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The stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises through IT scenarios

Research Report

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Foreword

This report discusses the results of a pilot study into the stimulation of the diffusion and adoption of information technology (IT) in small and medium-sized enterprises (SMEs). The study was carried out within the framework of the research programme of the Eindhoven Centre for Innovation Studies (ECIS). ECIS is a research institute of the Faculty of Technology Management at the Eindhoven University of Technology. Its research is focused on the identification and analysis of the determinants and consequences of innovation and technological change in organisations, networks, sectors and national economies. This is seen as the key to better organisation and management of innovative processes in organisations and networks and to a better formulation of technology and innovation policies.

The present study deals first of all with the representation of theoretical approaches and concepts related to the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises. Secondly, on the basis of the theoretical insights obtained, a so-called IT scenario model has been developed, operationalised and tested. This model is a concrete instrument for stimulating the diffusion and adoption of information technology in small and medium-sized enterprises through direct communication with entrepreneurs on the subject of information technology.

This report can be a useful source of information to certain agencies that wish to know more about the theoretical and practical concepts and approaches related to the diffusion and adoption of information technology in small and medium-sized enterprises. These agencies may be universities, research institutes, umbrella organisations promoting the interests of small and medium-sized enterprises or the national government.

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Contents

Abstract

This report embodies the final results of a pilot study into the stimulation of the diffusion and adoption of information technology (IT) in small and medium-sized enterprises (SMEs) through a so-called IT scenario model. The reason for conducting this study was that we observed a lack of integration in the theoretical approaches at the meso- and micro-levels as far as the diffusion and adoption of information technology in small and medium-sized enterprises were concerned and also a relatively low degree of diffusion and adoption of knowledge in this sector regarding the strategic application of information technology. The aim of the study was to relate the theoretic approaches at the meso- and micro-levels to each other in order to develop an instrument, the so-called IT scenario model, with which the diffusion and adoption of information technology in small and medium-sized enterprises might be stimulated. The *central research question* was: *'Which aspects are important for the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises?'* The study consists of a theoretical and an empirical component.

The theoretical part encompasses an exposition of the relations between information technology, economy, small and medium-sized enterprises and diffusion and adoption mechanisms. Information technology has gradually led to a situation in which information, as an important source of knowledge, can be transported faster and cheaper over large distances and is as such a major stimulus in the knowledge economy. For an important part, the influence of information technology apparently needs to be analysed at the application level in the supply chain, in which the developments in the supply chain sparked off by IT are described with the use of such terms as standardisation, differentiation, specialisation and integration. In this, certain steps can be recognised, such as efficiency improvement, effectiveness improvement, competitive edge improvements, integration possibilities of information flows in industry sectors and phenomena of supply chain reversal. Thus, in the knowledge economy, the diffusion, adoption and implementation of technological knowledge in business processes fulfils an important function. Small and medium-sized enterprises constitute the target group in this study – an extremely heterogeneous group that represents the largest part of companies in national economies. There is a great difference between small and medium-sized enterprises and large-scale industry as far as the material and behavioural advantages are concerned, and this may explain the relatively low adoption degree of information technology in small and medium-sized enterprises. A greater diffusion and adoption of information technology among this group is therefore desirable.

Diffusion research generally aims to analyse the diffusion of innovations in a social system. In this particular case, it involves part of the Dutch small and medium-sized industry sector. Communication with potential adopters is the central theme in the diffusion process as this helps to reduce the uncertainty that exists among entrepreneurs with respect to information technology. Homogenisation of the group of potential adopters is a necessary requirement for optimising the effectiveness of communication. The environment and associated communicative connections of this group of potential adopters has thus a great influence on the adoption degree of an innovation in that social system. The adoption of information technology takes place at the micro-economic level. It is particularly the phases involving the 'provision of knowledge' and 'confidence-building with regard to the adoption process' that are important in this study as these phases relate to the growing awareness of the innovative character of information technology that is so essential in the diffusion and adoption of IT. In general, it may be stated that the awareness of entrepreneurs in small and medium-sized enterprises regarding the role and possible applications of information technology is relatively low, whereas this actually is a crucial element in the innovation adoption process. To some extent this has something to do with the dynamics of the adoption context, which makes it particularly hard for small enterprises to develop and maintain some conception of this context. Adoption of information technology involves learning about, and becoming aware of, the dynamic environment in relation to the role of information technology. The desired promotion of the diffusion and adoption of information technology in small and medium-sized enterprises highlights the need for better communication in this sector with regard to innovation. The concepts developed in terms of scenario

methods and IT growth-phases offer clear starting points for transforming and applying theoretical approaches to homogenisation, environment dynamics, uncertainty, awareness-raising, communication and learning in the model. Elements of recent IT growth-phase models can also be used as alternative measuring instruments for examining the productivity relation between information technology and economy somewhat further.

The empirical part relates to the development, operationalisation and testing of the IT scenario model. This model can be described as *'a structure that integrates economic and business aspects of developments in industry, supply chains and information technology into an industry-specific scenario for entrepreneurs in the small and medium-sized industry sector'* consisting of three main components, i.e. an environmental aspect, six phases and three aspect areas (strategy, technology and organisation). The model has been operationalised for the hairdressing and furnishing industries on the basis of various criteria. To test the model, it was used as a frame of reference in the IT stimulation project called 'Get more out of your computer' in which the enterprises in the hairdressing and furnishing industries were categorised into phases. This subsequently enabled the communication to be focused on the phases that still had to be realised and the associated aspect areas. The business visits made clear that the IT scenario model can be a useful frame of reference to structure the process of knowledge exchange as far as the strategic application of information technology is concerned.

The conclusions in the study refer to the theoretical context, the IT scenario model and the operationalisation and testing thereof. It is concluded that unequivocal theoretical bases for stimulation of the diffusion and adoption of information technology are still lacking. In relation to this, many approaches and concepts from various scientific disciplines have been examined in this study. With respect to the operationalisation and testing of the model, the conclusion is that the model may be a useful and accessible instrument for advising and informing entrepreneurs in small and medium-sized businesses about information technology. In this way, the model can contribute to the diffusion and adoption of information technology in small and medium-sized enterprises. A joint utilisation of communication channels such as an industry-specific consultancy or multimedia application can be very effective in this respect. In short, the IT scenario model is an instrument that may help to increase the diffusion and adoption of information technology in small and medium-sized enterprises and can therefore play a significant role in the diffusion and adoption policy relating to information technology in this sector.

The recommendations in this study focus on the theoretical framework, the development of the communication concept and the deepening and broadening of the IT scenario model. It is first of all recommended to further examine the relevant theoretical developments in order to integrate more firmly the various theoretical bases that relate to the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises, also with respect to the model already developed. Secondly, it is recommended to convert the model that has been developed into a practically employable multimedia communication concept in the shape of a CD-ROM or web site application. Finally, it is advisable to deepen and broaden the IT scenario model. By deepening is meant that certain relevant theoretical approaches and concepts should be incorporated more emphatically into the model. By broadening is meant the operationalisation and application of the model in multiple branches of activity. It is therefore also recommended to identify the position and future of the IT scenario model from a policy perspective.

Introduction

This report[1] embodies the final results of a pilot study into the stimulation of the diffusion and adoption of information technology (IT)[2] in small and medium-sized enterprises (SMEs) through a so-called IT scenario model. The reason for conducting this study was that we observed a lack of integration in the theoretical approaches at the meso- and micro-levels as far as the diffusion and adoption of information technology in small and medium-sized enterprises were concerned and a relatively low diffusion and adoption degree of knowledge of the strategic application of information technology in this same sector. The IT scenario model may help to increase the diffusion and adoption of information technology in small and medium-sized enterprises. It was developed on the basis of approaches in economic theory, innovation theory, business administration, management science and cognitive psychology. To test the model, it has been used as a frame of reference in an IT stimulation project aimed at the hairdressing and furnishing industries.

The first chapter of this report explains a number of matters with reference to the research context and structure as far as the development of the IT scenario model is concerned. Chapters 2-5 describe the theoretical bases relevant to the development of the model. Chapter 6 discusses the structure of the IT scenario model and the industry-specific operationalisation and testing of the model in the hairdressing and furnishing industries. Chapters 7 and 8 give a detailed description of the model operationalised for the above-mentioned industries. In Chapter 9, we end this report with the final conclusions and some recommendations.

[1] Wherever we have used masculine forms (he, his, etc.) to denote persons, this was solely done to avoid awkward constructions. It goes without saying that the femine forms also apply in these instances.

[2] The literature often refers to information and communication technology (ICT). In this report the terms 'information and communication technology' and 'information technology' are considered synonyms.

Chapter 1
The study: outline and structure

The rapid economic and technological developments in the globally oriented business world make the strategic use of information technology (IT) essential. In Section 1.1, the relation between economy and technology is therefore explained somewhat further. This provides the basis for the exposition on the relation between small and medium-sized enterprises and the application of information technology in Section 1.2. Sections 1.3 and 1.4 subsequently describe the wish to stimulate the diffusion and adoption of information technology in small and medium-sized enterprises and the research questions and structure.

1.1 Technology and economy

The relation between technology and economy and the developments in the perception thereof finds expression in the history of economic growth theory. In contrast to, for example, business-cycle theory, growth theory attaches central importance to the economic development in the medium-to-long term. Here, technological development is considered the major source of growth. In traditional *neo-classical* growth theories, technological development as such remains unexplained. Its various manifestations may be labelled as labour-saving, capital-saving or neutral and may even be incorporated into annual statistics, but technological development remains exogenous. There is not even an explanation for economic growth as such. The more recent *new* growth theories (Romer, 1990; Lucas, 1988) do mention endogenous technological development and also explain the differences in growth rate. These models take into account that the production of technological knowledge, as opposed to its application, usually goes hand in hand with a decrease in scale advantages. However, the most important observation in these models remains that the production of knowledge has external effects, also known as *spill-over* effects. The production of knowledge by one firm may also have consequences for other firms. Depending on the specific situation, knowledge possesses more or less the characteristics of a collective good (Wolfson, 1988): its use by some is not at the expense of its use by others (non-rivalry) and it is hard to exclude or make exclusive (non-exclusivity). With respect to the external effects of knowledge production, the literature makes a major distinction between the so-called *rent spillovers* and *knowledge spillovers* (Los, 1999). Rent spillovers are usually *embodied* in new products, production resources or processes from which other firms or industries may profit. Although perhaps desirable, payment through licences and the like is difficult to realise, particularly when different industries are involved. *Knowledge spillovers* often lead to the possibility of imitation improvement, for example, through 'reverse engineering'. *Knowledge spillovers* can also occur through the mobility of well-trained staff and fairs, trade journals and conferences.

In comparison with the above-mentioned neo-classical approach, the more recently developed *evolutionary* growth theory pays much more attention to the dynamic aspects of technological innovation, particularly to the institutional and environmental factors that determine the conditions under which innovations take place. A recent description of the theory and a comparison with orthodox economic theory can be found in Saviotti (1996). An important phenomenon in this evolutionary theory is the tendency of technologies to develop according to technological regimes, along natural trajectories (Nelson and Winter, 1977) or according to technological paradigms (Dosi, 1982). These concepts are very similar and mainly come down to technologies developing under specific circumstances along relatively clear paths until a specific limit has been reached. There does exist a certain compulsiveness, however. Like in neo-classical theory, the individual manufacturer tries to increase his profits, but his efforts are thwarted for lack of information. To be able to make choices nevertheless, so-called routines are created or developed. A routine can be defined as the entrepreneurial behaviour that is regular and predictable, developing over time and springing from the results of previous search activities. Some enterprises will possess other, and perhaps better, routines than their competitors, which generally leads to heterogeneity in technology use, price structure, investment decisions and the like.

The consequences of evolutionary growth theory for technological development greatly differ from the modern neo-classical approach. First of all, we have the validity of recommendations that are of a general nature in the neo-classical variants, while they differ from country to country, from region to region, depending on the institutional environment in the evolutionary growth variant. Another important distinction lies in the treatment of external effects, which are considered to be crucial in all three variants. In the traditional variant the emphasis is placed on the subsidising of R&D expenditure and determining property rights through patents, for example, because otherwise too little would be invested in R&D from a social perspective. The modern neo-classical variant, however, emphasises the supply of human capital and leans towards investments in human knowledge. In its turn, the evolutionary theory leads to a far broader range of recommendations in comparison to the other two variants. In addition to the recommendations mentioned above, the theory provides advice that is directly related to the importance that is attached to diffusion, adoption and implementation of technology (Saviotti, 1996).

