for the translation of the whole text and all the figures, all of which ultimately led to many hours of consultation with the final editor. The student assistants did a great deal of supporting work by collecting data, and adapting figures and correcting them.

We thank them all for their contributions. Without them this book could never have materialised.

"The science of the use of usable science"

Delft, October 2002
W. ten Haaf
H. Bikker
D.J. Adriaanse

About the authors

Wouter ten Haaf began his career as a secondary school maths and physics teacher. He qualified as an electro-technical engineer at Delft University of Technology and afterwards worked in West Germany for a number of years, firstly as a micro-electronic designer. Later on he fulfilled various managerial functions there in the fields of product development, sales and general management. He returned to the Netherlands in 1981 where he became associated professor within the Business Engineering and Management department at Delft University of Technology. After the retirement of Pierre Malotaux he was made responsible for the Business Studies side of the Delft School of Business Engineering and Management. Since then, together with Henk Bikker, he has been responsible for supervising the further development of that business school. In his approach to the field it is people that are central which is something that emerges from the research into and the teaching focused upon the methodology of problem resolving, the effectiveness and productivity of co-operation and management and the processes directed towards personal growth, also in the light of the "Systems Approach". These fields of research, which basically belong to the area of human sciences, are issues he tries to translate into the worlds of thought and experience of people with scientific and technological backgrounds in general and for (prospective) managers, particularly with such backgrounds, so that these fields become accessible and manageable for them.
He is also active in the field of social service. For 17 years he was the national chairman of a society occupied with social work. Apart from working at Delft University his enterprise 'Ten Haaf Consultancy and Education' provides business courses and training for people in industry. On top of that he is a course leader in the field of Business Engineering and Management at the College of Engineering in The Hague where he provides postgraduate education for managers. Apart from being a co-author he also contributed to the creation of this book by taking responsibility for the final editing.

Henk Bikker studied aviation engineering at Delft University of Technology and started working at Fokker in 1961. There he was responsible for managing one of the company's production programmes and later for production preparation and management at another Fokker plant. He was subsequently made responsible for the project management of the F28 Fellowship Centre Division, the VFW-614 wings and the Airbus programme. As head of the "New Parts Factory" design team he introduced the product oriented production line organisational concept to a factory that had originally been organised along the lines of a functional oriented organisation. This kind of re-organisation was the first of its type and scale to be undertaken in the Netherlands. In the period that followed it was new aircraft construction that was of central importance to him in his role as head of the engineering department. That was a period when interest in innovation was growing and modernisation paths in product development were emerging. In 1978 he moved from Fokker to the Industrial Organisation department at Delft University where that same interest in innovation and modernisation paths in product development was consolidated in a research

programme. He then went on to produce numerous national and international publications on the interrelationship between product design, production and service and the scientific approach to all of that with the aid of the "Systems Approach".
In 1994 he succeeded Jan in 't Veld and was made professor and head of the Industrial Organisation section. Since then much attention has been paid to the development of "New Systems Concepts", notably where the matter of the manageability of the primary processes in industry and technological service provision is concerned. Together with Wouter ten Haaf from the Business Engineering and Management department he is responsible for the provision and further development of education and research programmes within the framework of the Delft School.

Johan Adriaanse read chemistry at Delft University of Technology. After having rounded off this engineering course he worked in the chemical industry sector for 6 years where he was involved in the field of production process development and facility re-engineering. He then joined the staff at Delft University where, for a number of years he was occupied with interdisciplinary research into organisational change. After that he became senior consultant to the Dutch Marine Research Institute (MARIN) where he carried out research into organisation patterns on board ship and within shipping companies and into the consequences of that for the redesigning of freight ships. When he returned to the university in Delft he embarked upon research into the optimisation of design and engineering processes. In addition to that he worked as an organisation advisor for the medium and small business sector.

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Part one
A systems approach to organisations

1 Business Engineering and Management, an introduction to the field of study

1.1 Introduction

In this first chapter we would like to create a framework that will serve as a basis for your further examination of the ensuing chapters of this book.

The first issue to be examined will be the question: What is meant by Business Engineering and Management, how is it oriented and how can the relevant insights be of use? This thus makes it necessary to explore certain key concepts such as: company, enterprise, institution and organisation since those are the main objects of study in the field of Business Engineering and Management. What do terms like organisation and management mean?

Once this has been done it then becomes possible to examine in more depth a number of characteristics of the managerial approach and to see why it is so difficult to select an appropriate approach from the huge range of theories, methods and techniques, all of which *can* be relevant in an "introduction" to this specialist field. All in all, this will constitute a justification for "our" approach.

This first chapter will close with an overview (or main outline) of the topics to be dealt with in all the following chapters.

1.2 Exploring Business Engineering and Management

This book has been given the title: Fundamentals of Business Engineering and Management Studies; a Systems Approach to People and Organisations. Evidently it is therefore all about the knowledge and skills which relate to how companies function. But what do we mean by companies? Do companies function differently from other organisations? And, is Business Administration something different from Organisation Engineering?

1.2.1 The company as a specific organisation

In everyday conversation we find that the word "company" is linked to a multitude of business sectors: the construction, restaurant, garage, building, trade, agrarian, energy, broadcasting corporation, insurance, post, transport and newspaper sectors …
Simultaneously we also encounter, on a daily basis, a number of "organised co-operative associations" which we would not be so quick to label "companies", such as: the United Nations, NATO, employer's associations, student unions, the church, the family, society …
In the Business Management Lexicon the word "company" is defined as follows:

> *a company is a more or less independent organisation that produces something. It is a combination of people, means and actions leading up to a product or service. It also embraces other organisations, universities and organisation consultancy bureaux. In all cases it is possible to identify an objective that reaches beyond the objectives of the company's individual members.*
> *(When, in spoken language, one refers to business what one is usually referring to is businesses in their totality, that is, businesses or companies in which the primary objectives are economic ones).*

In everyday usage enterprises and companies are often seen as being synonymous.
Collins Cobuild English Dictionary defines "company" as follows:

> *A company is a business organisation that makes money by selling goods or services.*

The word "organisation" is, in principle, applied to all units which have been systematically created in order to achieve a certain goal. Such "goal-orientedness" and "systematic composition" are things that are characteristic of all organisations, as is reflected in the first definition of company given above.
Businesses or companies have one extra characteristic, though, which is that they manufacture products or provide services. Within companies such products or services are there to be traded so that incomes may be earned to guarantee the company's continuation and possible expansion. Companies are organisations set up and kept going for a specific purpose, with or without a view to becoming profit-making.

1.2.2 Business Sciences and Organisation Sciences

Against this background, organisation sciences and business sciences may be characterised as follows:
Within the field of organisation sciences and studies the main focus is on the co-operative issues arising within organised units in the broadest sense of the word. Those may be human organisations of differing sizes covering a diversity of areas, or other biological or ecological systems. The theories and notions dealt with tend to be

abstract and only directly applicable to a limited extent. Often they first need to be related to specific organisations or issues.
Business sciences, on the one hand, and Public Administration Sciences, on the other hand, is a good example of this. Business sciences are oriented towards the co-operative issues alive within companies. The object of study and experience is "the company in its social context". Public Administration Sciences deal with problems occurring at a macro level, the object of study being "society in its context" and notably "public administration".
In practice, the terms Business Sciences (studies and theory) and Organisation Sciences (studies and theory) are often interchanged. Up to a point this is understandable when one realises that much organisational research is directed towards phenomena in human organisations, including within companies.

1.2.3 Business Sciences: a multi-disciplinary approach

As some readers might have realised, we have continually been speaking about "organisation sciences" and "business sciences", in other words we have been expressing this in the plural.
This has very much to do with the historical development of this young field of study. Although organisations are as old as the human race itself, it was only some 120 years ago that the scientific study of organisational issues commenced. At first the study centred on the setting up of production processes in factories developed during the course of the Industrial Revolution. The managing of such companies, which were becoming increasingly complex, also became a subject of study. The first people to carry out such studies were technologists.
In conjunction with what amounted to a somewhat technological optimisation it was discovered that having a better idea of costs and benefits was vitally important. Everything needed to be aimed towards achieving the best possible economic results from the scarce means available. From their points of view, economists began to occupy themselves with the functioning of companies in financial and economic respects.
At this time - partly at the instigation of political forces and trade unions - lawyers started working on developing the legal frameworks related to working conditions, work contracts and social insurance in cases of illness, accident occurrence and invalidity.
Round about 1930 people in America had discovered, by means of research, how instrumental attention to the person as a person (as an individual, as a social being) was when it came to the matter of realising high productivity and high yields in production. The behavioural sciences (sociology, psychology) came into their own and from these angles research started being conducted and recommendations started being made which were always directed at increasing productivity by improving the social climate.
One might characterise the academically supported approach to questions arising within companies during the first period as follows:

- every discipline had its own approach and way of solving matters (one-sidedness)

- the production process (work method, work organisation) needed to be optimised; the individual was expected to adapt to the job, in line with production process design.

Since the Second World War, and notably since the sixties, people have somewhat confidently arrived at the conclusion that if one is to resolve business problems then one must *combine* the insights drawn from the various academic disciplines. It has moreover become apparent that people who are, nowadays, better educated and more verbal, no longer accept what was once the prevailing situation of having to adapt to work methods and organisational forms: people demand "a say in matters" and "work that matches their capacities".
These changes in the ways of viewing people and organisations have led to experiments set up by researchers in the various fields that are aimed at achieving better ways of co-operation when studying and resolving issues. Economists and technologists have united to develop products and production methods that are qualitatively good from a technical point of view while also being economically cost-effective. Similarly, technologists and behavioural scientists have united to create work organisations and divisions of labour that are technically effective and which, as regards job content and working conditions, correspond better to what people want and to what they can do.

Ultimately, it is all about optimising what is:
- technologically possible
- economically remunerative
- social-psychologically desirable
- socially acceptable

The notion of having better co-operation between the various academic mono disciplines when launching organisational issues at business and social level would only seem logical since it is also, after all, imperative. Indeed, the problems themselves do not conform with our notions of academic areas.
In organisational science such co-operation is difficult to realise in practice. On the one hand that has to do with the fact that we do not know exactly how unification and integration of knowledge from the various fields can be combined in a scientifically reliable way. On the other hand, our discipline-oriented education also prepares us badly for taking a broad view of things and for working together: it is rather the opposite that is true. This problem was not fully recognised within the universities until the nineties; since then more and more attention has been paid to co-operation and to "integrally approaching" subjects.