1.2 Small and medium-sized enterprises and information technology

The focus on diffusion, adoption and implementation of technology is particularly important for the application of information technology in small and medium-sized enterprises, as SMEs hold a prominent position in national economies, and also because the level of application of information technology is relatively lower in SMEs (OECD, 1993, 1995). It is therefore desirable and essential that policies stimulate the diffusion and adoption of information technology in SMEs. This does not only apply to companies in high-technology sectors, but also to those in other sectors. However, most of the small enterprises are 'technology followers' rather than pioneers in the development and application of new technology. These smaller companies usually innovate by combining elements that are actually already known, resulting in innovations[1] that merely consist of a new combination of products, markets and existing technology. Innovations that involve original research and the generation and application of new knowledge are far less common. Nevertheless, there are also sufficient opportunities for these enterprises to make use of the innovation possibilities provided by information technology. Research of the Dutch Council for Small and Medium-sized Enterprises (RMK, 1995, 1996, 1997a, 1997b) has shown that the significance of information technology is primarily related to improvements in the competitive position, market position (e.g. vis-à-vis the informal circuit) and internal management (reduction in costs).

The present study also examined the bottlenecks that might occur during the implementation of information technology in small and medium-sized enterprises. It turned out that bottlenecks occur in two areas. First of all, there is the problem of knowledge diffusion. Secondly, the actual application of knowledge in an enterprise may be problematic (knowledge implementation). An important observation was that most of the small enterprises lack strategic insight into the possible applications of information technology and the way in which this innovation should be implemented in their organisation. Matters such as uncertainty, bounded rationality and satisfying behaviour make this group of enterprises relatively inert regarding search, selection and strategic application of innovations such as information technology. This inertia is related to the presence of firm-specific routines (Nelson and Winter, 1982) originating from learning processes, which reflect the regular and predictable behaviour of an enterprise. To influence these routines, knowledge of the possible applications of information technology should reach the smaller enterprises more adequately. Better organisational conditions need to be created and more attention needs to be paid to the development of a strategic vision on the possible applications of information technology, not just within the enterprises themselves, but also in networks.

1.3 Definition of the problems

As far as economic growth and technological development is concerned, evolutionary theory indicates that the diffusion and adoption of knowledge is just as important as the development of that knowledge. It may be stated that the diffusion and adoption of knowledge and, consequently, of technologies in small and medium-sized enterprises still leave considerable room for improvement in comparison to large companies. The development

[1] The term innovation can be defined as 'an idea, practice, or object that is perceived as new by an individual or other unit of adoption' (Rogers, 1995: 11).

of theories on the diffusion and adoption of technology (information technology in particular) in small and medium-sized enterprises is rather scanty and fragmented due to the fact that it is specifically aimed at the meso- and micro-levels.

In this study the micro-level relates to one firm or organisation and the meso-level to clusters of organisations. However, a sharp division between these levels cannot be made. This is why this study paid particular attention to the interface between these two levels. Examples of theoretical points of view with alternating emphasis on the micro- or meso-level are the innovation cycles of Abernathy and Utterback (1978) and Barras (1990), Williamson's transaction-costs approach (1975, 1985), Porter's five competitive forces concept (1980), the supply chain management concepts (SCM) (cf. Bechtel and Jayaram, 1997), Scott-Morton's consistency model (1991) and the IT growth-phase models (cf. Nolan, 1979; Venkatraman, 1991). The theoretical link between the various points of view oriented towards the meso- and/or micro-level is either lacking or very limited. This is partly the reason why the methodical application of policy instruments to stimulate the diffusion and adoption of technology in small and medium-sized enterprises is still in its infancy.

In view of the foregoing, this study is based on three starting-points. The first starting-point encompasses *the stimulation of the diffusion and adoption of technological innovations in a social system* by means of a targeted knowledge transfer. In this, the terms *diffusion*, *adoption* and *implementation* constitute the three main movements in innovation and diffusion theories. In this study the term *diffusion* is defined as 'the process by which an innovation is communicated through certain channels over time among the members of a social system' (Rogers, 1995: 5). The term *adoption* is defined as 'the process through which an individual passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt the innovation, to implementation of the innovation, and to confirmation of this decision' (Rogers, 1995: 20). The term *implementation* is defined as 'the user process that leads to successful adoption of an innovation of new technology' (Voss, 1988: 59). The second starting-point relates to the fact that, in this study, *some of the small and medium-sized enterprises in a sector or industry* are labelled as 'a social system'. This mainly concerns enterprises with fewer than ten employees. Furthermore, specific attention is paid to businesses at the end of the supply chain, which are characterised by knowledge-intensive services and direct contacts with customers. Knowledge-intensive services lend themselves well for applications of information technology, as this technology plays a fundamental role in processes that involve the collection, storage, processing and diffusion of actor-specific information. This leads to the third starting-point, namely the focus on *information technology* as the technological innovation that needs to be diffused to, and adopted in, some of the small and medium-sized enterprises. In this, information technology can be considered a generic technology, which justifies it being labelled as 'an innovation that is not industry-based' (cf. OECD, 1995). This has to do with generic technological features (hardware, software and communication) and generic implementation characteristics in the strategic, organisational and technological fields. The concrete types of information technology differ per industry or sector. This study focuses on those types that relate to process innovation. Together, the three starting-points indicate that this study pays specific attention to the stimulation of the diffusion and adoption of information technology in some of the small and medium-sized enterprises.

1.4 Research structure

The goal of this study is to relate theoretical concepts on the meso- and micro-levels in order to develop an instrument, the so-called IT scenario model, with which the diffusion and adoption of information technology in small and medium-sized enterprises can be stimulated. The *central research question* is therefore the following:

Which aspects are important for the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises?

The following six *subquestions* can be derived from this central question:

1. ***What is the relation between economy and information technology?***
2. ***What is the relation between small and medium-sized enterprises and information technology?***
3. ***What is meant by diffusion and adoption of information technology?***

4. ***How can the insights obtained from the above subquestions be modelled in an IT scenario model?***
5. ***How is the model operationalised for a specific industry?***
6. ***How is the model tested?***

The subquestions make clear that present study consist of two parts, i.e. a theoretical part and an empirical part. The study is of an exploratory, non-longitudinal nature; the emphasis is therefore mainly on the theoretical part. The theoretical part relates to the first four subquestions and encompasses a study of the literature with reference to the theoretical aspects underlying the IT scenario model. Many different theoretical approaches and concepts from economy, innovation theory, business administration, management science and cognitive psychology will be discussed. Matters such as decision-making concerning adoption, and implementation, which are certainly relevant to the innovation trajectory, will not be discussed in great detail.

The empirical part of the study finds expression through subquestions five and six. In this part the IT scenario model will be operationalised for two industries. To some extent, the model was tested empirically within the framework of the 'Get more out of your computer' project initiated by MKB-Nederland, the Dutch Federation of Small and Medium-sized Enterprises, which is an umbrella organisation that promotes the interests of approximately 125,000 entrepreneurs in the sectors of handicraft, construction, retail trade, health care, hotel and catering, recreation and tourism, manufacturing industry, transport, and business services. More than 115 industry organisations and approximately 450 regionally and locally oriented entrepreneurial associations have joined MKB-Nederland. Mid-1997, the 'Get more out of your computer' pilot project was started up in order to develop a methodology for informing and advising the small and medium-sized enterprises about an adequate application of information technology. Adequate application implies a simultaneous orientation towards three areas: strategy, technology and organisation. The parties involved include the Rotterdam Regional Training Centres Albeda and Zadkine, Nehem KMC (consultancy), the multi-media company De Overdracht and the Eindhoven University of Technology (EUT). The methodology has subsequently been converted into a CD-ROM-based communication concept. This concept consists of an informative component with pre-programmed data on the industries and a diagnosis component in which industry-specific data are inventoried by means of questions. On the basis of this inventory, the CD-ROM produces a so-called IT plan, which gives a specific enterprise some insight into the relation between strategy, information technology and organisation. The plan also contains a concrete IT advice. This instrument entered its implementation phase in the spring of 1999. Three industries in the Rotterdam region were involved: the furnishing industry, the hairdressing industry and the clothing industry. Knol (1998) gives a more extensive description of the project and the CD-ROM concept (methodology, structure and content).

Limited testing of the IT scenario model meant that it was not in its entirety subjected to a scientific test, but that part of the IT scenario model was evaluated as a frame of reference for the information and consultancy activities that were organised for the benefit of the enterprises involved in the 'Get more out of your computer' project. On the basis of this test, conclusions were drawn as to the possible role of the IT scenario model in the diffusion and adoption of information technology in the small and medium-sized enterprises in the hairdressing and furnishing industries. Appendix 1 provides some more information on the structure and contents of the CD-ROM concept of the 'Get more out of your computer' project.

This report is divided in 9 chapter. Chapters 2-5 relate to the theoretical aspects concerning the development of the IT scenario model. The empirical aspects of the model will be discussed in Chapters 6-8. Chapter 2 describes the economic aspects of information technology and therefore refers to the first subquestion. The subjects treated in this chapter include information as an economic commodity, information technology and economic growth, the relation between information technology and the market supply structure and supply chain, and the innovation cycle and its description in terms of standardisation, differentiation, specialisation and integration. In Chapter 3, the two focal points of this study are outlined, i.e. information technology and small and medium-sized enterprises (subquestion 2). Subjects that will be treated include the new IT paradigm, information technology as technological innovation, the Dutch small and medium-sized enterprises and the application of information technology in small and medium-sized enterprises. Chapter 4 subsequently tries to

outline a framework on a theoretical basis meant to provide some insight into the mechanisms underlying the diffusion of a technology in a social system and the aspects relating to the adoption of a technology in a specific business. Chapter 4 therefore relates to subquestion 3. Chapter 5 deals with a number of concepts including scenario methods and IT growth-phase models that function as a bridge between the theory represented and the IT scenario model to be developed (subquestion 4). Chapter 6 describes the structure, industry-specific operationalisation and testing of the IT scenario model (subquestions 5 and 6). The industry-specific operationalisation of the model for two industries is the subject discussed in Chapters 7 and 8 (subquestion 6). The final conclusions and recommendations follow in Chapter 9.

Chapter 2
Economy and information technology

A thorough understanding of the relation between economy and information technology is required to get some idea of the implications of the diffusion and adoption of information technology in small and medium-sized enterprises. Section 2.1 therefore gives a description of information as an economic commodity. Sections 2.2 and 2.3 subsequently shed some light on the relation between information technology and the market supply structure and supply chain. The innovation cycle and its description in terms of standardisation, differentiation, specialisation and integration are treated in Sections 2.4 and 2.5. The subject of information technology and economic growth comes next in Section 2.6. The chapter ends with the conclusion in Section 2.7.

2.1 Information as an economic commodity

Our society is becoming more and more an information society based on a knowledge economy (cf. OECD, 1996). The quest for knowledge to improve the quality of life has always been the major source of economic growth. However, information technology has gradually led to a situation in which information, as important source of knowledge, can be transported faster and cheaper over large distances. Moreover, our economic production does now no longer consist merely of material goods but includes more and more intangible, knowledge-intensive services. In economic theory, however, information and knowledge are not ordinary goods. There is a strong interwovenness with the notion of external effects (1.1). Knowledge and information are in principle not scarce or competitive. The consumption of existing knowledge and information by some does not take place at the expense of the consumption of others. In actual practice, knowledge and information can hardly be excluded or made exclusive by asking a price for it. According to traditional growth theory (1.1), all this means that there is a constant risk that, from a social point of view, too little will be invested in new knowledge, because the development costs are not recovered. For what does remain scarce is the capacity to understand existing knowledge and information and create new knowledge and information. This capacity is mainly stored in the heads of people, who have to be trained for every new function. Modern growth theory places therefore great emphasis on investments in human knowledge. Evolutionary growth theory relativises the weight of external effects of knowledge and information most by actually accentuating the significance and problems of the diffusion, adoption and implementation of technological knowledge in business processes.

2.2 Information technology and market supply structure

For the individual user, the usefulness of information technology as a technological application depends strongly on the scale on which others make use of the network and thereby enlarge the access to it. This added value through the increase in scale can also be found in the literature as 'network externality' (Katz and Shapiro, 1985, 1986; Preissl, 1995). For example, computers equipped with Windows form a network. The average user opts increasingly for this system, not only because of its inherent qualities, but especially because so many others are using it, so that texts and programs can easily be exchanged. The users of this largest network are subsequently confronted with a *lock-in effect*: switching to another, smaller network results in less externality. In this way, a natural tendency towards monopolisation seems to have evolved. The suppliers compete to become the largest in the field by constantly improving the speed of their system. Eventually, a situation will be created similar to that in the railway transport or energy supply sectors. For a long time, all kinds of authorities wanted to control these types of activities, but are now incorporating the market mechanism as far as possible. What it boils down to is that network management remains a common interest, while production and services are subjected to the competition in the market through temporary concessions, subcontracting, etc. As owner of Windows, Microsoft has meanwhile acquired a near-monopoly in the PC-software market, but remains innovative because its market is contestable. After all, lower communication costs and the Internet lower the access barriers in various parts of

the market. This also applies increasingly to smaller enterprises: new knowledge-intensive industries can be established at increasingly lower costs of capital (PC, intelligent software).

2.3 Information technology and the supply chain

The analysis of the influence of information technology on the innovation process mainly involves analysis at the level of the supply chain. In the literature, such analyses fall under the heading *Supply Chain Management* (SCM). Initially, in the seventies, these analyses were focused on improving the logistic flows of products and material through the introduction of information technology (Bechteld and Jayaram, 1997). Special emphasis was placed on the functional areas of purchasing, manufacturing and distribution. The main advantage of information technology could be found in cost reductions, for instance as a result of greater efficiency in supply management (Van Goor and Exel, 1997; SLIM-project, 1997). In the eighties, more links in the supply chain (e.g. design and recycling) were gradually integrated into the analysis. Furthermore, the analysis was not only confined to material flows, but also included information flows between relevant actors. Particularly in the nineties, the attention shifted more and more towards information integration within and between various organisations, which made the application of information technology indispensable. Competition does not only exist between firms, but also between various supply chains. Stock (1990) distinguishes between the traditional and the non-traditional approach in logistics. Non-traditional logistics is viewed as an integrating concept requiring direct links between the functional areas of the firm, on the one hand, and the firm and its environment, on the other. The intention is handling logistics in less isolation from the rest of the firm; acting more strategically, not just in an operational sense. According to Mears-Young and Jackson (1997), this new concept has not led to any significant changes compared to the traditional one. Too much emphasis is placed on the outcome of logistics, i.e. end-consumer satisfaction, and not enough on the interests of the stakeholders involved. Logistics need 'revolutionaries' who will explore other paradigms to see what these have to offer.

Cooper et al. (1997) have come to the conclusion that there is an absolute need for the integration of business processes in the supply chain, encompassing more than logistics. They present a SCM framework consisting of three major and closely related elements: business processes, management components and the structure of the supply chain. Successful supply chain innovation has to address the simultaneous adaptation of all three parts. Hewitt (1994) articulates the process-oriented supply chain redesign. With that, it becomes clear information technology will be essential for the necessary restructuring of the supply chain. Information technology enables the more efficient functioning of the relevant stakeholders while enhancing product quality and service delivery through internal and external changes of the production process. Actually, we can recognise in this the framework for IT-induced business reconfiguration developed at the MIT School of Management in the early nineties (Venkatraman, 1991). In 5.3.4 this model comes up for further discussion.

More concretely, the above-mentioned supply chain innovation implies a more regular service to the customer, and a faster, more individual-oriented and more reliable product. To achieve this, often the whole internal labour and organisation structure of the enterprise needs to be restructured and transformed into a more flat and flexible organisation. New labour structures will be born such as teleworking, freelance labour and new autonomy structures. In most cases, changes in the external organisation structure of enterprises will at least be just as large. Whole chains of activities change their structure, focusing on the end consumer. The traditional way of setting up the supply chain according to the *push* principle or the *build-to-stock* principle is nowadays undergoing fundamental changes, which tend to move more towards the *pull* principle or the *build-to-order* principle. In the literature, this is denoted by the term *supply chain reversal*; the transition from a supply economy to a demand economy. This last principle leads to the transformation of mass production into a production based on mass individualisation (Van Assendonk, 1998). Pine (1993) speaks of mass customisation - a strategy that uses information and manufacturing technology to efficiently produce goods with maximum differentiation with low cost production. The customer will increasingly become the starting-point for activities in the supply chain. Actors in the supply chain will change their functioning (e.g. the wholesale trade) and also their relations will change, i.e. they will become more tightly-knit and clustered. As a consequence of these supply chain changes and the introduction of information technology, substantial parts of the small and medium-sized enterprises will have to undergo innovation developments. All this we may conclude from the above-

mentioned supply chain integration (5.3.4) as described by Venkatraman (1991). However, as we have already mentioned, the end consumer will become more and more the starting-point of all activities in the supply chain. In such a case, one can speak of a reverse supply chain. The supply chain will obtain the quality of the 'old' handicraft, with information technology enabling a more efficient production.

2.4 Innovation cycle: the interaction between process and product innovation

In the economic literature, which tries to clarify technological development, an important role has been attributed to the evolutionary theory. A recent description of the theory and a comparison with orthodox economic theory can be found in Saviotti (1996). An important phenomenon in evolutionary theory is the tendency of technologies to develop according to technological regimes, along natural trajectories (Nelson and Winter, 1977) or according to technological paradigms (Dosi, 1982). These concepts are very similar and mainly come down to technologies developing under specific circumstances along relatively clear paths until a specific limit has been reached. In other words, engineers do not only rush from one bottleneck to the other, but, consciously or unconsciously, focus on certain technical problems using more or less familiar methods to find solutions. To a certain extent there is imperative necessity. A well-known example is the pattern of the advancing miniaturisation of semiconductors. Another example is the production of electricity in the past twenty-five years, reaching low product costs by constantly building large production plants. Despite these examples, there still exists a lack of clarity about the clearness and the possible existence of these trajectories for the total economic/technological process. For example, twenty years ago, Abernathy and Utterback (1978) pointed out the concept of an industrial innovation cycle involving product innovation, standardisation, and subsequent process innovation. They pointed out that mostly small companies fight for a market share in the first phase of the cycle. Radical new ideas for products are tested until eventually a dominant design evolves. What follows is product standardisation and further process renewal. This results in mechanisation and computerisation, so that advantage can be taken of large-scale production. Production on a large scale goes hand in hand with a concentration of production and integration of the branch of industry.

The gradual introduction of information technology in many companies and sectors, and the accompanying move from industrial to more service-oriented activities, seem to leave their mark on the innovation process. We are no longer involved with the familiar forms of capital goods renewal and the accompanying computerisation of labour. In various industrial sectors information systems are introduced (e.g. the chemical industry) and/or easily adjusted computer-controlled machines are installed (e.g. in the automotive industry). As a result of process innovation, existing products can in general be marketed faster and more extensively and will be more user-friendly and reliable. Moreover, an improvement in the information flows brings about different relations between suppliers, processors, customers, etc. This could be interpreted as process innovation (enhanced efficiency), which in itself leads to a better, faster, and more reliable product. This concept was coined as the 'reverse product cycle' by Barras (1990): process innovation being the main result of the introduction of information technology, followed by product innovation. For a more extensive description of this 'reverse product cycle', the economic concepts of standardisation, differentiation, specialisation, and (vertical and horizontal) integration might be used. This will be discussed in the next section.

2.5 Standardisation, differentiation, specialisation and integration

2.5.1 Standardisation, differentiation, specialisation

Technological innovation in a company or in a branch of industry depends on the interaction between a number of factors. One of these is the standardisation of products and processes. This may lead to an increase in scale and mechanisation. Moreover, standardisation leads to time saving since the wheel does not need to be invented again and again. Based on these standards, individual companies will therefore have increased opportunities for further shifting competition through differentiation and specialisation. Differentiation allows a producer to get a higher added value than his competitor by offering a specific, high qualitative product, which the consumer is

willing to pay for (Porter, 1985). Specialisation is an important part of this strategy. By increased standardisation, followed by differentiation and specialisation, companies can enhance their profiles in an ongoing phase of technological development. The standardisation and differentiation/specialisation necessary for innovation can only be established through cooperation, and thus require an increasing integration within the company, sector or branch of industry. Information technology can play an important role in this.

2.5.2 Integration

We define integration in a very broad way, not limited in terms of a hierarchical structure (Williamson, 1975). Our definition is not related to the single dimension of ownership and may involve strategic alliances, partnerships, contracts, collaboration and linkages between dependent or independent organisations. Transactions cost economics may help us towards understanding these cooperative relationships (Williamson, 1975, 1985; Hobbs, 1996; Saviotti, 1996). Cooperation and coordination among firms is limited by the *transactions costs* of managing the interaction. Transactions costs consist of two components: coordination costs and transaction risk. *Coordination costs* are the direct costs of integrating decisions between economic activities. *Transaction risk* is the cost associated with the exposure to being exploited in the relationship. It is widely recognised that information technology reduces coordination costs (Malone et al., 1987; Nooteboom, 1992), e.g. by increasing the transparency of supply and demand, or by reducing uncertainty, with better means of collecting, selecting and processing data. But information technology can do more: it can reduce coordination costs while also substantially reducing transaction risk (Clemons and Row, 1992; Clemons et al., 1993).

Three major sources of transaction risk can be identified: transaction-specific capital, information asymmetries, and loss of resource control. Fundamental economic characteristics of software reduce the investment sunk in a specific relationship, e.g. the possibility of modularity and replicability of know-how, and the support of conversion and translation of protocols and interfaces at low cost. As to information asymmetries and loss of resource control, information technology allows much more cost-effective monitoring of cooperative arrangements. Clemons and Row (1992) conclude that the reduction in transaction risk leads to greater reliance on outsourcing, that is, on use of outside agents to achieve economies of scale, scope, or specialisation. The reduction in coordination costs structures this outsourcing as stable, cooperative, value-adding partnerships. The application of information technology in these networks leads to situations in which the two extremes, i.e. *market* and *hierarchy*, can occur simultaneously (Clemons et al., 1993; Preissl, 1995). Clemons et al. (1993) call this 'the move to the middle'.

Vertical integration

The next starting-point in the analysis of the link between information technology and integration is Porter's five basic factors framework (Porter, 1980). A closer vertical cooperation also reinforces the position with respect to the horizontal relationships that are mentioned below. According to Porter, close cooperation between supplier, enterprise and buyer leads to tightly-knit distribution channels, which may form a stumbling block for potential entrants, substitutes and competitors in the same branch of industry. Suppliers and buyers are characterised by a vertical relationship.

Suppliers

Cooperation with larger companies within networks of suppliers and contracting firms is becoming increasingly important for the innovation process in SMEs (Oerlemans, 1996). Thus, the larger companies make fixed and reliable agreements about supplies with usually smaller companies that are able to function as *main suppliers* (innovators, developers) or *jobbers* (executors). Integration and large-scale industry are achieved while the individual enterprises themselves remain small or medium-sized. Consequently, SMEs often fulfil the role of supplier, whereas jobbers function as suppliers that supply parts or processing on the basis of detailed instructions provided by the firm contracting out. Mainly, this involves contracting out capacity. Strong vertical relationships exist when there are close cooperative relationships between firms contracting out and so-called 'co-makers'. This concerns the establishment of long-term relationships with a limited number of suppliers on the basis of mutual trust. Electronic Data Interchange (EDI) and Product Data Interchange (PDI) may help to

strengthen vertical relationships. EDI leads to more efficient logistics between supplier, enterprise and buyer (also via trade). PDI enables companies to process the 'joint' product and integrate different disciplines in a better way, and particularly to go through the design stages much faster. Close cooperation in the field of product and process development provides all the parties concerned with a more secure basis for investing in new technologies.

Buyers

Linking the internal IT systems of a company with the activities of buyers results in a dominant distribution channel, which offers specific and highly valued service to the buyer and provides the company in question with information about the behaviour, needs and characteristics of the buyer. This facilitates direct marketing and new ways of distribution and selling. More time has to be spent on drawing and keeping the attention of the public. For example, product differentiation can be increased if a company can improve the way in which it caters for the needs of individual customers. The implementation of information technology will strengthen the position of the consumer considerably. New services are offered such as those on the Internet, which, for example, search on behalf of the customer for outlets that sell a certain CD at the lowest price. On the one hand, the market becomes more transparent because of the improved search procedures for consumers. On the other hand, however, this transparency becomes blurred as entrepreneurs increase their product differentiation.