1.2.4 Business sciences, Business Administration, Business Engineering and Management

Here above it was suggested that the terms organisation sciences, Organisation Engineering, Organisation Theories, Business Sciences, Business Administration and Business Theories are often interchanged. The fact that Business Administration is

oriented towards questions put by businesses and asked within businesses (in the broadest possible sense) has also already been mentioned.
With business *sciences*, the onus is on gathering knowledge relating to the functioning of businesses and the issues which thereby arise. Since research topics often emerge from practical situations they generally also require co-ordinated examination from a number of disciplinary angles. The objectives are still: to find out and to explain.
With Business Administration it is more a question of applying knowledge in relation to concrete problems. Business Administration research thus tends to be more usually directed at the immediate resolving of problems. For this reason, Business Administration recognises many methods of approach and techniques for analysing and tackling such problems. Scientific knowledge and methodology are the tools that are used. The objectives are: to understand and to resolve problems.
In the Collins Cobuild English Dictionary the term *theory* in the sense of 'a school of thought' is defined thus:

- *A theory is a formal idea or set of ideas that is intended to explain something*
- *The theory of a practical subject or skill is the set of rules and principles that form the basis of it.*

The approach adhered to in this book is known as that of the "Delft School", a specific approach derived from co-operation between the Malotaux 'Business and Management Studies' chair and the In 't Veld 'Industrial Organisation' chair at Delft University of Technology.
The toolbox contains a set of cohesive methods. These are methods that have been frequently applied in practice and which have been thoroughly developed.

1.3 Central concepts

1.3.1 The concept "organisation"

The words organise and organisation derive from the word "organ" (Lat. orga'num = tool, Gk. organon) and the Collins Cobuild English Dictionary gives the following relevant definition:

> *An organ is a part of your body that has a particular purpose or function, for example your heart or lungs.*
> *To summarise: a composition suited to the realisation of various purposes which may also be seen as a tool for a particular function.*

In everyday usage the word "organisation" has a number of meanings.

- the activity of "organising": 'organising that party was quite a task', meaning, in other words, that much needed to be done in order to realise that particular event. In short, it is the process of making plans and ensuring that they (may) be executed.

- an organisational unit: the Philips organisation is having a difficult year, or: the trade union organisations have instructed everyone to interrupt their work for a while. In this sense it is the company or institution that is being referred to.
- the way in which something is organised, its arrangement: what characterises the navy is the fact that it is a very hierarchical organisation, or: the Ministry of Justice is a bureaucratic organisation. Here organisation relates to the way in which inter-relationships and job execution are arranged.

When taken out of context it is sometimes very difficult to identify the sense in which the word organisation is used:

> *through organisation an organisation with the following type of organisation has been created ...*

Apart from the word organisation, we also have the word "organism" which stands for:

- *organic structure, combination of parts of a functional and therefore dynamic whole (animal organism)*
- *organised body; being that possesses organs*
- *systematic composition of various components for a certain goal: the nation is an organism*

The word has, it would seem, many parallels to organisation: systematic composition, goal.
With organism, however, we do in the first place think of living beings: creations that are not externally made up but which develop from within, which grow. Organisations are constructed. With human organisations such as companies and institutions the building blocks are things such as people and groups.
The fact that those individuals or groups possess a certain, or rather uncertain, uniqueness and input is something that makes organisations also behave, in some respects, like living creatures.

What, then, is: Organise?
To equip with organs? To provide with tools?

The Business Engineering and Administration Lexicon defines Organise as follows:

> *The process of creating efficient relations between people - means and dealings - in order to achieve certain objectives; creating an organisation.*

The achieving of such a goal can sometimes be one-off, demanding a limited amount of time, like the organising of a party or like constructing a bridge. People thus organise in a project-based way how things are going to be done and who is to do what. This is therefore termed project organisation.

It is furthermore also common for organisations to be set up for much longer durations in order to continue achieving certain objectives. Organisations like hospitals, power companies or ones that are rather less production-oriented such as Greenpeace and the Church are good examples of this. Organising thus focuses on the question: how can more permanent organisations be set up in such a way that their long-term function is optimally fulfilled (institutional or business organisation).

1.3.2 The concepts "business, institution, enterprise"

In Section 1.2 a business was characterised as an organisation that generates products or services, so fulfilling a function in societal production. In the past, a clear differentiation was made between "profit" (aimed at earning) and "non-profit" activities. Companies were also classified as belonging to the "private" or "government" sector as far as ownership relationships were concerned.

The companies that belonged to the public sector were those that were set up by state or municipal authorities, invariably to provide products or services to meet primary societal requirements, such as gas, water, electricity and transport companies, health care and education. In those cases it was not so much making profit from invested capital that was important as meeting certain needs. There was, moreover, little or no competition between such companies.

Facilities of this kind, established by the government, were often known as "institutions" and they included associations and foundations.

(The term "institution" is also applied to organisations that are not established and financed by the government and which take different legal forms (association, foundation, etc.). Frequently they have one ideal objective and are not profit-oriented. They are not companies).

Private sector companies are those that used to be set up on the basis of private initiative with money derived from entrepreneurs/owners and/or shareholders. Often these businesses were known as "enterprises": industrial enterprises, trading enterprises. Though these types of businesses also endeavour to meet social needs the pressure to be profit-making is much greater in these instances because of the demands of the providers of capital, on the one hand, and because of the existing competition on the other hand.

In everyday language, the terms company and enterprise are frequently made synonymous. With the term enterprise one thinks chiefly of the economic aspect (finance, the market) or of the legal form (one-man businesses, limited company, public limited company etc.); with the term company one thinks more readily of what the enterprise does and how this is achieved (technology).

This simple view of businesses, as being either profit or non-profit making is becoming more and more obsolete. Many public sector companies are being privatised in order to fulfil their primary purposes. Insofar as that is not happening, though, public sector organisations are having to become increasingly "market-oriented, customer-friendly and efficient". Financially, too, they must be self-sufficient.

1.3.3 The concept "management" = "leadership and organisation"

In this book, the term "management" is understood to mean "leadership and organisation". Day in, day out the term management is used, it stands for a number of concepts:

- the *activity* of providing leadership and organising, also known as "managing".
- the *group* of people responsible for providing leadership (the management = the group of managers).
- the leadership-providing *function* of a company or department: top-management, production-management, financial-management, personnel-management.

Besides this, the term "management" is also used to denote various branches of science, e.g. management-science or, quite simply, management.

The *function* of leading and organising companies and institutions may be described as follows:

> *looking after and further developing labour forces and the available human talent, capital and other means required to give rise to goods and services and to make them productive.*
> *Thereby doing that in such a way that the interests of employees, investors, consumers and suppliers, and society as a whole are exploited to best advantage, both in the short-term and in the long-term.*

Companies fulfil a diversity of functions within society, they: provide products and services, supply goods/services to customers, they pay taxes, they offer employment …
Such activity demands perpetual adjustment to a number of external groups. Adjusting to the environment is but one aspect, another facet is the internal agreement that has to be reached between individuals themselves making use of the means available within the organisation.
The greatest responsibility for "leadership and organisation", and thus also for business engineering and management, is that of ensuring that both types of agreement are satisfied and that they remain in harmony with each other.
A company's immediate environment (the community, society) is like a co-operative union of people continually subjected to development and change; developments in technological, social, cultural and political areas. This is intensified by the fact that the immediate environment is also influenced by global changes. Within organisations, too, one may speak of there being a perpetual flux of change.
The implications of all of this is that day in, day out these adjustments demand complete and utter attention, in other words, they require management.

1.3.4 The concept "society"

"Society, that's you!" is the familiar slogan in a Dutch TV advertisement produced by SIRE (i.e. the Dutch Institute for Non-Commercial Advertising). In other words, we are all being addressed: society is US.

The Business Engineering and Administration Lexicon provides the following definition:

> *A society or community comprises the total sum of people living together in its entirety in which many forces and groups have a part to play and within which organisations also have a function.*

Society is a somewhat abstract denotation of something that we recognise as existing but which we find very difficult to define. Despite the fact that we are able to identify all kinds of groups and organisations within society and also point, with a degree of pride, to what we have managed to build up over the centuries, our description falters when we try to explain how society is made up and how it functions as something communal. Society is composed and controlled on our behalf, as though it were an entity. Simultaneously, though, we perceive around us a great diversity of groups and interests in which it is hard for us to find something communal, unless one's national team is playing football.
In conjunction with Business Engineering and Management, it is especially important for that same society to comprise a richly textured diversity of individuals, groupings, organisations and institutions - each with their "own" interests and demands - in an endeavour to forge an own sense of direction.
It is within that social context that businesses operate. In their capacity as goal-oriented organisations companies are involved, in many different ways, with society and its numerous groups. Companies need society to achieve their objectives and so they also place demands on society. But the community, individuals and groups concerned also place demands on companies. That confrontation gives rise to tension and becomes threatening and restricting, especially when there are opposing interests at stake. At the same time that same society also offers the companies possibilities and opportunities.
As a part of society, companies likewise have to adapt to what the social environment offers them in terms of limitations and possibilities. Simultaneously, businesses will sometimes also (in conjunction with their continuity or desire to grow) try to endeavour to influence the environment. Through marketing activity, for instance, attempts are sometimes made to expand a product or service's marketing area. Just think, for example, of the various lobbies in The Hague for companies like DAF, Fokker and Amsterdam Airport and issues such as the Betuwe rail connection and the Wadden Sea.
Companies do not, therefore, blindly conform to social developments: they also play a (greater or smaller) part in those very developments themselves.

1.3.5 The concept "entity"

In the previous section it was asserted that society is a rich tapestry of individuals, groups, organisations and institutions. All these "organisms" have their "own" interests and desires. To a certain extent they are, or at least they behave like living creatures.

What is characteristic of living creatures, of individuals, but also of groups and organisations is that they strive to:

- *maintain* their existence
- and also: the *development* of their being

Maintaining or continuing almost invariably leads to resistance to the changes or limitations imposed by the environment; the *external situation* in which one is placed.
The endeavour to develop is something which might be seen as an aspect of the individual abilities to want to expand or utilise. This points inwards, to what one as an individual or as an organisation can do and wants to do: *the internal situation*.
In business administrative literature companies, organisations and institutions are sometimes identified as entities within society. For the word "entity" the Collins Cobuild English Dictionary offers us the following definition:

> *An entity is something that exists separately from other things and has a clear identity of its own*

Van Dale's Dictionary defines the concept as:

> *Actual existence, something that is essential.*

The word "essential" refers, in turn, to the word "essence" which is applied to indicate living, or independent beings, viewed as living. Organisations, companies and so on, apparently display several characteristics which are also peculiar to living creatures: they create objectives and take action to realise those objectives, they develop, they display a certain type of behaviour, etc.
According to the system approach - to be discussed further in the next chapter - the word entity is sometimes also used as an indication for a basic element when considering a greater whole. One may see a company, for instance, as a conglomeration of interacting departments (entities or elements) such as: purchasing, production, sales, research, engineering, administration, personnel and organisation, the directorate, etc. A company can also be seen as an entity within, or basic element of, society.
In various chapters of this book this notion will be further considered.

1.4 An approach

1.4.1 What should be looked at, ... to achieve what?

In the field of business administration one looks to companies, to how they function in their environment, to how they function internally and to how the internal and external functioning are tuned to each other, or, harmonise.
But how can that be established or described? Can that be done objectively and unequivocally?

When we ask various people to describe a passenger car factory like NEDCAR Born (in the Netherlands), we get, for instance, the following answers:

- a producer of societally desirable goods
- a producer of environmentally polluting articles
- an instrument for generating profit for one's shares
- a saleable "object" that has a monetary value (when taken over)
- a construction and assembly floor
- a provider of employment
- a producer of tax revenue
- a "consumer" of tax revenue
- a place where all kinds of production processes take place
- a place with poor working conditions and a high level of absence due to illness
- a place where people can develop
- a place where people can earn money
- a user of raw materials, semi-manufactured articles, components and accessories

What is clearly apparent from these statements is that people evidently have very different associations when they think of car factories: for each of the people questioned that factory concept has a positively different meaning. This may be an indication that possibly very different observations are combined with very different interpretations of what one sees. It would seem to be, at the very least, plausible to assume that the people behind these utterances are involved with the factory from very different angles, they take different stands and are involved in different ways.

In and around companies it is possible to differentiate various groups of concerned parties, such as: employees with very different positions within the company, consumers and users of the products and services, suppliers of raw materials, power and equipment, those who provide capital, and authorities in their various capacities. Each of these groups expects something different from the company and has, indeed, different interests. Partly because of this, different things are considered.
What also has to be borne in mind is that there are observational differences between what one individual "sees" and what another sees because what we are able to observe and how we do that is very much determined (and particularly limited) by our personal development (upbringing, education, experience). In short, our observations are SELECTIVE. One can rightfully endorse the Dutch adage: "I can see, I can see what you can't see!" or, to put it another way: my reality is not your reality.

Important though it is, further expanding on this theme derived from the field of psychology and philosophy, remains beyond the scope of this introduction. The topic has, however, been briefly touched on here because:

- it makes it easier to understand that within organisations people often do have very different views about what should happen and about how things should be done. Co-operation is not automatic!
- it makes it easier to understand that amassing "knowledge" on the functioning of the object of study known as "business" requires quite some agreement, as far as

gaining insight into the various academic disciplines is concerned since they too are selective in the way they approach organisations, both regarding what they look at and how they look at it.

Examining organisations from a certain angle is in one way necessary because we have no other way of doing this. It is, however, dangerous to want to change the way organisations function when problems arise on the basis of a limited and especially one-sided view of things. This is something that we want to avoid as much as possible in this book.
This can be avoided by endeavouring in one's approach to keep one's eyes firmly fixed on establishing a balanced view of:

- the organisation and the environment
- the organisation and the individual
- the various parties involved, position-wise and interests-wise
- the processes (what) and the people who contribute (how, with what)
- all aspects: technical, economic, social ...

Taking an as broad as possible view sounds very pretentious. After all, who possesses all the necessary knowledge and is able to integrate that in practice and do that in a "balanced" way?
This book, *Fundamentals of Business Engineering and Management; a Systems Approach to People and Organisations*, primarily aims to acquaint the reader with the way in which, step by step, more insight can be gained into the functioning of organisations and into the questions which thereby arise. In the next section more details will be given of the approach taken in this book.

1.4.2 Angles of approach

In the previous section it was suggested that different individuals have very different views of the phenomenon "company". It was also noted that every academic discipline has its own selective view of things: one looks through specific lenses at specific phenomena and makes connections in a certain way.

Here are a few examples:

Economics examines economic dealings at macro, meso and micro levels, the central concepts being scarcity and usefulness. The most important concepts as far as Business Engineering and Management is concerned are: costs/benefits, productivity, efficiency, investment results and the behaviour of the markets (labour, capital, raw materials and information).

With *Technology* it is especially the way in which scientific knowledge is applied that is particularly revealed in the way in which production processes are established for goods or services that is important: in the product development, process development and technology of creating something.

From the (social) *Psychological* viewpoint one looks at the individual in his social (organisational) environment. The central themes in relation to Business Engineering and Administration are: work motivation, job satisfaction, development, work place design (ergonomics), co-operation and leadership forms.

In *Sociology* it is particularly the interplay of various social groups that is studied: producers, consumers, managers, capital providers, employers, employees, and so on within the social context. The central themes here are: interaction, frames of reference, social structure, culture, norms and values, institutions, harmony and conflict, and power.

From the *Legal* aspect it is expected that regulatory intervention will come into play when opposing interests are manifested; that issues will be regulated by means of laws and sanctions. Themes relating to the employee and to the organisation, social assurance, social working conditions, working agreements and employee participation are involved, also with regard to organisation and the environment.

Alongside of, but also through, these scientific avenues *Mathematics and Statistics* form an important area of application when it comes to the matter of structuring, analysing and resolving business problems.
The contribution to knowledge that each of the separate disciplines can offer is extremely valuable but one-sided. Really one should be familiar with all the various knowledge from all the different disciplines and prepared to implement it in an integral way. Obviously it is not possible to realise that ideal by merely reading an "introduction" to that field.

But how can we provide insight into the many aspects of the field of study?
For this we have various and often applied approaches:

a) *via the historical developments in the field*
   Here one becomes acquainted with the problems relevant at any given time and with the contributions from various disciplines. In that way it also became possible to get to know the insight of all the "managementscience experts" who are sometimes hailed as gurus. Attention will be given to this aspect in the chapter entitled, "The History of Organisation Management". It would, however, be particularly dull and tedious to treat that chapter as an introduction to the field of Business Engineering and Management. Moreover, it is not just problems but also knowledge that has changed over the course of time. Not everything is still applicable. This, then, is not the right way.

b) *from the angle of the various disciplines*
   By consecutively examining what every discipline has to offer in terms of insight into the phenomenon "company", much knowledge can be gained. Since a uniform underlying framework is lacking it is difficult to get to the bottom of all the inter-relationships. This is therefore not the right way either.

c) *From the specific areas of attention that frequently present themselves in organisations*
The Dutch Open University, for example, chooses this approach which it refers to as a "functional area" where issues such as: production, marketing, finance, personnel and strategy are dealt with. This facet-wise approach is aimed at the sorts of managers that one often finds in organisations. This is not the best way.

d) *the structural approach versus the process approach*
These two approaches have nothing to do with the type of discipline lenses through which one surveys the company and, in an introduction of this sort, it would be going too far to go into all of this in detail, but what it basically amounts to is that the *process approach* looks at WHAT happens and HOW things happen in and around organisations. A process description or function model is an example of this.
With the *structural approach* one looks at how, for example, the various divisions of an organisation are linked to each other. An "organisation chart," is an example of this.

Each of the approaches listed above has its assets but ultimately this only gives us a partial view of reality. The important point is to search for appropriate combination possibilities.
In the following chapter the approach settled for in this book will be explained in more depth.

1.5 The structure of this book

1.5.1 About this book

The title *Fundamentals of Business Engineering and Management; a Systems Approach to People and Organisations* clearly indicates that this book is intended for readers who have little or no practical experience of companies, so that they may become acquainted with the organisational or business management oriented approaches.
The purpose of this book is therefore two-fold: to become acquainted with the phenomenon "business" and, to lay the foundations for organisation oriented and management-based knowledge.

Getting to know the phenomenon "company"
What is important here is that you gain insight into the way in which businesses are usually constructed and operate. The central questions asked in this connection are these:

- What takes place within the organisation: WHICH PROCESSES take place there? WHO (which entities, i.e. individuals or groups) do WHAT, WHY and HOW?

- How does a company function in and for its environment? This knowledge is imparted by presenting a number of business administrative theoretical presentation methods and practical examples.

Laying the foundations for business administrative knowledge
During the above introduction to the phenomenon company, various business administrative approaches were looked at and the accompanying concepts were dealt with. In this way a theoretical knowledge basis is provided upon which further specialisation, through the relevant literature or follow-up courses can be based.

1.5.2 The applied approach

At the end of Section 1.2.4 it was mentioned that in this book we adopt an approach known as the Delft School approach. What characterises this school of organisational theory is:

- the application of the *system and model approach*. This approach helps us to look at companies and problems in a systematic way, as opening up possibilities for what all disciplines can contribute. The system approach may thus be simultaneously seen as a "language" for the analysis and description of organisations. The approach recognises a limited and unequivocally defined framework of concepts.
- its primary point of view, that of *the process approach*. In this connection, the main angle chosen is that of the activities or processes which, together, are relevant.

This approach involves adopting a working method aimed at analysing and describing organisations and the problems that arise within such organisations. This produces a global or more detailed picture of the way in which an organisation functions. It is somewhat reminiscent of a map or ground plan but it certainly does not cover everything. It is therefore incomplete, while also being selective.
The merits of this approach reside in the fact that it offers an overview and the possibility "to zoom in" and examine images from a different angle. In order to properly understand organisations it is vital to have such contributions from monodisciplines. That is something that will be regularly demonstrated.
It was the systematic working method and the ability to provide overview and cohesion that led to the choice of this method as the "starting point" for this book. Apart from that, this approach also has a stepping-stone function: it provides possibilities for the integration of all kinds of more specific contributions from other disciplines.

As far as the contents of this book goes three models, developed in Delft, fulfil a central role:

- the model "Main functions in an enterprise". This model indicates which functions (processes) can almost always be found within companies or need to be fulfilled.
- the model "The life cycle of technical systems". This model describes how "products" come into being idea-wise, are developed, made, used and disposed of.

- the model "Thinking as a process". This model describes how we as individuals (can) deal with problems and arrive at solutions.

These three models display, as will become apparent, great interrelationships.

1.5.3 The contents

The chapters of this book are the following:

1. Business Engineering and Management, an introduction to the field of study
2. Businesses in the context of society
3. Introduction to the systems approach
4. The main functions in an enterprise
5. Organising operations
6. Management of Product Development from a Life Cycle Perspective 1
7. Management of Product Development from a Life Cycle Perspective 2
8. Objectives and policy
9. The Integration and Application of Models
10. Basic Forms of Co-operation
11. Working together in a task group
12. A fundamental problem approach model
13. Forms of leadership
14. A History of Organisation Management
15. Cost price calculations 1
16. Cost price calculations 2
17. Market Mechanisms

The logic behind this structure is as follows:

What will be examined in Chapter 2 is a company's environment and how influential this is for objectives and the working method adopted.

In Chapter 3 the reader will become acquainted with the system and model approach and with the relevant accompanying concepts.

Chapters 4 to 9 take a look at how organisations are structured and operate from within. First the broad outline will be given (Ch. 4) and then things will be examined in more detail (Ch. 5 to Ch. 9).

Chapters 10 and 11 are devoted to the company as a co-operation of people. The possibilities and limitations which this offers are looked at.

In Chapter 12 the central issue is: how do we deal with problems. Is there a recipe?

In Chapters 13 and 14 we return to the topic of co-operation between people. Chapter 13 illustrates the matter from the perspective of leadership. In Chapter 14 a summary is given of the history of the development of organisation theory.

Finally, Chapters 15 to 17 focus on two matters that are of great importance when it comes to gaining insight into the functioning of a company from an economic perspective.

These topics have been included because, as far as the authors are concerned, they do form part of the basics of organisational theory.

2 Companies in the context of society

The topics discussed in this chapter are the following:

- What are the differences between traditionally crafted and industrially made products.
- What part does industry play in the national economy and particularly in the Dutch economy.
- How does a company actually develop and what are the kinds of problems that can arise within its market.
- What are the kinds of situational changes that have been seen and how can companies react to such changes in all their various sectors. In this discussion we shall limit ourselves to the metal and electro-technical industries.