Horizontal integration

Horizontal relationships are formed by competitors in a branch of industry, new entrants and substitution possibilities. The extent to which potential entrants (e.g. foreign enterprises) have access to the market determines to a large degree the competition within a sector. Entrepreneurs can raise the access thresholds by using technological and product development to create a situation in which consumers will set higher standards with respect to the quality of a product. The strengthening of the vertical relationships as described above may provide an important basis for this. The possibilities of substitution by allied branches of industry (e.g. the DIY industry versus the local carpenter) limit the room that a sector has to take advantage of possibly favourable market situations and force the prices up. Information technology can lead to an increase in the number of possible substitute products. One example is the customer card of the retail trade, which makes it possible to offer direct banking services to the customer.

2.6 Information technology and economic growth

Over the past twenty to thirty years, the investments in computer equipment, software and other information technology have sharply increased. Today, these types of investments make up even more than fifty percent of the total capital expenditure in trade and industry. Theoretically, this should also have led to an increase in productivity and economic growth. However, productivity statistics indicate that the opposite is actually the case. There are a number of explanations for this phenomenon that was labelled the 'productivity paradox' (The Economist, 1996). A relatively large proportion of investments is swallowed up by replacements, as many PCs are prematurely traded in due to fast technological ageing. Furthermore, the productivity gains from information technology may not be realised as soon as expected due to considerable implementation problems. For the corresponding strategic and organisational changes are particularly drastic and crucial in the implementation phase of information technology. However, it appears that the most important explanation must be sought in the way in which the increase in productivity is measured.

The gains from information technology probably exist, but cannot be traced with the current measuring instruments. Griliches (1994) points out two problems that occur during measuring. First of all, information technology increasingly stimulates the knowledge economy, which is primarily a service economy. The product or result of services has always been difficult to measure in volume or monetary units. Profits improvement in health care, education and also in the financial sector is often brought forward as a quality improvement. Pragmatically, the output has always been equated with the number of hours worked in the sector. Thus, the annual increase in productivity is by definition equal to nil. As the provision is becoming increasingly important, this measuring problem will only get bigger. Moreover, services and products become more and more

interwoven. For example, about 70% of the value of the average car consists of intangible input such as R&D, schooling and training (The Economist, 1996). Thus, industrial production increasingly begins to resemble service provision, particularly when the production becomes more and more tailored to the wishes of the individual consumer (supply chain reversal and mass individualisation). At the same time, information technology makes that services begin to resemble industrial products. The traditional concurrence of production and consumption in the provision of services (cinema, doctor) is now not always necessary. It is particularly the codification of previously implicit knowledge in some branches of the service industry that makes direct contact between the service provider and consumer superfluous (videotapes, medical information on CD-ROMs). These services can be stored and marketed as products, so that also a possible increase in productivity can be measured. Secondly, Griliches (1994) observed that a large part of the gains from information technology is not so much expressed in terms of cost reduction, but far more as quality improvement, whereby the customer has more options and can be served better and faster. These quality improvements, which are often the result of the application of information technology, can hardly, if at all, be measured. For example, in the past few years, the quality of medical care has been improved considerably by means of better equipment and thus the average length of hospitalisations could be reduced. Banks also upgraded their customer services considerably. Such matters are hardly reflected by the statistics.

2.7 Conclusion

Information technology has gradually led to a situation in which information, as a major source of knowledge, can be transported faster and cheaper over large distances and is as such an important stimulus to the knowledge economy. In this knowledge economy, the diffusion, adoption and implementation of technological knowledge in business processes are of central importance. Apparently, the influence of information technology should largely be analysed at the application level in the supply chain. Information technology enables the parties concerned to function more efficient, enhance the quality of products through internal and external process changes and improve the provision of services. More customers can be provided with a faster, more personal and more reliable product or service. The activities in the supply chain now closely resemble those of the traditional handicraft, while information technology enables a production that is many times as efficient. Moreover, the improvement of information flows leads to different relations between suppliers, processors, buyers, etc. One might consider this a process innovation (efficiency improvement) which as such leads to a better, faster and more reliable product. These innovation processes can only be realised through cooperation and an increasing integration within the company, sector or branch of industry. Although closer cooperation increases dependency and possibly reduces flexibility, it remains indispensable for the innovation process in the sector. Information technology can play an important role in the integration of all this.

Increase in productivity and economic growth resulting from innovation through information technology cannot be traced with the current measuring instruments. This is mainly caused by the increasing importance of service provision in the growing knowledge economy and the fact that a large part of the gains from information technology are not so much expressed in terms of cost reduction, but far more as quality improvement. An alternative measuring method that is geared towards the above-mentioned developments in the relation between information technology and economy will be presented in Chapter 5. More emphasis is placed on the learning experience and the increasingly complementary natures of capital and labour as production factors. All this corresponds with the developments in economic theory. After all, the possibility of substitution between capital and labour is central to neo-classical theory. This possibility is gradually losing its significance and is being replaced by the complementariness between capital and labour. The application of new technologies, more in particular information technology, causes shifts in people's tasks and jobs: on balance, routine jobs and low-quality labour will disappear and more broad-based jobs with more responsibilities will be created. This seems to reduce the possibilities of substitutability: labour and capital are becoming more and more complementary. Each new investment in technology will thus require the automatic appointment of the most highly qualified people to ensure adequate execution. More recent developments in economic theory that attach central importance to technological development, such as evolutionary theory, do not so much proceed from slight changes in the cost structure of economic inputs as neo-classical theory does, but far more from large-scale changes in relation to

new inputs and technologies resulting from new input combinations and innovations in management and organisation. All this will be realised on the basis of 'trial and error' and not so much on the basis of perfect information. Innovation is primarily based on notions such as 'learning by doing' and 'learning by using'. This will lead to a situation in which a new technology, once it has been established, will not be reversed, for example, just because the relative cost ratio between capital and labour is changing.

Chapter 3
Information technology and small and medium-sized enterprises

The two central themes of this study, information technology and small and medium-sized enterprises, will be discussed in this chapter. Section 3.1 briefly explains the new paradigm of information technology and Section 3.2 describes information technology as a technological innovation and explains a few aspects from a historical perspective. Section 3.3 gives a description of the Dutch small and medium-sized enterprises and Section 3.4 deals with the application of information technology in small and medium-sized enterprises. Section 3.6 contains a summary and conclusion. This chapter does not go into social questions such as the consequences of technology for society (Postman, 1992) or the possible dichotomy between the information-poor and the information-rich in society (Haywood, 1992). These subjects have only a limited relation with the problems formulated in Chapter 1.

3.1 Information technology as a new paradigm

Some parts of the global society of the nineties are about to experience an important change, namely the transition from an industrial society to a society in which information and knowledge are of primary importance (cf. Beniger, 1986; Lyon, 1988; Drucker, 1994; Castells, 1996; OECD, 1996). The current development and adoption of information technology heralds the beginning of a new period in which tremendous social changes will take place. The socio-economic and technological developments of the past twenty to thirty years have accelerated this process of social change. Generic information technology can be used in all economic and social areas. The effects of application will influence our entire society in a such a way that, in terms of scope, they can be compared with the effects of oil-based energy production in a previous period or those of the steam engine or the extraction of iron in even earlier times. Information technology will change the market conditions and the position of parties in the supply chain structures, and the role of the consumer will be of central importance in all this. This will have a great impact on the internal and external organisation structures of companies. As labour will be mainly based on knowledge, its form and content will change. The increasing importance of knowledge will also emphasise the intangible side of the production process and service economy.

Castells (1996) classifies the current economic order[1] as an informational global economy. According to Castells, this economic order is first of all *informational*, because the productivity and competitive advantage of the units in this economy (e.g. companies, regions, nations) basically depend on these units' capacity to efficiently generate, process and apply knowledge-based information. The application of information technology plays a very important role in this. According to Lyon (1988), three powerful institutions are responsible for the boom in information technology that has taken place since the invention of the transistor in the fifties: the defence industry, the government and the business community. In the past forty years, these three have laid the foundation for the current integration of information technology in society. In the second place, Castells (1996) considers this economic order to be *global*, because production, consumption, circulation and the components thereof (capital, labour, raw materials, management, information, technology and markets) are organised on a global scale. This concerns an organisation through direct connections or through a network of connections. Castells states emphatically that the term global should not be interpreted in the strictest sense, as there are still many areas and countries that do not really participate in international trade. At the global level, Castells also observed a regional differentiation of this global economy into three economic power blocks, the so-called *triad*

[1] Van Hulst and Willems (1992) define economic order as 'a coherent system of unwritten rules and customs which enables the market at large to function in a coordinated fashion'.

powers; these are Western Europe, the United States of America and the Asian block. Information technology has become one of the more important technologies with which the competitive battle between and within these power blocks is fought.

3.2 Information technology as a technological innovation

3.2.1 What is a technological innovation?

Under certain conditions information technology can be seen as a technological innovation, but what is a technological innovation? The term innovation is derived from the Latin word *novus* and refers to the introduction of something new. Rogers (1995: 11) defines the term innovation as 'an idea, practice, or object that is perceived as new by an individual or other unit of adoption'. The term technology is borrowed from the Greek words *techne* (artefact) and *logos* (reason) and Tornatzky and Fleischer (1990: 10) describe the term technology as 'a tool or tool system by which we transform parts of our environment, derived from human knowledge, to be used for human purposes'. According to Tornatzky and Fleischer (1990: 11), a technological innovation is related to 'the situationally new development and introduction of knowledge-derived tools, artefacts, and devices by which people extend and interact with their environment'. Tornatzky and Fleischer (1990) point out that, as opposed to Rogers' innovation concepts, the boundaries of innovations, and certainly those of technological innovations, are very difficult to define and that definitions of innovations are not always unequivocal. This is because technological innovations are usually clusters of technologies. For example, from the technological perspective, information technology comprises a whole range of technologies, protocols and methods (3.2.5).

Innovations can be classified into different types on the basis of, among other things, the innovative degree of the innovation and the environment in which the innovation becomes embedded. With regard to the innovative degree, a distinction is made between *radical* and *incremental* or *routine* innovations (Ettlie et al, 1984; Dewar and Dutton, 1986; Nord and Tucker, 1986; Tornatzky and Fleischer, 1990). According to a Schumpeterian line of reasoning, radical innovations involve new combinations in connection with creative destruction. Nord and Tucker (1987: 11) define routine and radical innovations in a organisational context as follows: 'a routine innovation is the process of introducing something that can be implemented with only minor adaptations of existing organisational routines and that fits within existing norms and values of organisation members. Radical innovation is the process of introducing something that is new to the organisation and that requires the development of completely new routines, usually with modifications in the normative beliefs and value systems of organisation members'.

Regarding technological innovation a distinction can be made between technological innovation related to products and those related to processes (Abernathy and Utterback, 1978). According to Tornatzky and Fleischer (1990), this distinction is important for the following reasons. In the first place, to gain insight into the complementary relationship between product and process innovations. This has already been discussed in some detail in Section 2.4. In the second place, process innovations have in general a greater influence on the social and technological system of the innovation context. In the last place, there are differences in the adoption and implementation processes of process and product innovations, which means that the recognition of innovation-specific limiting conditions and implications is a necessary prerequisite for a successful adoption, implementation and application of a process or product innovation. In this study, the emphasis is on process innovation through information technology, as process innovations are essential for the professionalisation of industry in the long run and thus are partly responsible for an improvement in the competitive position of SMEs compared to large firms or foreign industry (Barras, 1990). Another point is that large parts of the SME sector lack the necessary knowledge about the strategic embedding of process innovations such as information technology (1.2). Within this report, information technology is viewed as a technological innovation in cases where it is perceived as relatively new by potential adopters.

3.2.2 The development of an innovation

The development and application of an innovation is a process of focused accumulation of knowledge and skills. That so-called innovation development process can be considered from two different perspectives (Tornatzky and Fleischer, 1990). The first perspective relates to the *supply side* of the innovation and is aimed at the creation and production of the technology. With respect to this, Schumpeter (1950) differentiates between invention, innovation, and diffusion. The second perspective is typified as the *demand side* and focuses on the adoption, absorption and usage of technology. Rogers (1995) classified the total innovation development process into six main phases (Figure 1). Each phase is characterised by specific processes, activities and decisions, both on the supply and demand side of innovations. Rogers gives a sequential representation of the process, but innovation development is most certainly not a linear process. It concerns an iterative process of progress and feedback, in which also certain phases can be skipped altogether (cf. Kline and Rosenberg, 1986; Tornatzky and Fleischer, 1990; Frambach, 1993; Rogers, 1995). As a result, it does not always concern the development of a new innovation, but may also involve the continuous change of the innovation (re-invention).

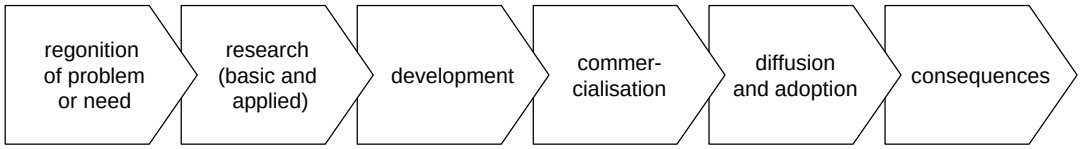


Figure 1: Innovation development process (Rogers, 1995)

In the last ten to twenty years, research was more aimed at the differences between the complex feedback processes in the innovation development process on the demand and supply side. In relation to that, Rothwell (1994) distinguishes the following five generations in the innovation development process:

- The *technology-push* generation mainly reflects the period incorporating the fifties and sixties. It concerns a linear innovation model in which R&D and production led to new products that could literally be placed on the market, without any feeling for the specific wishes of the market.
- The *demand-pull* situation of the late sixties and early seventies aimed more and more on the initiating role of the market in the innovation process as a result of increased and intensified competition. R&D activities were steered on the basis of the wishes and ideas in the market.
- According to various empirical studies, the previous two oversimplified concepts are not in line with the real situation. In the late seventies and early eighties, the scientific, technological and market forces were therefore integrated in a *linked model* incorporating the *technology push* and *demand pull*. However, this innovation process with feedbacks still remained a sequentially oriented process.
- In the eighties and early nineties, the emphasis is on the interactive, parallel innovation development process to reduce both development time and development costs. This so-called i*ntegrated model* occurred mainly in the automotive industry and electronics sector and made it possible to keep up with the fast developments (market, sector, technology).
- The innovation development process of the fifth generation is aimed at *systems integration and networking* (SIN). Horizontal collaborative relationships and vertical relations are intensified in a flexible way, while state-of-the-art information technology creates possibilities to coordinate and control the innovation process across the entire industrial column. In this way the innovative products and services that satisfy the needs of the individual consumer can be developed and marketed within the set development time and budget.

3.2.3 The characteristics of technological innovation

This study focuses on the interface between diffusion and adoption of technologically innovative information technology. The extent of diffusion and adoption of a technological innovation in a social system depends strongly on the characteristics of the innovation as perceived by potential adopters (Frambach, 1993; Bessant and Rush, 1995; Rogers, 1995). Rogers (1995) distinguishes five general characteristics of an innovation. For the sake of clarity, certain characteristics have already been related to information technology.

- The *relative advantage* of an innovation is one of the best predictors of the degree of diffusion and adoption of an innovation (cf. Davies, 1979; Frambach, 1993). An enterprise will decide to adopt an innovation only if the relative advantage in the form of, for example, an increased yield or cost reduction is evident. According to the Dutch Council for Small and Medium-sized Enterprises (RMK, 1996), the relative advantages of information technology relate to advantages in efficiency, effectiveness and competition. However, in the case information technology, the relative advantages are very difficult to quantify (cf. Renkema and Berghout, 1996).
- The extent to which the innovation is *compatible* with the current standards and values of the adopter(s).
- The degree of *complexity* of the innovation. The perceived complexity of information technology is generally high for a potential adopter who has no technical background. This is also caused by the many different manifestations and possible applications of information technology. It may be said that the way in which a certain type of information technology is applied will differ from industry to industry and even from enterprise to enterprise.
- The *trialability* of the innovation.
- The *observability* of the results of the innovation.

Tornatzky and Fleischer (1990) state that some of Rogers' approaches and ideas are far less significant with regard to the diffusion and adoption mechanisms of complex technological innovations. Partly because of this, they relate some more specific characteristics to technological innovations. However, these can largely be derived from the above-mentioned characteristics. As far as information technology is concerned, the following two interesting characteristics should also be mentioned:

- The *rate of technological development* of information technology. This characteristic is an impeding factor in the decision-making process concerning the adoption of information technology. Nooteboom (1989) uses the term 'obstruction of diffusion' for this.
- The degree of *interactivity*[1] of the innovation influences the rate at which the innovation is adopted in a social system (e.g. the SME sector). The adoption and application of an interactive innovation becomes more attractive when several adopters apply the innovation, because the more individuals communicate interactively with each other, the higher the practical value of the interactive innovation will be. In Section 2.2, we used the term *network externality* for this (Katz and Shapiro, 1985, 1986). The adoption rate of interactive innovations such as the telephone, fax and e-mail does not follow the classic S-curve, but shows exponential growth (Markus, 1987, 1990).

3.3 The development and application of information technology

3.3.1 The development of information technology

Current information technology is a very complex technology and comprises a range of technologies of different origins. Roughly speaking, the current forms of information technology come from the convergence of *computer technology* and *telecommunications technology*. In this section, we will give a brief outline of the development of information technology.

One of the first developments that contributed to the emergence of *computer technology* were the ideas of Leibniz (1646-1716) concerning the fact that all numbers can be represented by a combination of the two digits 0 and 1: the binary system. Babbage (1792-1871) subsequently developed a mechanical machine that could be used to carry out the four elementary arithmetical operations: addition, subtraction, multiplication and division. The article on algorithms that Turing published in 1935 also helped to lay the foundation for modern computer theory. The invention of the transistor by Shockley, Bardeen and Brattain at Bell Laboratories in December 1947 opened the way for the development of small-scale amplification and logic circuits. The chip led eventually to the development of mainframes, microcomputers and personal computers. Various operating systems were subsequently introduced, of which Windows, UNIX and LINUX-variants are nowadays the most widely used.

[1] Williams et al. (1988) describe interactivity as 'the degree to which participants in a communication process can exchange roles in, and have control over, their mutual discourse'.

Telecommunications technology began to flourish in the late nineteenth century as a result of the wide-spread application of wire connections for local telephony and the first successful tests of, *inter alia*, Guglielmo Marconi with the wireless system for the transmission and reception of electric waves. The invention of the radio valve in the early part of the twentieth century made it possible to realise wireless connections for communications in, for example, the merchant navy. The first public radio broadcasts followed a few years later. Figure 2 gives an overview of the evolutionary development of the most prominent telecommunications services over the past 130 years.

Figure 2: The evolution of various telecommunications services (OECD, 1989)

Figure 3: The convergence of telecommunications and computer technologies (OECD, 1989)

Primarily in the past twenty years, the types of telecommunications technology and computer technology have gradually converged into *one integrated digital technology* (Figure 3). This led to a clustered technology aimed at the real-time and interactive processing, storage and transportation of large amounts of digital information in the shape of data, text, moving images and sound. Terms related to this technology and these developments are the World Wide Web, e-mail, net computing, e-commerce, video conferencing, product data interchange (PDI) and virtual communities. Some of these technological innovations offer small and medium-sized enterprises opportunities for increasing their productivity and competitive advantage.

3.3.2 The application of information technology

In this section, an attempt will be made to explain the application of information technology (IT) somewhat further. The term *information technology* is a broad term and, because of the rapid technological developments in recent decades, it has many outdated definitions. Freeman and Soete (1985: 46) define information technology at a high aggregation level as 'a new techno-economic paradigm affecting the management and control of production and service systems throughout the economy, based on an interconnected set of radical innovations in electronic computers, software engineering, control systems, integrated circuits and telecommunications, which have drastically reduced the cost of storing, processing, communicating and disseminating information. It comprises a set of firms and industries supplying new equipment and software, but its development and applications are not limited to this specialised information technology sector'. From a more pragmatic and technological perspective IT is related to all technologies used to collect, store, process, graphically display, and transport data, and therefore encompasses computer equipment, system programs, application programs, and communication facilities. Examples are the order processing program in the furnishing shop, the hairstyle simulation facilities in the hairdresser's, an EDI system in the clothing shop, pay by computer (ATM machines, credit cards and Internet pay systems), multi-media facilities and the Internet. What is characteristic of information technology is that it is a generic technology that can be applied in many ways in diverse environments (OECD, 1995). Thus it is also typified as a collection of empty boxes that can be filled in any desirable way (Preissl, 1995).

The aim to use information technology in the production system of products and services has undergone some large changes in the past forty years. The first applications of information technology in the *sixties* were aimed at achieving efficiency advantages in the administrative processes. Particularly the laborious routine calculations could be carried out much faster, reliable and accurate with the use of information technology. Relatively cheap machines would replace human labour. In the early *seventies*, a beginning was made with the automation of entire standardised business processes by translating the working method of these processes into structured, formalised procedures. The aim was not only to work more efficient, but also to operate more effectively. A first step was taken towards the development of management information systems (MIS) that should support decisions at various levels, so that processes and activities run better. In addition, primary processes were automated using information technology with which machines could be programmed more flexibly. Although the costs can evidently be attributed to automation, the advantages of the application of information technology are usually found in other departments such as those of purchase, production, sales, etc. Porter's value chain (Porter, 1980) may help to shed some light on the role and use of information technology in enterprises (Figure 4).

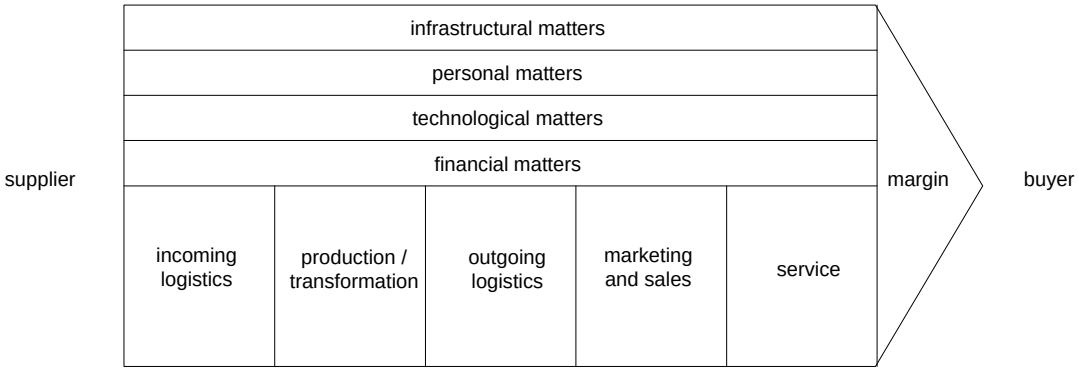


Figure 4:The value chain of Porter (1980)

In the *eighties*, the management information systems become decision-support systems and the automation of production is further developed to include separate applications such as Computer Aided Manufacturing (CAM) and Computer Aided Logistics (CAL). In addition to advantages in terms of efficiency and effectiveness, information systems lead particularly to a competitive advantage for organisations. Roughly speaking, this competitive advantage can be obtained in three ways:

- *Product development:* introducing new products or services on the market. Information technologies such as production automation lead to innovations in the product or service package.
- *Market development:* reaching new market with existing products or services. With the use of applications such as telemarketing, new markets can be reached through new distribution channels.
- *Diversification:* introducing new products and/or services on new markets. Through the application of information technology, and in addition to the current service and/or product range, a new service may be created, which is in the first instance offered to current buyers. This service may be so attractive that an organisation enters an entirely new market.