Some of the subjects dealt with in this chapter are so important to business that more attention will be devoted to them in separate chapters. From that point of view the elaborations given in this chapter are to be seen as convenient introductions to be continued elsewhere in the book.

2.1 Traditional and industrial products

The products created by any industrial company are the end-result of an interplay between people, raw materials and means. This is not a definition of what quintessentially constitutes industrial production. Industry is something that has emerged from traditional methods. If we just compare old trade and industry this might increase our understanding of matters.

Old trade characteristics	Industrial characteristics
- often involving handcraft or simple machines	- highly mechanised
- traditional working methods passed down from generation to generation, slow growth	- speeded up development. Research into production methods
- production method development left in the hands of coincidental evolution	- systematic setting up of production methods
- usually a boss with several workers	- involving larger groups
- little specialisation	- high level of specialisation
- own capital	- borrowed capital
- usually several items	- often large-scale production
- little preparation or no systematic preparatory thought	- a great deal of systematic preparation prior to the commencement of production

The major discrepancies lie in the aspect of research into production methods, in the large production numbers but also in the division between preparation and execution (see Chapter 10 on Basic Forms of Co-operation).

2.2 Industry and the Dutch economy

The occupation groups are dispersed as follows between the three sectors listed here below:

I Primary sector: agriculture, fishing, minerals.
II Secondary sector: industry and construction.
III The service sector: service provision (incl. the government etc.)

In recent times, the service sector has been further sub-divided, thus:

III The service sector: service provision geared to profit-making.
IV The public sector: the non-profit-making service sector.

The latter public sector concept is such a new one that no reliable figures for this are yet known and, in fact, its definition is not even certain. Some people include government bodies in this category while others do not.

Appendix 2.I gives a number of graphs to illustrate the relationships between these three sectors in the Netherlands and to show how this phenomenon has recently developed. Everywhere the primary sector's share is steadily decreasing. Initially this would have been taken over by the secondary sector but even that sector is now shrinking in the Netherlands, with the result that the service sector is showing signs of rapid growth. What one should bear in mind, though, is the fact that some 60% of the service sector depends on the secondary sector, one need just think for instance of the computer, software and machine trade sectors. As far as this particular development goes, the Netherlands clearly stands at the forefront in Western Europe. This is partly due to the country's geographical position and population density. Compared to the United States, however, the Netherlands is behind in this developmental respect.

The kinds of figures used are usually based on censuses, which generally only occur once every ten years, hence the reason that the graphs lag behind.

Appendix 2.II indicates the developments in the Netherlands. More recent figures are available in the annual Statistical Records but they, too, always lag two years behind the facts. An important phenomenon in Appendix 2.II is the way in which the labour

force has risen since 1980, in terms of a percentage of the population. That increase has chiefly been caused by the high number of women entering into the employment process. In the past the Netherlands was, in this respect, far behind the remainder of Europe and the USA, but now the gap is being narrowed. In the future that percentage will, however, drop again in the Netherlands as ever fewer people will be required to work for ever greater numbers of people. This will be caused by:

- the birth rate drop
- the raising of the compulsory education age
- the general ageing of the population
- the growing employment disability numbers
- the early retirement schemes.

In absolute terms, the number of jobs will have to rise even further if the expected population labour force percentage rises are to be realised and if our trade balance is to be retained.

Research has shown that job vacancies tend to be created in medium-sized and, above all else, small businesses.

The graph given below shows what are the implications of this for industry and the details come from The Statistical Yearbook issued by the CBS (the Dutch Statistical Office) (see the references).

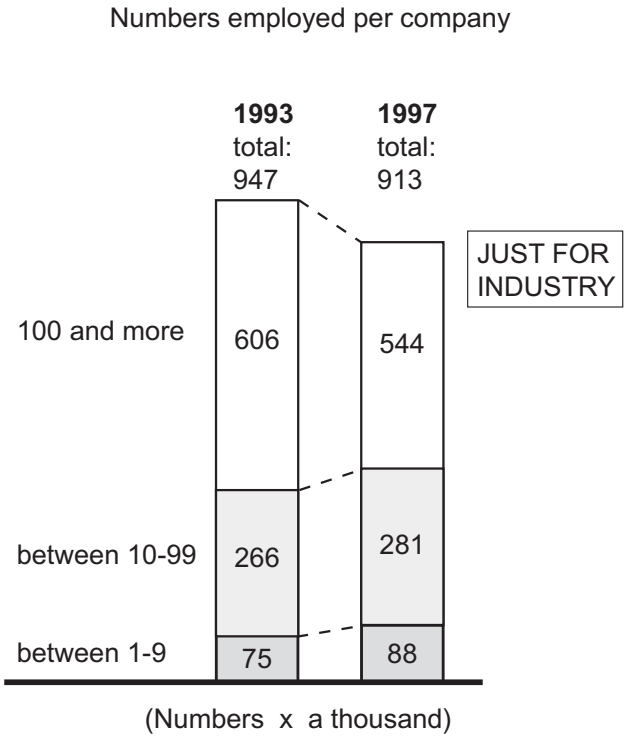

Figure 2.1 Number of persons employed in the Netherlands (x a thousand).
Source: CBS.

The USA reflects a similar trend.
The following figure gives an indication of the employment growth in the Netherlands in 1997, 1998 and 1999 and it shows the distribution between Industry and Trade.

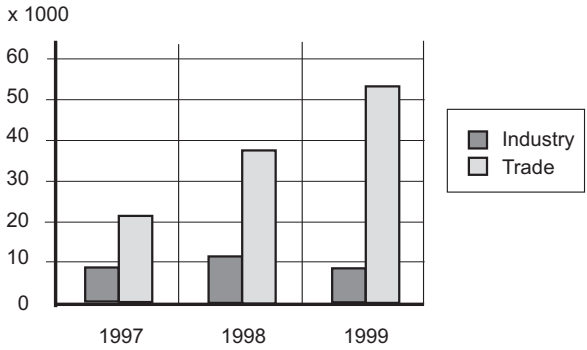

Figure 2.2 Absolute employment growth in terms of work-years.

Dutch industry comprises some 46,885 businesses and around 240 of these (0.5%) have more than 500 employees. In the construction industry this is around 66,210 companies of which about 45 (0.07%) employ more than 500 people. In the trade sector this percentage is much lower (approx. 0.08%). However among the industrial companies that employ more than 500 people about 37% of the industrial workforce is in service.
As far as industrial export figures are concerned:
- aro. 8000 businesses claim to export something
- aro. 700 of those businesses claim to export 90% of the total amount exported
- aro. 25 of those businesses claim to export 70% of the entire export volume.

In short, it may be asserted that by far the greater portion of companies produce almost exclusively for the domestic market. In future the contribution made to export, especially in the case of medium-sized and small companies, will definitely have to increase if the Dutch balance of trade is to be maintained.

2.3 How a business develops

Generally speaking, it all starts when someone discovers new, up until then unexplored, ways of satisfying market requirements or because someone discovers an improved formula for an existing product[1].
Application possibilities are then sought for the new discovery. Once the innovator has established what are, to his mind, good enough sales potentials – a big enough market outlet – he then goes about setting up a company in order to be able to supply his product in sufficient quantities.
There is evidence that such business founders sometimes tend to make their production setups rather rigid by, for instance, designing an entire manufacturing

[1] See also the case of the "Starting Entrepeneur" discussed in Chapter 4 on "The Main Functions in an Enterprise".

process to fit in with the production of that one particular product and that one particular design.
Such an approach can be successful, provided that there are no market competitors. The company will, of course, endeavour to expand its market. In so doing, the product will have to be made cheaper which will mean that it can be utilised in areas where it was at first too expensive. Such a phase involves rationalising production, improving working methods, mechanising, automation, etc.
At first, the customer 'accepts' the way in which the company makes its product. Gradually, though, there will be competition as others begin to become aware of that market and take over a part of it for themselves. As far as the customer is concerned, a product supplied by a rival will fulfil the same product requirements. The original company is then only able to compete in the areas of:

- Product quality (and form and packaging).
- The product price.
- Delivery time.
- Service quality (before and after completing the order).
- Promotion.

Alongside of that there remains the pressure surrounding the cost price and, thus also, the pressure to further rationalise the product's existence. In the organisational structures of companies there is increasing evidence of internal differentiation and therefore of functional structuring while among personnel members ever more job specialisation emerges[2].
As a matter of fact, it is partly because of the learning effect that companies that have been in production longer invariably have a headstart. Such a headstart is hard for newcomers to catch up on, provided that the company is aware of this and keeps on learning and developing.
After a while, the market will become saturated and the customer, too, who has by then had time to review his experiences of the product and to draw comparisons with rival products, will start making more individual and specific product demands. The original company is then given the choice of:

continuing or deciding to stop

For example, the large American chemical concern, Dupont, has developed a policy that is aimed at patenting as many as possible research findings so that for a number of years it will be able to continue producing in relative peace. Once any given patent expires production ceases and the market is left open to competitors.
In other words, policy-wise, a company is free to choose between 'leading or following'.
Should the original company decide to continue, as is usually the case, then it must further develop its products if it is to retain its market share. The marketing and research departments are perhaps able to envisage greater outlet possibilities by:

- Improving the product
  (qualitatively or by making the product 'do' more).

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2 See the introduction to this subject in Section 10.2.7.

- Altering the product
  (so that possibilities are opened up for new applications)
- Adapting the product to meet the special demands of customers.

The various approaches and possibilities explored for meeting these ends will obviously depend very much on the type of product that is being made. The way in which coffee, soup and soap commodities are produced will, for instance, be very different from the way in which coffee grinders, machinery and cars are manufactured.

In the preliminary phases, production departments will have done their utmost to guarantee that procedures can continue in an uninterrupted and well controlled way in order to ensure that, in turn, an as high as possible production level is sustained.

The kind of guarantees made are these:

* simple planning and progress checks
* advanced specialisation with machines and personnel
* detailed working methods
* standardisation
* time norms
* etc.

After all, it must be made cheaper!

For their part, the production departments will oppose the changes proposed by the sales department, which they see as nothing other than potential sources of disruption. Internal tensions will thus arise:

variability (product differentiation)

certainties versus

flexibility (quick adaptation to situation changes)

2.4 Changes in the market situation

Since 1945 people in most Western European countries really find themselves in the latter type of situation. Since that point in time technological developments have followed each other in ever faster succession and competition from abroad has increased sharply. Before 1940 the basic ideology of most companies was:

One must sell what the company is able to produce.

Such a production-oriented ethos was well summed up by Henry Ford when he famously proclaimed that: ‘Any customer can have a car painted any color that he wants so long as it is black’. After 1945 there was a definite transition and gradually the philosophy became:

The company must produce what one is able to sell.

(This final proposition does, however, have its limitations. It is, for instance, conceivable that a company is unable to provide the required quality without high investments being incurred, thus making the price too high and the product impossible to sell.)

This kind of a shift is often characterised as a transition from:

A producer's market to a consumer's market[3].

or from

A seller's market to a buyer's market.