The *nineties* were characterised by the computer meeting the individual needs of employees: the *personal computer* (PC) as a multifunctional and *multi-user* workstation. The customers in these years also demanded more in terms of delivery time and product quality. This required an integration of flexible production automation (FPA) with administrative automation. A clear example of this is the integration of Computer Aided Manufacturing (CAM) and Computer Aided Design (CAD) into CAD-CAM systems. Through this Computer Integrated Manufacturing (CIM), and in addition to the product, other services were created such as a customer-friendly order and delivery system. Information technology is increasingly applied in products and services in this period. The developments make it possible for computers to communicate with each other, within companies as well as between organisations. It is particularly the Internet that plays a key role in this. The *on-line* connections are increasingly supported by *off-line* applications such as chipcards and CD-ROMs. Basic functionalities of the chipcard are the storage, processing and exchange of data with the 'outside world'. This makes it possible, for example in health care, to check the identity of the card-holder (who is the patient and who is his doctor), to give the card-holder certain rights (which databases is the doctor allowed to check), to record various data (what medicines does the patient use) and to support certain transactions (payment, proof of insurance). The most important characteristic of CDs is that they can contain very large amounts of information. CD-ROMs are increasingly used for storing and distributing information, particularly by publishers, and also more and more in other sectors.

Future developments in the field of information technology will be determined by the developments in hardware, software and networks (the infrastructure). Major hardware developments are the further miniaturisation of circuits and components, the increased speed and capacity of components and equipment, and simpler, faster and more reliable data processing as a result of the digitalisation of all information (data, text, image and sound). In addition, the prices will drop. In the field of software, increasingly stronger and extensive programming

languages are being developed. Developments are more aimed at specific applications, and systems and subsystems can be linked much better. One may think in this respect of the so-called 'smart homes' in which many aspects concerning safety, comfort, communication and technological management are integrated via software circuits.

In more and more situations, network systems are transcending the limits of the individual organisation. Central to this is the optimisation of the industrial column, supply chain or sector. This type of innovation makes it possible to serve the customer more often and to provide him with a faster and more reliable tailor-made product or service. For this purpose, often the entire internal labour and organisation structure of the enterprise has to be transformed into a flatter and more flexible organisation with fully trained employees. New, more independent types of labour emerge, for example, teleworking and freelancing. The changes in the external organisation of companies are in many cases just as large. The structures of whole chains of activities are changed and in this process the end-consumer is the main focal point. Parties in the supply chain get a different function (e.g. the wholesaler) and their relations become closer and often take the shape of clusters. It is particularly because of these changes in the supply chains that many small and medium-sized enterprises cannot escape the innovation developments resulting from the application of information technology. In Figure 5 the industrial column of the clothing industry has been represented as an example of a supply chain. The first sector in the column is the textile industry. This comprises the manufacturers of clothing fabrics in the cotton and wool industries. The sector in which the fabrics are made into clothing is the clothing industry, consisting of clothing manufacturers and haberdashers. In between production and sales of clothing, one finds the intermediate trade sector consisting of wholesalers, distributing agents, purchase and sales combines. The last sector is the retail trade in which the key activity is the sale of clothing. In addition, there are institutes and bodies that provide specific services to the various enterprises in the industrial column.

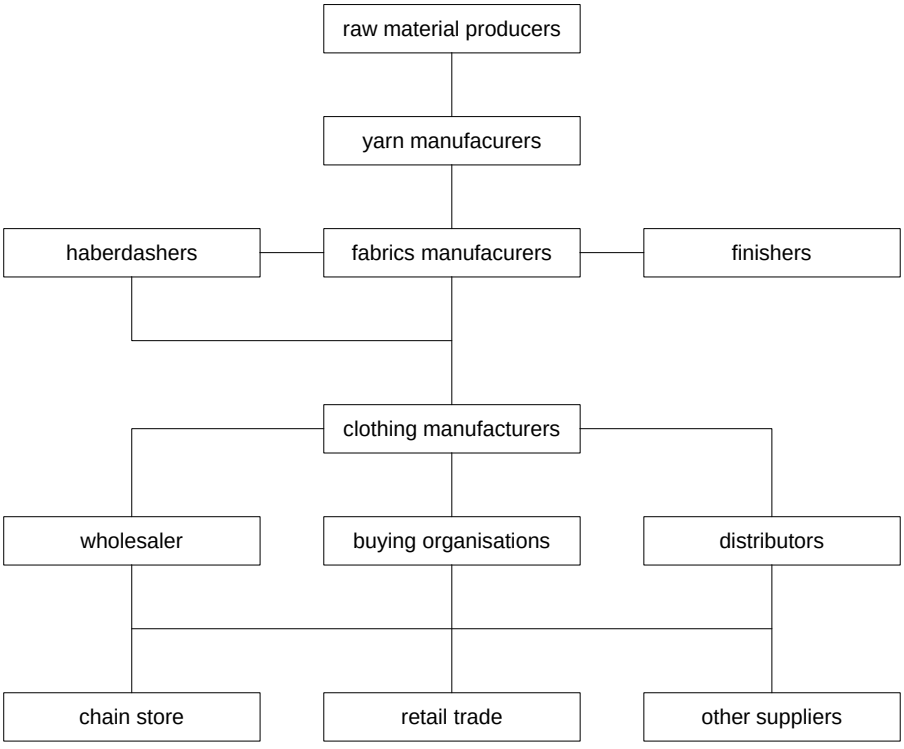


Figure 5: The industrial column of the clothing sector

The customer will become more and more the focal point of the activities in the supply chain. Insofar as this is not yet the case, one may speak of supply chain reversal. Supply chains thus obtain the character of the old handicraft, while information technology enables a production that is many times as efficient. The tailor-made production starts after the customer's wishes have been explicated: in the past, this happened at the tailor's; in the future, this will happen at a fully automated textile factory after the customer’s measurements and preferences are recorded in the shop or via the Internet. A similar 'back-to-the-past' tendency can be observed in the

consumers' behaviour pattern and the employees' work environment. In the past, consumers used to buy quite a number of products from mail-order firms and suchlike. This tendency has now come back in the shape of teleshopping. In the past, employees, for example those in the textile industry, usually worked at home, where their employer came to collect and bring the necessary goods. It was only much later that large-scale *production plants* came into being. Information technology makes teleworking reality: at least the outworker has come back to some extent.

3.4 Small and medium-sized enterprises

3.4.1 A definition of Dutch small and medium-sized enterprises

Small and medium-sized enterprises are defined differently in various countries and institutions (OECD, 1995), which makes it very hard to compare al kinds of international research results. The OECD (1995) gives an overview of definitions of SMEs of a dozen countries in and outside the European Union. In general, small and medium-sized enterprises in the Netherlands are defined as entirely private enterprises – except in agriculture, fishing and mining – with profit motives and less than 100 employees. In the Netherlands, enterprises with less than 10 employees are usually called small firms. Figure 6 shows the position of small and medium-sized enterprises in the Dutch economy.

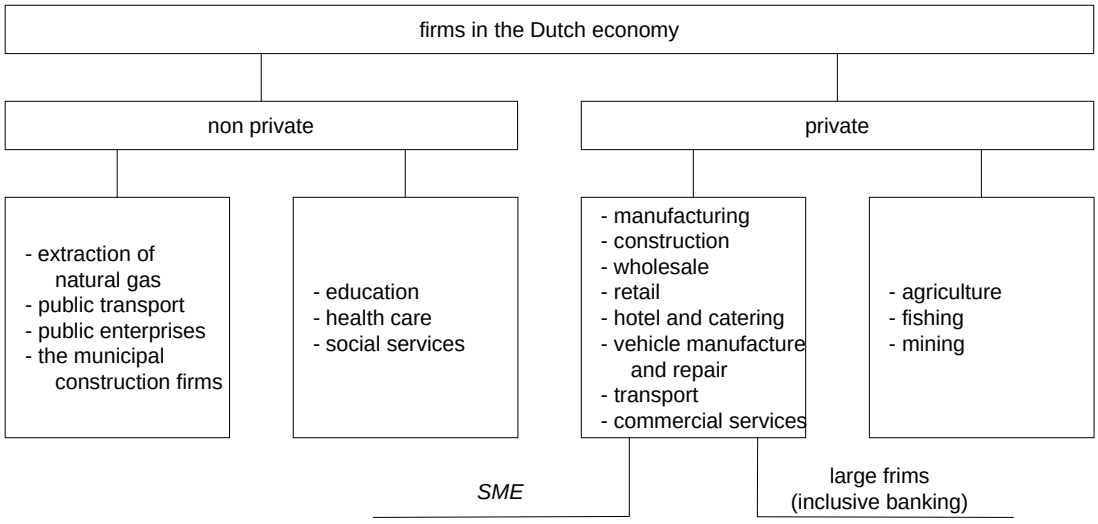


Figure 6 The position of SMEs in the Dutch economy (Maathuis, 1995; RMK 1997c)

Statistics, including those of the OECD (1993), indicate that, since the eighties, small and medium-sized enterprises have played an increasingly important role with regard to the Gross National Product (GNP) of developed countries. In the late nineties, small and medium-sized enterprises formed a large part of the total number of enterprises in the Dutch economy. Table 1 shows that, in 1996, circa 99.1% of the enterprises active in the private business sector were small and medium-sized enterprises. This amounts to more than 440,000 enterprises. Small and medium-sized enterprises are characterised by a great diversity (Kelly and Brooks, 1991; Nooteboom et al., 1992). This makes it hard to speak of the SME sector in general terms as it displays such a wide variety with respect to the following points (cf. Maathuis, 1995):

- The market on which the enterprise is focused;
- The nature of the business activities of the enterprise;
- The size of the enterprise in terms of turnover or the number of employees;
- The type of organisation and entrepreneurial behaviour;
- The age of the enterprise and the growth phase the enterprise is going through;
- The location of the enterprise.

Focusing on three aspects, Table 2 represents the percentage of SME sectors in the total number of small and medium-sized enterprises over the year 1997. It may deduced from this table that a large number of the enterprises can be found in the business-services and retail sectors. Key sectors in terms of labour volume and contribution to national income are those of business services and the manufacturing industry.

Sector	Number of active enterprises (x 1,000) in private business in 1996						
	SME				large firms (1)	Total	SME / Total
	Number of employees			Total			
	0	1-9	10-99				
Manufacturing	15.32	19.00	9.19	43.49	1.38	44.87	96.9%
Construction	20.99	17.92	6.50	45.50	0.39	45.79	99.1%
Wholesale	22.70	21.68	6.11	50.48	0.39	50.87	99.2%
Retail	39.07	45.36	3.94	88.37	0.24	88.61	99.7%
Hotel and catering	11.79	23.88	2.04	37.71	0.10	37.81	99.7%
Vehicle manufacture and repair	7.36	10.42	2.05	19.82	0.08	19.90	99.6%
Transport	10.71	9.89	3.29	23.89	0.28	24.17	98.8%
Commercial services	50.48	32.37	5.85	88.70	0.79	89.48	99.1%
Other services	19.00	24.62	2.41	46.02	0.25	46.27	99.5%
Total	197.39	205.12	41.36	443.88	3.89	447.77	99.1%
(1) Large firms are enterprises with 100 or more employees.							

Table 1: The number of active enterprises in the Netherlands in 1996 (RMK,1997c)

SME sector	Number of enterprises	Labour volume	Contribution to national income
Manufacturing	9.8%	18.2%	22.1%
Construction	10.2%	15.1%	15.0%
Wholesale	11.4%	14.5%	19.9%
Retail	19.9%	13.3%	8.9%
Hotel and catering	8.5%	7.2%	4.4%
Vehicle manufacture and repair	4.5%	4.3%	4.2%
Transport	5.4%	6.6%	7.9%
Commercial and other services	30.3%	22.5%	22.3%
Total SME sector	100.0%	100.0%	100.0%

Table 2: Dutch small and medium-sized enterprises according to three aspects in 1997 (RMK, 1997c)

3.3.2 Differences between SMEs and large firms

There are various differences between small and medium-sized enterprises and large firms, for example, in the fields of marketing, management, internal and external communication, financing and growth (Rothwell and Zegveld, 1982 and Appendix 2). As regards differences between SMEs and large-scale enterprises, Rothwell and Dodgson (1994) distinguish material advantages and behavioural advantages. The relative strength of the larger enterprises mainly stems from their material advantages, which are related to the economics of scale and scope, the availability of relatively cheap financial means, ways to spread risk, a greater capacity to specialise people and means, etc. (Nooteboom, 1994; Rothwell and Dodgson, 1994). On the other hand, the relative strength of smaller enterprises stems from the behavioural advantages related to matters such as higher work motivation of employees, more variation and improvisation in tasks, tacit knowledge about unique skills, more efficient communication, and flexibility resulting in less bureaucratic decision-making procedures and a more cooperative style of management (Nooteboom, 1994; Rothwell and Dodgson, 1994; OECD, 1995). Problems generally characteristic of SMEs are related to a lack of knowledge and lack of time in which to acquire knowledge, a lack of management skills, a fear of growth and an accompanying short-term perspective, a poor external orientation which means that signals from the environment are not recognised until it is too late, a weak financial position resulting in low levels of investment, and a lack of means to school employees in-company (cf. Soh et al., 1992; OECD, 1995; Fuller, 1996; Stroeken and Coumans, 1998).