The lifecycle of products is getting shorter and shorter. In 1977 it was estimated that the lifecycle of Philips' products could be put at between three and six years. In 1986 Kumpe and Bolwijn wrote that Philips' products have to be replaced every year. Moreover, far greater product variation has to be provided. In 1972 Philips produced some 100 different colour television models, by 1988 that had increased to 500. In 1982 Philips manufactured 10 different types of CD players, by 1988 that had risen to 150 different types with every year a new generation appearing on the market. Not only does this hold for the mass-production industry but also for small series and individual article manufacture where a similar trend can be detected. When endeavours are made to prolong any product lifecycle the product tends to be altered a number of times in the process and these alterations have to be passed on by the producers. At other times, manufacturers are forced to accept all sorts of customer requests so that production part series always remain different. All in all, this means that much more often than in the past changes have to be made in the work place while *series sizes* diminish. The *batch size* (i.e., the number of products commissioned simultaneously in one particular order) of a certain electro-mechanical product fell in eight years from 130,000 to 40,000 pieces per batch. In addition customers are demanding higher and more consistent *quality* levels. The lamp reject percentage accepted by Japanese car factories is no longer measured in terms of percentage or permillage but it is rather a case that it has to be smaller than 50 p.p.m. (parts per million). In the U.S.A. when it became apparent that, on average, Toyota cars needed to be repaired once every six months while, on average, American cars needed to be repaired once every seven weeks, even ordinary salesmen started noticing this.
As if all of this was not enough, customers began to demand shorter *delivery times*, greater reliability surrounding *delivery times* and all for a lower *price.* Market requirements are perpetually changing. Adaptations not only have to be made more frequently but they also have to take place faster and that demands a high degree of flexibility.
Flexibility is the ability to recognise necessary changes, to anticipate them and to be able to rapidly realise change arounds.
The key concept here is being able to anticipate as well as merely react. One can think of numerous areas and kinds of flexibility:

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3 See also Section 6.2.2 "Societal developments and the consequences" that this has for the developmental functions of companies"and Section 6.3.3 "The origin of product ideas". In those sections the phenomena discussed here are further explained and are referred to as "the technology push" versus "the market pull".

- *Modernisation* flexibility. New products (long-term) and product sorts and variants (short-term), new product methods and processes (LT).
- *Volume* flexibility. Changing the number of products to be produced:
  - in the long-term through capacity flexibility
  - in the short-term through volume flexibility in the form of altering batch sizes.
- *Mix* flexibility. Being able to produce different products simultaneously in varying series sizes.
- *Organisational* flexibility. The rapid adaptation of people, means and processes to varying circumstances.

Within that organisational flexibility **De Sitter** differentiates between the following:

- *Structural* flexibility. Long-term:

the production-organisation structure.

- *Operational* flexibility. Short-term:
  - personal flexibility
  - tool and machine flexibility
  - routine flexibility
  - conversion, alteration, handling and position flexibility
  - adaptational flexibility.

At the same time it should not be forgotten that all kinds of other details or differently grouped details are constantly required, thus:

- *Informational* flexibility.

Obviously, it is never simply one kind of flexibility in isolation that one has to deal with but rather the integral flexibility of the whole company. In short, this involves the flexibility of people, means, materials and information, or, a flexible production-organisation structure.

The complexity of the whole thing increases thus making *controllability* more difficult and increasing the need for certainty among managers. The present production team will frequently try to find solutions by reverting to a high degree of centralisation of control systems aided by computers. Gradually it has become clear that the high integration of computer information systems has not led to the degree of success that people had expected. The availability of Personal Computers makes possible a level of decentralisation that can lead to a better controlling of the entire process while introducing greater flexibility. What is essential when it comes to expanding controllability is that control capacity is introduced low down in the company's hierarchy. In the former mass production situation it was 'economy of scale' that formed the basic ideology. That led, in turn, to increased bureaucracy and centralisation, complex rules and procedures and detailed regulations. The new market situation, with much smaller series production, demands a different kind of production philosophy. Decision-making powers need to be brought much closer to the point of action. Products, processes and machines are becoming ever more complex and breakdown sensitivity is greater than in the past. If something goes wrong then it must be possible to instantly intervene. Through mechanisation and automation fewer people need to be involved in processes but the smooth progress of things has, because of that, become more dependent on people. Ultimately it is people's skill and motivation that is crucial to success.

In the same product and market framework it will, in the future, also be necessary to pay much more attention and completely different attention to productivity. From an American study carried out in the eighties among 195 companies it emerged that 52% of these companies had an annual productivity rise that was less than 5% while 22% reported rises of over the 5%. After the figures had been corrected in connection with inflation it emerged that 32% had really shown a decrease in productivity. What was even more remarkable was that 25% of the companies did not even know where their production achievement lay. The emphasis at management level is on the effectiveness of direct labour. There is still very little interest in the interaction and relationship between the different process functions. The interaction between design and production and between marketing and production tends to be neglected and that is just where there is plenty of room for improvement. It is only very slowly that people are beginning to realise that with productivity it is the total cost per product that counts. It is not so much every individual job function that needs to be examined as the total production process involving selling, designing, buying, production and service. It is more a question of paying attention to the entire process costs and the throughput time in the work place than to the work place production costs. From the moment of ordering to the moment of delivery 40% or less of the throughput time is in the work place. The remaining processes take place elsewhere. Improvement on this front demands an integral approach and the ability to think in terms of process and product flows and other organisational set-ups. This subject has, to our way of thinking, become so central to industrial success and societal survival, that we have devoted a special chapter[4] to problems of this kind in this book.

Kumpe and Bolwijn make the following divisions, time-wise.

In order to establish lower cost prices the emphasis, up until the fifties, was entirely upon efficiency.

In the sixties, however, quality became just as important as efficiency.

Towards the end of the sixties a third element in the competitive battle was to come to the fore, namely, flexibility. In the eighties, companies were expected to achieve more flexibility while keeping costs down and quality high.

The nineties brought the added market requirement of greater and speedier innovational pace. The focus came to be not only on technological innovation but also on the modernisation and integration of the entire process starting with product design and leading up to the point of delivery and that is something that cannot take place without social-organisational renewal.

2.5 Corporate strategy

The first publications on the subject of strategic planning, now known as corporate strategy, date from the seventies. It was **Ansoff** who introduced the concept product/market-combination, which was later extended to product/market/technological-combination (PMT). In many instances this led to a diversification of the

4 Chapter 7 on “Management of product development from Life Cycle perspective 2”.

product range, often through the taking over of other businesses. In that way business risks could be spread, at least that was the idea.
In 1980 **Porter** shifted the emphasis to competitive analysis and to the analysis of value chains within companies and in rival companies. He questioned how each product fared on the market in relation to rival products and further analysed this in relation to the particular life cycle phase in which a given product found itself. By value chain he meant, the expenses incurred in every phase of the entire process, from the purchasing of raw materials up to the stages of distribution and after-sales service. Naturally one's attention must be especially directed towards the phase in which the highest percentage of the total costs is created which is not invariably, as people think, the manufacturing phase. He also pointed to the link between the market situation and the required organisational structure but he did not further elaborate.
In this field more attention was furthermore paid, towards the end of the eighties, to the introducing of such a strategic plan and also to the influence of the power of the various interested parties (stake holders). The relationship that this had to the desired internal organisational structure was also given increasingly more attention. In the nineties it was proposed that strategic decision-making should relate to:

- the extent of an organisation's activities
- 'matching' those activities to the environment
- 'matching' those activities to the people and means within the organisation
- allocating and re-allocating the key people and means within the organisation
- the values, expectations and objectives of those responsible for influencing strategy
- the direction in which the organisation expects to go in the long-term
- the consequences of changes throughout the company as a whole

In short, it is all about establishing a good balance between *opportunities and threats.*
The environmental factors that are seen as having an influence on the organisation are these:

- the economic climate
- demographic developments
- socio-cultural views
- capital markets
- technological developments
- labour markets
- ecology
- competitors
- state authorities
- suppliers

In the various analyses, use is consistently made of matrices in which the own organisation and products are considered in much the same way as those of the competitor. In that way a company's strong and weak points can be examined and endeavours can be made to establish a strategy.
Here below are a few examples of such matrices:

		Market share	
		High	Low
Speed of market growth	High	star	?
	Low	dairy cow	dog

Figure 2.3 The Boston Consulting Group matrix.

		Competitive position		
		Strong	Average	Weak
Attractiveness of that market	High			
	Average			
	Low			

Figure 2.4 GE's Business Screen.

		Competitive position		
		Strong	Average	Weak
Phase of product / market development	Developing			
	Growing			
	Shake out			
	Mature			
	Declining			

Figure 2.5 Product/market evaluation matrix.

		Industry maturity			
		Embryonic	Growing	Mature	Ageing
Phase of product / market development	Dominant				
	Strong				
	Favourable				
	Tenable				
	Weak				

Figure 2.6 Arthur D. Little matrix.

We shall now examine the various aspects in more depth.

2.6 Market[5]

> The definition of a *market* we will apply in this section is: a group of buyers and sellers who are in sufficiently close contact with each other to effect exchange transactions.

How a company can and must react to the changing situation in its environment will depend greatly on the market form within which it operates.
The *market forms* are to be distinguished by examining combinations of two aspects:

1st What is the position of the buyer in relation to the product?

5 For more extended details on the subject market, see Chapter 17 on "Market mechanisms".

- *Homogeneous* meaning that the buyers have no preference for a specific supplier. When there are price differences one simply takes the cheapest products.
- *Heterogeneous* meaning that there is more space for product variability within the market.
  What the buyers particularly take into consideration is the brand name or the supplier.

2nd The number of producers or providers of the same product in relation to the number of consumers;

- *Polypoly* meaning that, on the one hand, production is in the hands of a large number of relatively small enterprises, each of which is not capable of significantly influencing either the total supply or the price while, on the other hand, the total number of consumers is large.
- *Monopoly* meaning that there is only one producer controlling the entire range of the relevant product and therefore also the price fixing.
- *Oligopoly* lies mid-way between the two above-mentioned forms. There is a limited number of producers, each of which has an important part to play in the entire product offer.
  Each separate producer is capable of exercising significant control over price fixing.

A market form is thus always characterised by a combination of both aspects discussed above, examples being:

- *Homogeneous polypoly.* This applies in the case of products such as apples and pigs. The producer is only able to adapt the numbers he has to offer to the market situation. The cost prices involved for the various competitors usually vary only slightly.
- *Heterogeneous polypoly* (known these days as monopolistic competition) and involving branded articles such as chocolate, cigarettes and washing powder. Here it is not only the product quality but also the packaging, the supply conditions and the fixed business relations with certain suppliers that determines the buyer's choice. The producers are able to influence prices a little and also, through their advertising, their sales and market share.
- *Monopoly,* examples of such companies being gas and electricity companies.
- *Homogeneous and Heterogeneous oligopoly*. Typical oligopoly products are manufacturing machinery and cars. Through his image construction and sales network each producer is able to considerably influence sales.