3.5 Information technology in small and medium-sized enterprises

3.5.1 The application of IT in small and medium-sized enterprises

Various studies have shown that the adoption rate of information technology in small and medium-sized enterprises compared to that in large enterprises is relatively low, not only in the Netherlands, but also abroad (cf. OECD, 1995; RMK, 1996, 1997a; Vogelesang, 1996). As an indication, Table 3 represents the degree of automation in Dutch small and medium-sized enterprises in 1992 and 1995. This table shows that the degree of automation in the service sector (business services, banking and insurance) is relatively high. The hotel and catering sector and retail sector have a relatively low degree of automation.

SME sector	Percentage of SMEs with one or more computers	
	1992 (1)	1995 (2)
Manufacturing	65	81
Construction	53	72
Wholesale	71	84
Retail food	35	54
Retail non-food	45	53
Hotel and catering	27	39
Vehicle manufacture and repair	64	84
Transport	52	73
Commercial services	81	87
Banking and insurance	82	100
Total SME sector	59	71

(1) Study KNOV / NIPO in 1992 (OECD, 1995)
(2) Study NIPO business monitor - 2nd quarter 1995 (Vogelesang, 1996)

Table 3: Automation according to the Dutch SME sector in 1992 and 1995

With respect to the differences between groups of small and medium-sized enterprises as far as the application of technology is concerned, Nooteboom et al. (1992) describe three categories of entreprises.

- The first category consists of the *technology-driven firms*. These enterprises are usually involved in, or dependent on, fundamental research in areas such as bio-industry (e.g. crop improvement through genetic modification) and information technology (e.g. speech and image technology). These firms are also called *new technology based firms* (NTBFs).
- The *technology-following firms* constitute the second category. They focus on the development, embedding and commercialisation of technologies in their products, services or processes. SME sectors from Table 3 that fall (partly) into this category are, for example, the manufacturing industry, construction industry and commercial business services.
- The third category is that of the *non-technological firms* and SME sectors such as the hotel and catering industry, retail trade and transport. Many small and medium-sized enterprises fall into this category.

Cragg and King (1993) point out that the application of information technology in small and medium-sized enterprises usually involves accounting programs, and Fuller (1996) refers to a number of studies that confirm this. Fuller (1996) states that information technology offers small and medium-sized enterprises many strategic opportunities, but that only a limited use is made of this possibility in actual practice. On the other hand, Cragg and Zinatelli (1995) point out that IT applications in small and medium-sized enterprises are no longer exclusively used for accounting and that also more strategy-oriented applications have been adopted, such as integrated programs for order and stock management, EDI (Electronic Data Interchange) and web sites on the Internet. In this respect, small and medium-sized enterprises usually use industry-specific standard packages.

Increasing cooperation and further integration is vital for the application of information technology in small and medium-sized enterprises (2.5). Only in this way, matters such as standardisation, differentiation and specialisation can be realised in small and medium-sized enterprises. In this, an integral orientation towards the following areas is essential (cf. Maathuis, 1995; Preissl, 1996; RMK, 1997a; Stroeken and Coumans, 1998):

- A *strategic orientation* towards such matters as forms of cooperation, structural changes in the industrial column, marketing methods, distribution channels, etc.
- An *organisational orientation* towards such matters as organisational structure, management methods, schooling, labour organisation, etc.
- A *technological orientation* towards products and services, manufacturing systems, information systems, electronic data processing, etc.

3.5.2 Bottlenecks in the application of information technology

Particularly in small enterprises, the introduction of the newest types of information technology does not always run so smoothly. There are a number of reasons for this. First of all, these firms usually do not possess any specialised knowledge in the field of information technology, partly because they focus all their attention on operational activities and thereby have only little time left for innovative and strategic activities. This also prevents them to personally acquire knowledge about the newest developments. In addition, they often do not know which sources of information they should consult. All this makes that small technology-following firms are insufficiently informed about the possibilities of information technology and fail to recognise the advantages of a specific application for an organisation. Experience has also taught that the introduction of information technology may even lead to some unexpected advantages.

Once the problem of acquiring sufficient insight into the possible applications has been solved, there still remains the problem of how to specify the demands and wishes. Many small enterprises cannot exactly formulate their demands without the help of an external expert, also because sellers of information technology tend to sell them systems that are more extensive and complicated than necessary and often do not provide the correct information as to the time it takes to learn how to handle the system. When they wish to obtain independent advice, small enterprises usually refer to the existing network of formal and informal contacts, including, for example, customers, suppliers, colleagues, friends, family and acquaintances. The decision-making process is strongly related to the views of the people consulted, who may be reliable and unprejudiced, but whose views are not necessarily based on expertise.

As innovation through information technology usually starts with the production process, this type of innovation requires more changes in the functions, tasks and responsibilities than other types of innovations. It does not only concern technological knowledge, but also knowledge about the necessary changes in the organisation and jobs and tasks of employees. Innovation involving the use of information technology requires some insight into both the technical and organisational aspects of the application. As many studies have shown, technology-following enterprises only make use of the organisational aspects in a very limited way. What is required is formalised and standardised information processing, which is often lacking in small enterprises, because their working method is often rather informal.

In addition to organisational adjustments, the implementation of information technology for innovative purposes also requires sufficient strategic vision. For example, it requires another way of looking at marketing as it will become more complicated to get a good idea of the market demand and market structure. This concerns above all a vision regarding the possibilities and necessity of cooperation (how and with whom?). The problems and focal points concerning the adoption of technology as mentioned in this section are represented in Table 4 (cf. Delone, 1988; Soh et al., 1992; Bessant and Rush, 1995; Cragg and Zinatelli, 1995; OECD, 1995; Fuller, 1996).

Bottlenecks in the adoption of technology
• A lack of awareness with regard to modern technological developments • Problems with monitoring modern technological developments • Problems with obtaining external information • Insufficient availability of trained staff • A lack of management skills • A lack of means to finance the innovations • Problems with finding financing or other funds • Problems with the use of software. These mainly occur when the software developer has a different vision as to the functionalities of the computer program

Table 4: Bottlenecks in the adoption of technology

Essential in the adoption of information technology is that it becomes clear to the potential adopter what role the innovation may play in an organisation. It is necessary that knowledge of the possible applications of information technology should reach the smaller enterprises more adequately. Better organisational conditions need to be created and more attention needs to be paid to the development of a strategic vision on the possible applications of information technology, not just within the enterprises themselves, but also in networks. That is in the first instance a task that the enterprises have to perform themselves. In addition, supportive policies of intermediary organisations such as industry-specific organisations and the government are needed.

3.5.3 Innovation policy on information technology

Also from the perspective of international competition, the development, diffusion and adoption of information technology become increasingly important. Knowledge needs to be made available and diffused, particularly in small and medium-sized enterprises. However, the market shows three types of deficiencies in this respect (OECD, 1995). In the first place, the availability, adequate functioning and reliability of an infrastructure (institutional and physical) are prerequisites for economic activity in general and for the adoption of new technologies in particular. There are, however, some *infrastructural deficiencies*. In the second place, there are deficiencies with regard to the provision of *information*, as inadequate and prematurely provided information on new technological opportunities and threats lead to suboptimal allocations of means. In the third place, there occur *capital deficiencies* and *capability failures* with regard to the development of the information technology potential in small and medium-sized enterprises. This concerns problems with financing and technical, organisational and strategic skills. Given these deficiencies in the market, the national or supranational government is the most appropriate authority to stimulate the diffusion and adoption of information technology in small and medium-sized enterprises through innovation policy. As an intervening body, it should, of course, relativise the pro-innovation bias somewhat. The Dutch innovation policy is expressed in, among other things, the policy document called 'Knowledge in Action' (Minez, 1994a) published by the Netherlands Ministry of Economic Affairs in 1994. It gives an indication of how the Dutch government wants to strengthen the position of the Netherlands in the global market and improve the innovative capacity of the Dutch economy by 'increasing the knowledge intensity of the Dutch economy'. Additional visions and actions are ventilated in documents such as 'Information Superhighway: From Metaphor to Action' (Minez, 1994b) and 'A Vision for Acceleration' (Minez, 1995).

The descriptions and foundations of the innovation policy on technology aimed at small and medium-sized enterprises are discussed in Den Hertog and Fahrenkrog (1993), Hanna et al. (1995), OECD (1995), Dodgson and Bessant (1996), La Rovere (1996), the B&A group (1997) and Clark and Guy (1998). To provide some insight into the possible policy measures concerning information technology and small and medium-sized enterprises, a summary is given below. This summary of policy measures as described by Den Hertog and Fahrenkrog (1993) are represented in Figure 7. The vertical axis in the figure represents the level or type of policy intervention. The macro-level relates to more general initiatives, whereas the initiatives at micro-level are directly aimed at individual actors and specific technologies. The horizontal axis in the figure relates to the aspects per orientation: supply side, diffusion and demand side. Field IV contains the policy initiatives that are directly applicable to small and medium-sized enterprises in general. Usually, two different policy angles can be distinguished, namely *hands-off* and *hands-on* measures. In relation to small and medium-sized enterprises, the *hands-off* approach encompasses 'those measures and activities that are oriented towards creating and maintaining a nurturing environment for small and medium-sized enterprises in their attempts to adopt information technology and make use of their economic potential' (OECD, 1995: 44). A typical *hands-off* measure is the liberalisation of the European telecommunications market in the past ten years, which resulted in more competition in the field of services and costs. This stimulates businesses to introduce process and product innovations in the field of telecommunications. By contrast, *hands-on* policy is 'directly oriented at the individual enterprise and is aimed at enhancing its internal potential to adopt information technology and thereby enhance its economic performance' (OECD, 1995: 44). Typical examples of a *hands-on* approach are the Mister Project, the successful KIM scheme and the 'Get more out of your computer' project. The Mister Project, which

ran from 1995 to 1997 in Rotterdam, was an incentive project of Port CommunITy Rotterdam, the Syntens[1] organisation and the Dutch Federation of Small and Medium-sized Enterprises (MKB-Nederland), aimed at providing advice and support to several dozens of port-bound small and medium-sized enterprises as far as the application of information technology was concerned (Van Baalen and Beije, 1998). The KIM scheme placed recently graduated students from higher professional education and university at an attractive charge as knowledge providers in small and medium-sized enterprises which had no more than one highly skilled employee (Minez, 1999). A teacher from the Regional Training Centre and an industry-specific CD-ROM were the central elements in the 'Get more out of your computer' project (October 1997 - September 1999) set up by the Dutch Federation of Small and Medium-sized Enterprises to inform a group of Rotterdam entrepreneurs in the furnishing, hairdressing and clothing industries about the strategic opportunities that information technology has to offer (1.4 and 6.6).