In the next section we shall limit ourselves to the situation that exists within the metal and electro-technical industry, in other words, to types of companies that are involved in oligopoly market forms.

This shift to a definite consumer market is something that has placed many businesses in a difficult position. It is, in fact, something that makes very different requirements of the production mechanism and of management and, since 1990, of Research and Development departments as well.

A consumer market demands a completely different mental approach towards company management. It is no longer enough to simply concentrate on the questions: how can we make existing products as good and as cheap as possible and how can we achieve our delivery dates. All company departments must develop far greater flexibility if they are to meet the ever-changing demands of customers or, even, the demands for completely new products. Not only personnel and company management but also the organisation's structures, the layouts and the machines will have to make the required greater flexibility possible. The central question is:

HOW CAN COMPANIES, IN THEIR VARIOUS SECTORS, LEARN TO REACT TO SUCH THINGS AND ANTICIPATE SUCH MOVES BETTER ?

On the one hand, more must therefore be done to meet the needs of the customers and to even anticipate products and to possibly in time switch to other products. On the other hand, however, it is not possible to meet every customer's individual 'whim'. In the ensuing sections a brief review will first be given of the process of switching to other products. Afterwards the contribution that each different company sector can make towards striking a responsible balance between the various factors will be discussed.

2.6.1 Diversification

Sometimes it is possible to temporarily continue producing and further developing the same kinds of products, sometimes it is necessary to switch to closely related products and at yet other times it is necessary to deviate much more and to change to entirely different product types to keep the company in business.
In the latter case one must bear in mind that:

- The design office has its own specific knowledge and experience.
- The production departments have their own specific machinery and special knowledge and experience.
- The marketing division will be oriented to a certain market and circle of customers for given types of products.

It is necessary to continue to make as much as possible use of this knowledge and equipment in the production process.
What is most important, though, is to ensure that the transition to new and different products is gradual. Experience has shown that at every diversification step it is wise to always establish links with the existing situation on at least two of these three knowledge front areas.

It is especially when new market areas are explored that extra risks will arise. The chances of success concerning the various combinations of market knowledge and knowledge of the design and production method are estimated in the way given in the following matrix:

		Market	
		Known	New
Design and production knowledge	Known	Existing situation	Chance 1 in 4
	New	Chance 1 in 2	Chance 1 in 10 to 1 in 100

Figure 2.7 The chances of succes matrix.

In the sixties and seventies of the 20th century there was a diversification boom which was often manifested in the taking-over smaller companies. This trend led, in the eighties, to an obvious reaction and to the focusing, once again, on what was referred to as a company's 'core business' area. Experience has indeed shown that in general only a limited number of activities related to each other can be properly controlled within one business.

2.7 Product renewal

How can one arrive at ideas for improvement or for the creating of new products?
There are various possible avenues:

- To, oneself, make a strengths and weaknesses analysis of one's own products. Such an analysis can be partly based on own knowledge and customer experience and partly on a similarly made analysis of rival products. What is to be highly recommended is that this does not remain limited to a technical analysis of the product but that rather a strengths and weaknesses analysis is again made of the entire company. Simultaneously, an analysis should also be made of the company's position and of the various products available on the market, that is to say, in relation to the competitors.
- Having marketing analyses carried out:
  - for versions of existing products, possibly on the grounds of analyses of the possible variations in customer requirements (again analysing own products and those of the competitor);
  - in order to establish what are the customer's needs.
    In this case it is advisable to look for the *functions* needing to be fulfilled for the customer and not for the products that he might possibly need. The first issue constitutes a more fundamental approach.
- The customers will themselves raise questions relating to improvements or renewals and they will sometimes even make demands for completely new product functions.
- To look for applications for existing products in entirely different areas like, for instance, the using of synthetic fibres in road construction work.
- To investigate in order to see whether existing business knowledge can be applied in entirely new areas like environmental conservation and deep-sea mining.
  When it comes to carrying out marketing analyses use is generally made of existing marketing research bureaux. Only a small number of companies have their own such departments.

Such marketing research might lead to:

- The further development of existing products.
- Various refined versions of the existing product, adapted to meet the demands of certain customers.
- The development of new products, designed to meet certain customer requirements.
- Goal-directed research aimed at resolving certain demand problems and resulting in the new product.

Examples:
The kind of example that can be given for the further development of an existing product is: the upgrading of a small ship's motor to give it more power or to lessen some specific aspect of usage or to reduce noise.
When altered to suit the demands of various customers such a motor can be given two carburettors instead of one and it can be made to operate differently, for instance, with or without an automatic choke.
In this respect, designing a new product to meet the demands of a customer might involve: designing a new motor of *X* kW that uses *Y* specific fuel and has *Z* maximum dimensions.
When developing a new product one must also bear in mind the aspect of the problems of diversification (see above). A ship's motor of the sort just mentioned might be adapted for use as an emergency generator for electricity supplies (both for ships and on land).

Purposeful research conducted in the motor industry branch in order to resolve the requirement problem of 'less vibration' which could lead to the discovery of the gas turbine (or the Wankel engine).

It is necessary to do all of this systematically and according to plan. What are the kinds of product developments that are to be expected at what stages and at what point does a step need to be taken. It all has to do with planning the product life-cycle. In Chapters 6 and 7 this will be gone into in more depth. The perpetuation and sustained viability of the concern will demand that all these activities fit in with the company's policy and that they also fit into the long-term planning of the business as a whole. This will be further discussed in Chapter 8, 'Objectives and Policy'.

2.8 The research, development and design sector

In the nineties the emphasis was very much on the shortening of development periods from the point of initial concept to serial market production. This, too, came about under pressure from Japanese competitors. We are now able in Japan and in Europe to bring out a new car model within the space of about three years. Sometimes it becomes apparent from the above-mentioned types of analyses that a certain kind of product needs to be put on the market within a very short space of time. The time normally taken within the design development department to achieve that is too long and so buying a *licence* can sometimes help to speed things up.

Example. It has been established that there is a demand for dish-washing machines and one is eager to put one's own trade mark on the market as soon as possible. In such a situation buying a licence can be a good solution. This thus gives one space for development in that area and space to gain experience.

In terms of own product research and design, great flexibility and good organisation is also required in the relevant departments.

On top of everything else, close interaction between all parties involved from the very first stage is an absolute prerequisite if a good saleable product is to be evolved. A product's cost price is, to a large extent, determined by the *product design.* The fewer the component parts, the less expensive a product will usually be. The kinds of materials and sorts of connections used (screws, bolts, welding or clicking together) will also be of paramount importance. DFP (Designing for Production) and DFA (Designing for Assembly) are important factors. It was by operating in that way that within a space of five year's time Philips managed to bring down the number of sub-assembly stages by 25% for CD players, by 50% for video recorders and by 55% for tuners. Between 1975 and 1985 the number of components used in colour TVs dropped from 450 to 80. This, too, turned out to be one of the greatest contributors to quality increase. With DFP it is chiefly 'simplifying' by standardising that is concentrated on and with DFA the onus is on modular design. The key concept with DFA is that of obtaining 'fewer components' and simpler connections. Endeavours are made to, as far as possible, switch to cheaper production methods like for instance spray moulding one synthetic part instead of turning, milling and boring a number of metal components to collectively fulfil the same function as that achieved by one moulded artificial part. If a product design is to be produced that can be practically 'automated' then DFA techniques are essential. The aim is to reduce the labour content aspect of the final product as much as possible. Where car radios were concerned the labour content facet was cut by 60% within the space of five years. With shavers Philips managed to bring down the labour aspect by 65% of the original time investment. Because of this, it is increasingly becoming the case that with many products, assembly is making up an ever smaller part of the total cost price. With small series assembly it would seem that it is essential to properly build up the end product in a modular way so that modules can be used for different customers and so that customer's requirements can be more easily integrated into the design. As well as applying the referred to techniques, task forces can be created and production engineers can be stationed in drawing rooms to look over the shoulders of designers, together with tool constructors. When it came to developing the Concorde (SST) BAC took the step of placing the entire Technical Development department *in* the drawing room.

Within this system it would seem advisable to replace these brought forward process and tool engineer positions with others after several years so that they can again be brought closer to the production process. What also seems to be very effective is building what is known as an installation mock-up in which designers, production preparation engineers and manufacturing employees come together to discuss problems collectively.

What is extremely important for flexibility in the design and engineering sector is the applied specification system. In the Netherlands the system still widely used is one that is of German origin, however, the American design system offers great advantages.
More details of this are given in Appendix 2.III.

When it comes to production flexibility, what is especially important is having what is known as a *modular* product set up. What this means, in other words, is that the product is so fabricated that it is built up of separately constructed and even separately testable sub-assemblies. This is something that can be applied to a greater or lesser degree. If that sequence is followed, the product engineering or detailed design phase offers the following possibilities:

- A basic final product to which variations can later be introduced.

Example. A basic ball gown design to which different bodices can be added and a bolero or different belts.

Such variations can be introduced at various different locations:

- By the customer himself at home, with the company - if need be - providing the required extras.
- By a special company or separate department set up to deal with special customer requirements.
- During the own production process.

Example. The Fairchild factory (USA), responsible for building the Fokker F27 under licence, only actually introduced one or so of seven specific customer requests to the production line; excluding, for instance, radio and interior design suggestions. It was an emergency radio communication system that was used to fly the plane 60 miles to the company Horten and Horten. That company, which was completely independent of Fairchild and worked for other firms as well, built in all the customer requests. This company's entire organisation was geared to speedily implementing customer requirements without the need for too much design work etc.

- Designing a basic final product in such a way that special customer requests influence the production process just at the latest possible stage.

Example. Sometimes customers want to have operation panel instruments built in that might deviate from those provided in standard sets. In view of the long throughput time required for such panels it is wise to leave a sufficiently large enough space in the area where the optional equipment might be built in and to only cover over that gap at a very late stage with a special covering plate if no adaptations are required.

- Presuming that there is a basic product situation of the type described above, one can account for influences that are specific to the early stages of the combined construction process and which definitely cannot be postponed to a later stage, by building in 'provisions for' into *all* products.

Example. A radio chassis containing what seem, at first sight, to be useless extra spaces or unused projecting parts or an extra cable cluster with apparently unnecessary wires.

- Another possibility is that of creating an end-product from as many as possible existing standard sub-compositions if a company wants to supply a properly finished off end-product in various versions.

Example. Composing an electronic system from a number of standard black boxes or integrated circuits.

This can also even be achieved in the shop like, for example, with the more expensive ranges of cameras that come with lenses, viewfinders, lens hoods and filters.
Alternatively, it can be achieved by the customer at home, as may be seen with wall furniture combinations, fitted kitchen units or PCs.
Even with component parts, it can be best to not continually think up new designs but to rather incorporate as many as possible previous designs. In many cases one can standardise a great deal more and establish such matters in own norm documents. Sometimes it is possible to design a new essential part along the lines of an existing component part with which people already have work preparation and production experience. Group technology in the drawing room, goal-oriented documenting and effective classification are all ways and methods that can aid the speedy location of a comparable old part in the design archives.

2.9 The production sector

Production departments continue to strive for a certain degree of peace and regularity. In part this is a consequence of the normal human aversion to change but it is partly born of necessity: so that everything remains controllable, so that cost prices can be kept as low as possible and calculable, so that norms can be fixed, supply levels limited and productivity controlled.
In these departments also, though, much greater levels of flexibility must be realised while maintaining standards of quality and efficiency. Flexibility can, in part, be increased by adhering to the above-described alternative way of designing products. Shortening production times can also lead to greater flexibility because a new or adapted product will thus be pushed faster through the production process. Short *throughput* times not only contribute significantly to flexibility but also to cost price reduction. The stock reserves in work places become reduced which means that the entire capital tied up in on-going activities is also reduced and thus also the rent levels. By performing good integral logistical analyses, also including in the calculations the quantities of finished products, Philips has been able to cut down on its stock levels by 15% to 50%. It would seem that stock reserves are, above all else, a consequence of organisational forms and management methods. Even though it is not all only about reducing throughput times in work places; such considerations are certainly just as important in the preliminary design and work scheduling phases. Working in a modular fashion and establishing good agreements between drawing rooms and production lines can help to substantially reduce production times. People demand, moreover, high levels of *delivery reliability*. Goods have to be supplied on the promised dates, no earlier and no later. The demands placed on the controllability of the production process are therefore high. Simply automating planning and information systems will not be sufficient to expand flexibility enough. It is notably in

the defence industry that it is becoming evident that those in charge of placing orders are switching to much smaller orders per assignment and that perpetual modifications of previous orders are being requested. These lines of business are being forced to go over to much shorter throughput times and to smaller batch sizes which is again something that calls for shorter *turnaround* times for machinery. All of this demands different organisational structures which cannot be realised within functional structures because that would again lead to waiting times within each department. Hence the reason that in the eighties there was a strong drive for a switch to group-organised production structures involving dealing with one component, from A to Z, within one department thus creating mini type factories within the company. Such processes are known as production islands, *cells* or avenues. In this way, throughput time reductions dropping from 12 to 5 weeks or sometimes even from 6 months to 1 month can be achieved. It is therefore all about as much as possible limiting the number of transitions from one department to another. Here, too, by changing the product design it is sometimes possible to make big profits.

In such kinds of organisational developments where there are consequences for product design Japan became a definite forerunner with concepts such as JIT (Just-in-time production) and Kanban, that is to say, manufacturing parts cell-wise and applying 'flexible manufacturing systems'. Shortening turnaround times by introducing SMED (Single Minute Exchange Dies) has also gained much attention. What is essential in this context is to see to it that beforehand as many as possible machine-independent procedures are carried out so that the production process does not have to be interrupted for so long. This has meanwhile caught on in American and European industry.

It would appear that such changes are innovated at the expense of efficiency. It would seem that a product's flow-through speed is more important than seeing to it that people and means are optimally deployed. There are thus slack periods, both with people and means, which means to say that in certain work areas, efficiency diminishes. With Scientific Management the focus has always been on the efficiency of one working area and, at the very most, the efficiency of an existing department. Under the pressure of all these developments it is now becoming understood that what ultimately counts is *the productivity and efficiency of the company as a whole.* If, through a certain loss of people and means, supplies can be heavily cut back and controllability significantly improved, then the *total* production costs will thus often drop and what it is all about, after all, is those *total costs.*

People are not fully enough aware of the fact that production-organisation structures are not static elements but that they are rather also production means with their own economic lifetimes.

2.10 The marketing sector

Despite being bound to comply as much as possible to customer demands, marketing departments are able to contribute to resolving these new design and production problems by taking the following lines of approach:

- Directing advertising chiefly at existing versions and only deviating from that policy if that is what the customer wants. Only therefore making special offers if sales would otherwise stagnate.

Example. Just one type of motor is advertised for pleasure boats. Only upon special request is it revealed that it is possible to produce and build in a different motor selected from a range of other motor types.

- To, in consultation with Design and Engineering, Production and Marketing, offer a whole package of suggested variability versions, that is to say, very many combination possibilities derived from a relatively low number of special extras.

Example. Notably in the case of cars, one often finds that by allowing the customer to choose from a (limited) number of extra possibilities he gains the impression that his car is virtually entirely adapted to his particular demands.

One then has to check for price list inconsistencies. In certain instances, when totted up, the price of all the loose extras turns out to be lower than the price fixed by the manufacturer for model X which already contains all those particular extras.

- The Sales Department has to recognise all the quasi-demands of the customer and endeavour to get around them or talk around them. In this connection it has at its disposal various repelling instruments in the form of higher prices and extra delivery times.

Example. If a special dish is ordered in a restaurant this will often entail an extra waiting time (requested in a friendly way!)

Douglas once charged KLM a 1000 dollars to lift a cabin door from its hinges and remove it. Half of the hinge fixture was simply left in the partition.
On the other hand, the salesman has to watch that the customer does not request accessories simply to delay the sale or to push down the basic cost if indeed such wishes are hinted at.

- By creating sales forecasts or prognoses on which to base production planning the sales department can also contribute to making production processes more smooth. Such prognoses should be realistic and stripped of all possible salesperson's optimism. Furthermore, such prognoses should not be continually amended. It is always advisable to include the forecasts produced by two previous prognoses in one's new forecast graphs. Sometimes one will see that the predicted half year sales increases were also, on the two previous occasions, projected six months in advance and that this time lag only continues to move up.

Marketing Departments should also concentrate on industrialising. At present it is far too often the case that people operate according to their intuitions.
The methods and organisational forms adopted by marketing departments will depend very much on the type of customer involved. The way in which the need problems of an anonymous group of customers is dealt with will differ greatly from the way in which the needs of a known customer for a specific machine are responded to.
In the case of mass consumption goods there is such a thing as a *'marketing mix'* composed of:

- The product (quality, design, packaging).
- The price (consumer's price and trade prices).
- Advertising and sales promotion activities (thematic and special reductions).
- Distribution (choosing the trading outlets).

> The 'marketing mix' is thus the combination of all the factors that the marketing man can control and wield to achieve his goal of selling the product in quantities that are as big as possible.

When selling just a few articles it will not be generally desirable to deploy such methods. The emphasis will then be much more on short delivery times, high quality, favourable financial arrangements and good after-sales service.

2.11 The service sector

Making a product operational and maintaining a constant level of operation is what is becoming much more important to the customer. This can be done:

- At the customer's request, possibly by establishing a service subscription.
- By providing service, possibly even against the wishes and desires of the customer, simply to boost the service image.
- To protect the brand name and to safeguard the product's reliability.

Example. When selling planes it is often the case that, the free services of a number of servicing engineers are offered for six months or a year. This is done to make sure that the aircraft do not complete too few flying hours or to see that they do not even crash because of insufficient expert upkeep in the early stages.

- The rapid supply of spare parts.
  - Should supplies be kept and for how long? In The USA it is legally laid down that all spare parts should be deliverable until 10 years after the last model of a given product has been manufactured.
  - Possibly by dismantling not yet marketed products and extracting the desired parts.

Example. Fokker guaranteed that every emergency spare part order could be responded to in such a way that within 24 hours of receiving the order the component would be on its way by air freight. If the part was not instantly available it would, if necessary, be obtained from a production-line aeroplane.

- Clear and good guarantee conditions and user's instructions.

Despite excellent guarantee arrangements quality still has to be very good because even if repair is free of charge the customer becomes very annoyed when the product breaks down and has to be taken away for a while.

- In conjunction with further production and company policy.

Example. Increasingly more companies no longer carry out receipt checks on the components received from their suppliers. It is demanded that everything is 100% in order but checks are not carried out on arrival. It is generally the case, however, that on the other hand the attitude remains more flexible during the guarantee period. This is cheaper for the

company and the customer 'applauds' the flexible guarantee system although again, just as in the previous example, the hindrance and feelings of annoyance once again arise.

An essential aspect of service remains the good level of communication between the customer and the supplier and the ability to react quickly to complaints.

2.12 Conclusions

Market situations are in a state of perpetual change and the choice facing each company remains:

to carry on just as it has done in the past

or

to adopt a different attitude to engineering and production in relation to market demands by coming up with a creative answer to these problems in both the design and organisation areas of the engineering and production departments.

If one goes for this latter option then ways will have to be found of keeping *all* departments informed of each other's problems when it comes to dealing with market demands. Many of the solutions leading to greater flexibility seem to make one particular product more expensive *within* one particular department. When *all* departments and *all* products are brought together it is often possible to bring prices down by striking the right combination balance. The solution finally settled for must be one that is *good for the enterprise as a whole.*

In view of all the problem facets existing in all the different departments this remains a complicated and difficult issue but one that *must* be resolved if the business is to remain viable. An atmosphere of open interaction between the departments, devoid of narrow-mindedness and a willingness to show devotion to the objectives of the company as a whole are necessary if the company is to survive.

If no creative answer is found to this problem then the threat of being taken over or of going into liquidation will hang above the company's head.

This problem and the integral problem approach which is, in our view, inevitable when it comes to being successful in solving these problems within any 21st century business environment, are further elaborated in Chapters 6 and 7.

2.13 Appendices

2.I How the working population is divided between the three sectors
2.II The working population in the Netherlands
2.III The specification system

Appendix 2.I How the working population is divided into three sectors

How the working population is dispersed over the three sectors percentage-wise. The move from sector I to sectors II and III has progressed further in the Netherlands than in Western Europe as a whole (the Netherlands included).
The USA is a stage further. In 1980 its tertiary sector was 68% while in the Netherlands that was 65% and in Western Europe as a whole 50% in that same year.

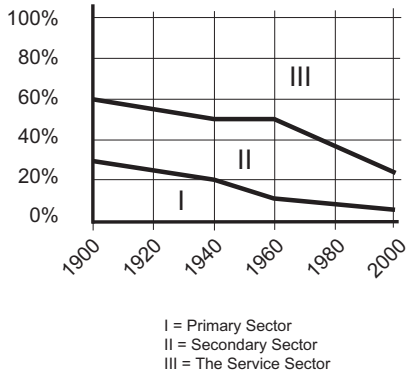

Figure 2.8 How the entire Dutch working population is dispersed between the three sectors.

Appendix 2.II The working population in the Netherlands

	Population Census			
	1960	1970	1980	1998*)
Total population	11.5 million	13.1 million	14.2 million	15.7 million
Working population	4.0 million	4.7 million	5.0 million	7.0 million
Divided between:				
Agriculture	9.0%	7.4%	5.5%	3.0%
Industry	41.5%	39.1%	29.6%	22.1%
The service sector	38.5%	40.6%	45.7%	60.9%
Central government and military services	11.0%	11.7%	14.2%	7.4%
The registered labour reserve		1.2%	4.9%	6.5%

Figure 2.9 The working population in the Netherlands (from the CBS Statistical Yearbook).

*) Derived from the Statistical Yearbook for 2000 published by the Central Statistics Bureau (CBS).

In 1998 the entire population rose to 15,654,200; the prognosis for 2020 is now 16,894,000. In 1998 the working population rose to 6,957,000. This meant that in 1998 the registered labour reserve, that is to say, those without work and seeking

employment dropped to 5.2% After Luxembourg (2.6%) and Austria (4.4%) the Netherlands had the lowest unemployment average in Western Europe.
What is meant here by 'Industry' is the process of obtaining minerals and establishing public services and the construction industry.
Included under the "Service Sector" are also the sectors: education, health and welfare, culture and recreation.

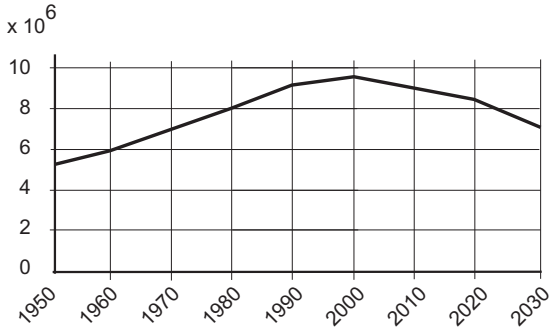

Figure 2.10 Potential working population: the average variation.

Extracted from: the CBS population prognosis for 1934-2035.

Appendix 2.III The specification system

A specification system for the Netherlands.
Up until the end of the fifties it was almost exclusively a specification system known as the 'European' or 'German' method that was employed in the Netherlands. It is a system that many companies still use today.

CHARACTERISTICS OF THE EUROPEAN SYSTEM

- The detailing of sub and detailed-assemblies (alongside of main and final assemblies) takes place on the basis of *drawing* technical grounds. The parts of the detailed design denoted as 'lower' assemblies are determined by the engineer. Details of the actual *construction* technical steps are at this stage of less importance.
- If more than one assembly is given in detail on one drawing then the design will be given the number that belongs to the most important composition. The remaining smaller compositions on the drawing in question are not given a separate number.
- The system does not really take into account the exact technical *detailed designing* steps involved in production. Because of this it is often the case that when making production preparations and when in the work place, whole series of drawings are required to prepare or produce relatively small production compositions.
- For the identification of certain production compositions those involved in the preparation process have to draw out and keep accounts of new numbers.
  On top of that, new numbers are needed for smaller compositions that were not given own numbers on the original design drawing.

- The parts of a composition are indicated on the illustration pages with the post numbers 1, 2, 3 etc. Behind every post number on the parts list page is, a part number and a name followed by certain specific details.
  Every "part" thus has one post number and one part number.
- As soon as, according to the designer of details, the drawing pages are too full or too obscure because of the many numbers he can work out a number of corresponding parts on separate drawings. Here the technical *drawing* insight of the details designer will be decisive, that is to say, his insight into what a certain section will look like when it becomes a completed product, is what will count.
- If a drawing introduces modifications then a transparent copy will be kept.
  If the original drawing is changed completely then the details designer is again free to choose the post numbers, also where existing parts are concerned. It is thus possible to find a number of previous versions of such drawings in the archives denoting certain parts which have each time been given different post numbers.
- When interpreting the drawing the ways in which post and part numbers refer to each other will be used as a guideline when it comes to finding one's way around the various drawing pages. The post number of a certain part may be different in all subsequent references. One therefore has to be very careful if one wants to avoid making mistakes when interpreting drawings. Moreover, it is often the case that in the production documents all post number references must be adjusted every time a number is changed.
- When a drawing is modified an indexing system is used for all the drawing pages to make sure that none of the pages are confused with those of previously issued drawings.
  In the process, all the non altered sections will automatically also be given higher indexes. There has to be a separate record system to show how per customer and per order the relationships lie between:
  - The relevant series numbers of end products.
  - The contents of the accompanying drawing package in relation to the drawing numbers and the valid index for each drawing.
  - The modification standards for the parts and assemblies of every relevant drawing corresponding to the index called up.

The European drawing system is primarily oriented towards the definite establishing of *end-products*. The determining of interim production stages and the introducing of modifications gives rise to major objections. The chief repercussions are 'search pictures' in the production process, extra work in the preparatory stages and an unnecessarily high risk of mistakes because of the confusing information generated. Beyond this it is necessary to have an extensive record system in order to register the modification standards of the consecutive end-products, together with their compositions and parts.

CHARACTERISTICS OF THE NEW SYSTEM

The 'American drawing system' was first devised in response to a request made by the USA air force. The chief underlying objective was to have a system that would be able

to meet the needs of a serially set up production system, notably in relation to aircraft. All the various requirements linked to systematic maintenance also had to be accounted for in such a system. The system thus became primarily *production* and maintenance oriented as becomes obvious from the following listed characteristics:

- The drawings give a step by step impression of the production realisation work. The detailing of small, sub and main compositions is related to the production steps as they are taken in reality. Before that happens, and on the basis of the drawings, intensive discussion takes place with the executors on the construction sequence and on the assembly methods to be adopted.
- The installations are drawn in such a way that a complete set of drawings is produced for each of the work areas to be installed. With the European system installations, for instance hydraulic or electrical installations, are completely worked out per installation on own drawings, on what are known as the integral drawings. With the new system, though, 'installation rooms' or 'zones' are distinguished, according to the needs dictated by the product. For each installation room a specific set of integral drawings is created with *all* the installations.
- The consecutive composition variations and all the various components are each allocated a number which is known as the part number. The number is retained throughout the product's life cycle: drawing number + sequence number = part number.
- One assembly and its related parts is, as far as possible, worked out under one drawing number. The assembly variations influenced by, for instance, project development or project improvement are given in the original drawing page tracing.
- Reference is made on every assembly drawing to the technical destination, that is to say, to the next higher composition. Conversely, on the assembly drawing, reference is made to the sub-assemblies by means of part numbers and naming systems. The references made to the various assemblies at different levels is given schematically in Figure 2.11.
- Changes given on the drawing are immediately recognisable and possible to locate. With every subsequent alteration made to the drawing sheets only what has changed and therefore needs to be added is drawn again. The impression of the old part is retained on the drawing. In the parts list a new composition variation column appears indicating which old and new parts are used in the variant.
  New parts should be taken to mean both the new single parts or details and the new lower sub and detailed assemblies.
- The essence of every change that is integrated is briefly summarised on the drawing. As far as all the many smaller modifications are concerned, the production people are preferably informed by means of a separate modifications attachment on a sheet of paper which is then placed with the drawing. The maximum number of alteration sheets that can be attached to any one drawing is usually restricted to five. They are then occasionally integrated into the original tracings.
  With every following alteration the drawing is given a new A, B, C, etc. index. The higher index only appears on the modified parts list and drawing sheets. When

again issued the drawing sheets are registered, together with their new (or already existing) index, on what is known as a release bill. In this way, use of the drawing, together with the new modifications standard, is authorised.

- The drawing package of an end-product is built up in a modular fashion. This increases flexibility with regards to the fitting in of further product developments. The components that are differentiated are:
  - A basic drawing package.
  - A drawing package for the versions.
  - Drawings for customer's requests.

The basic drawing package remains, in principle, valid for all the following end-products. Standard provisions for versions and for possible customer requirements included in the package ensure that the production of the corresponding basic production part is disrupted as little as possible.

The end-product versions – with an aeroplane, for instance, a large freight door or an extended cabin version – are detailed in separate drawing packages (version modules). The same goes for the customer requirements relating, for example, to installations and furnishing. A separate drawing package (customer request module) is made for every customer requirement.

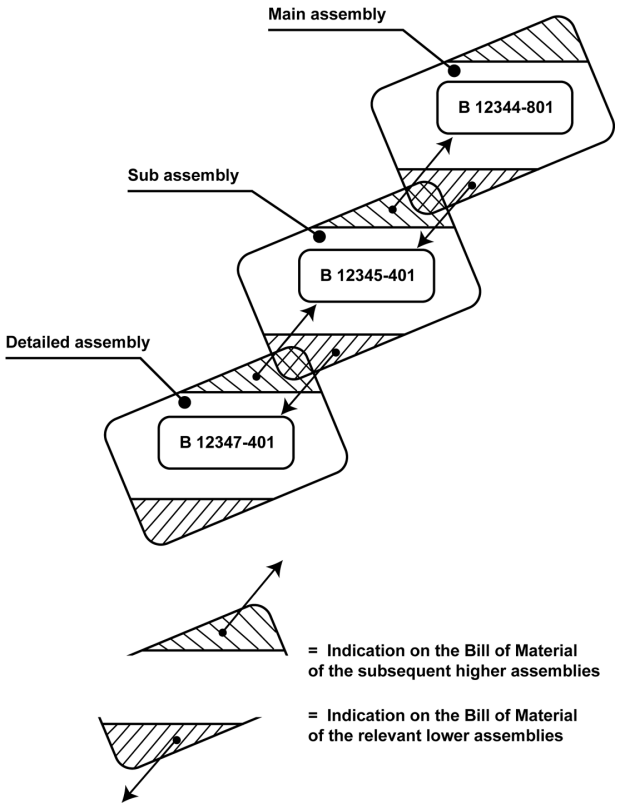

Figure 2.11 How one assembly relates to another at the different levels.

The entire drawing package is thus built up in this way, from the basic package and a selection from the assortment of version and customer request modules. This is schematically illustrated in Figure 2.11.
The drawing gives the final destination of each composition variant as well as the relevant corresponding parts. In the basic package direct reference is made to the end-product indicated by means of a series number which is valid for various of the variants. In the case of version and customer requirement modules key numbers are used under which all the drawings destined for a certain module are collected. As and when required the Sales Department can designate from the modules assortment a certain number of the modules for specific end-products.

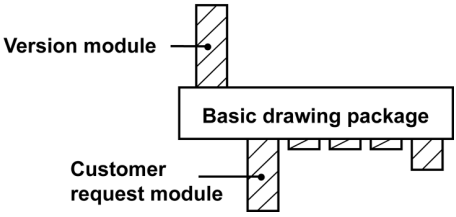

Figure 2.12 The composition of a drawing package.

- Every exact end-product version is determined by a varied mixture of specifications of and by a checking of the main elements of the drawing package. By indicating which versions and customer request modules are applicable in the case of a certain end-product all the parties involved may be speedily and unequivocally informed about the order in main outline. A specification of the alteration criteria for the various drawing packages gives a supplementary refinement of the order instructions.

The system may be accessed for questions posed in retrospect concerning the status, or the technical specifications, at the time of delivery. In the event that a certain shortcoming has to be rectified it is possible to quickly trace which drawings/parts are related to which modification criteria. By establishing a product's final destination it is subsequently possible to find out to which other products those drawings have been declared applicable.

SUMMARY

From the methods that characterise the old drawing system and the accompanying remarks it would appear that that system was basically a product-oriented one. The system is directed towards specifying and presenting the end-product and parts of it, insofar as that is thought necessary, by the engineer. Obviously the USA drawing system also included product specifications. Regarding the presentation, allocation, identification etc. of instructions and documentation the system is, however, primarily oriented towards production and customer requirements. The USA system takes into consideration the functions that the drawings need to fulfil during the respective production realisation and service activities. The system design also accounts for the organisation of production integration and the organisation of maintenance processes.

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