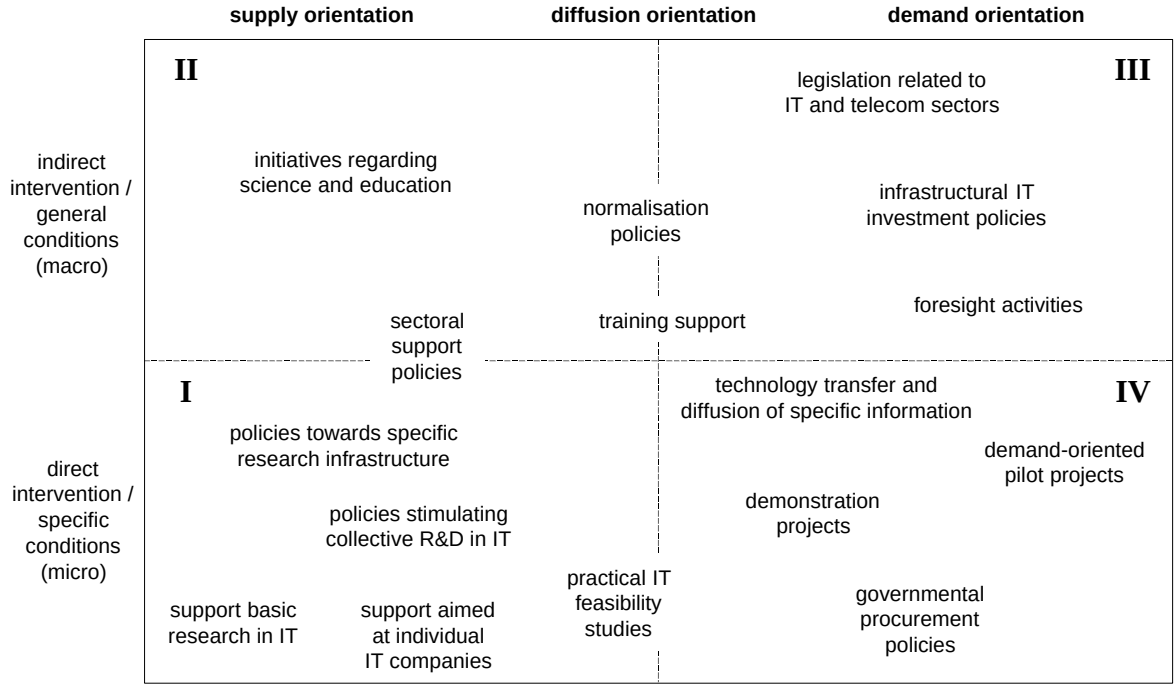


Figure 7: Information technology policy measures (Den Hartog and Fahrenkrog, 1993)

The Dutch Council for Small and Medium-sized Enterprises (RMK , 1997a) observed that apparently there is much knowledge available in the field of information technology, but also that the actual application is lagging behind. This means that particularly *hands-on* initiatives from field IV in Figure 7 deserve the necessary attention (structures for knowledge transfer, demonstration projects, government procurement policies and demand-oriented pilot projects). These initiatives are aimed at creating a greater awareness with regard to innovation and stimulating learning processes. In this, intermediary bodies and advisers play a considerable role. Regarding the transfer of knowledge to small and medium-sized enterprises through intermediary bodies, Maathuis (1995) observed a number of major bottlenecks:

- Incentive programmes often have a structure that is too broad for specific target groups;
- Knowledge institutions are not always orientated towards specific user groups;
- There is no system available for the transfer of knowledge;
- The knowledge acquired often has an aggregation level that is too high for solving the problem;
- The acquisition costs of knowledge are often too high for small and medium-sized enterprises.

[1] The Syntens organisation was set up in early 1998 and has one establishment in the Netherlands. Syntens is an amalgamation of InnovatieCentra and IMK-advies.

The employment of advisers (in connection with intermediary institutions) provides an opportunity to provide small and medium-sized enterprises with knowledge of the strategic use of innovations. Advisers strongly reduce the uncertainty of entrepreneurs. For example, Sog et al. (1992) observed that the automation level in small enterprises is higher when advisers were involved in the adoption and implementation processes. According to Bessant and Rush (1995), there exist a few deficiencies in the advisers' *bridging* activities, such as the fact that the advice given to entrepreneurs is not integrated in a larger project or policy framework based on a long-term vision, the poor matching of advisers and customers, and the limited use of instruments (quality control, project monitoring and management systems) necessary to complete the advisory route adequately. In addition, courses, training and workshops are excellent tools for informing and educating entrepreneurs, in which also the contacts with fellow entrepreneurs contribute to a broader perception of certain innovative developments or applications (cf. Preissl, 1995). To broaden and deepen the perception, the creation and articulation of scenarios form a concrete method for initiating learning processes and raising awareness. For the past ten to twenty years, this method has been used in large multinational enterprises and offers interesting opportunities to stimulate the diffusion and adoption of technology in small and medium-sized enterprises. The scenarios will be discussed in greater detail in Section 5.2.

3.6 Summary and conclusion

In this chapter, we have tried to explain the relevant aspects of information technology and small and medium-sized enterprises, as these are the central themes in this study. It is important to know that information technology goes hand in hand with structural socio-economic and technological changes. A new paradigm evolves, based on information, knowledge and information technology. In Chapter 2, we have already discussed a number of aspects from an economic point of view. Information technology is a technology with which the primary and secondary business processes of enterprises can be supported and improved. In this, a number of steps can be recognised such as improvements in efficiency, effectiveness and the competitive advantage, opportunities for integrating information flows in the industrial column and the phenomena of supply chain reversal.

Small and medium-sized enterprises form a very heterogeneous group representing the largest part of the total number of companies in the Dutch economy. There is a great difference between large firms and small and medium-sized enterprises as far as material and behavioural advantages are concerned. This explains the relatively low adoption rate of information technology in small and medium-sized enterprises. This is also the reason why the development and implementation of an innovation policy specifically aimed at stimulating the adoption of information technology in small and medium-sized enterprises has become increasingly important over the past ten to twenty years. Particular emphasis should be placed on creating a greater awareness with regard to information technology and stimulating learning processes. It is also desirable to accommodate directly and specifically as large a group of companies as possible. In the case of this heterogeneous group of small and medium-sized enterprises, this will be not be very easy. For a better understanding, the following two chapters will go deeper into the theoretical aspects of the diffusion and adoption of information technology.

Chapter 4
The diffusion and adoption of information technology in small and medium-sized enterprises

In this chapter, we will discuss some of the relevant theoretical approaches from the literature in relation to the diffusion and adoption of information technology in small and medium-sized enterprises. These approaches come from several fields of study, in particular from innovation sciences and organisation science. Other fields of study that are connected to the subject treated in this chapter, though to a lesser degree, are communication sciences and cognitive psychology. On the basis of the theories involved, we will try to sketch a framework that will provide some insight into the mechanisms underlying the diffusion of a technology in a specific group of companies (4.2) and aspects relating to the adoption of a technology in a specific company (4.3). The relation between diffusion and adoption will be looked at in 4.1. Subsequently, the bottlenecks in the diffusion and adoption of information technology in small and medium-sized enterprises will be identified. In Section 4.4, we will give a summary and present our conclusion.

4.1 The relation between diffusion and adoption

The terms *diffusion* and *adoption* are described and defined in various ways in the literature (or not defined at all). Partly because of this, these terms are sometimes used rather indiscriminately. The purpose of this section is to clearly delineate these two terms and to indicate the relation between them. In the context of this study, the two terms will be used as defined by Rogers (1995: 5). He defines diffusion as 'the process by which an innovation is communicated through certain channels over time among the members of a social system'. Adoption is 'the process through which an individual (or other decision unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision' (Rogers, 1995: 20). These definitions reveal that diffusion compared to adoption generally works at a higher aggregation level than adoption, being mostly at the macroeconomic and mesoeconomic levels. Diffusion does also relate more to the supply side of innovations. All this depends heavily on the delineation of the term *social system*. If the social system is related to a branch of industry or a group of enterprises then we speak of *inter-firm* diffusion (Davies, 1979). *Intra-firm* diffusion is related to the dissemination of an innovation in an individual organisation or enterprise and falls outside this study. One may therefore say that the diffusion research in this case is aimed at 'the aggregate behaviour of the sample of firms, without necessarily relying on an explicit microeconomic modelling of single firms' decision processes' (Lissoni and Metcalfe, 1994: 109). The adoption process, however, takes place at the level of the individual adopting unit (supply side). At the microeconomic level, the so-called potential adopter is often an enterprise, a division, or an individual. According to Iivari (1993), an adopter (adopting unit) can be an organisation, part of an organisation or an individual that adopts, or has adopted, the innovation concerned. On the basis of the number of potential adopters in relation to the diffusion and adoption aspects, Iivari (1993) differentiates between macro- and micro-innovation theories. According to Iivari, research on the *diffusion of innovations* among a large group of potential adopters falls under the macro-innovation theory. Micro-innovation theories, on the other hand, study the *adoption of an individual innovation* by an individual adopter. However, Iivari also states that macro- and micro-innovation theories are so much related that a clear distinction between diffusion and adoption cannot be made. Insights into diffusion mechanisms provide insights into adoption mechanisms and *vice versa*. In other words, there is interaction. The question is how these diffusion and adoption processes take place and how they can be influenced in such a way that the diffusion and adoption of information technology in small and medium-sized enterprises may be improved.

4.2 The diffusion of information technology

4.2.1 Introduction

In this report, diffusion relates to the spread of the use or possession of information technology in a group of Dutch small and medium-sized enterprises that still has to be described. For policy reasons, it is desirable that this group has a high degree of homogeneity. In the literature, the spread of innovations in a social system is primarily denoted by the term *diffusion*, although other terms such as *dissemination*, *technology transfer* and *technology deployment* are also frequently used (Tornatzky and Fleischer, 1990). Although the diffusion of innovations is often approached from the supply side, it is the demand side that plays an important role in the diffusion of complex technological innovations (cf. Tornatzky and Fleischer, 1990; Attewell, 1992). Matching the various wishes and needs of the heterogeneous group of potential adopters with the organisational and technical possibilities of the innovation as created by the developers is essential. Rogers (1995) calls this process *re-invention,* whereas Robertson et al. (1996) use the term *innofusion*[1] for this.

In diffusion research one can roughly distinguish two main trends (Attewell, 1992; Lissoni and Metcalfe, 1994). The exponents of the first trend study diffusion from a more economic perspective, in which the diffusion process is mainly approached in terms of costs and benefits of the innovation. This trend includes, for example, the studies of Griliches (1957), Mansfield (1968), Stoneman (1976), Freeman (1982), and Jowett and Rothwell (1986). The second trend is tied to geographical and sociological aspects of the diffusion process, in which matters like actor networks and accompanying communication structures are discussed. Examples of these studies are Coleman et al. (1966) and Rogers (1995). The second trend in diffusion studies is mainly focused on the centre-periphery models of communication, also known as the classic diffusion models and the network-oriented models. This report, however, describes the diffusion of information technology from a more communicative perspective, since the dissemination and application of knowledge concerning information technology is essential for SMEs.

4.2.2 Diffusion process

According to Rogers' definition, the diffusion process can be viewed as a special type of communication, in which the message to the members of the social system is related to a new idea or phenomenon. A certain degree of uncertainty about this new idea or phenomenon is present within the social system and, according to Rogers (1995), uncertainty implies a lack of predictability, structure and information. The essence of a diffusion process is to break down or reduce this uncertainty among the members of the social system by means of communication. In this context communication can be defined as 'the process by which participants create and share information with one another in order to reach a mutual understanding' (Rogers, 1995: 5-6). One may deduce from this that communication has some influence on the innovation adoption of the potential adopter. Rogers states that information[2] can also be embodied in the innovation itself, whereby the diffusion of an innovation in a social system can also relate to the physical distribution of the innovation in that social system.

As regards the diffusion process, Rogers (1995) distinguishes four elements: 1. the innovation, 2. the social system, 3. the communication channels, and 4. time. The social system encompasses groups of actors that participate in this diffusion process, in which the so-called potential adopters are the most central group. In Section 4.2.3 the social system will be delineated in more detail. The innovation is the aspect that is to be diffused in the social system and of which the characteristics have already been discussed in Section 3.2. The communication channels are the means to make the innovation known to the potential adopters of the social system. These will be further explained in Section 4.2.4. The element of time is expressed by the adoption rate of the innovation in a particular social system within a particular period of time; generally the adoption rate can be depicted graphically as a sigmoidal curve (s-curve) (cf. Davies, 1979; Mahajan and Peterson, 1985; Rogers,

[1] Robertson et al. (1996: 334) describe innofusion as 'the process by which technological solutions that evolve in user firms during implementation are picked up and further diffused by technology suppliers'.

[2] Rogers and Kincaid (1981: 64) describe information in an abstract way as 'a difference in matter-energy that affects uncertainty in a situation where a choice exists among a set of alternatives'.

1995). Due to the specific characteristics of markets, inter-organisational networks, enterprises, and technological contexts, the adoption rate of an innovation such as information technology can widely differ per industry, region, or country (cf. Davies, 1979; Preissl, 1995). Figure 8 illustrates this schematically. The increase in the adoption rate of interactive innovations such as the telephone and e-mail does not follow the pattern of a traditional s-curve, but is more exponential (Markus, 1987, 1990). Interactive innovations become more attractive to the potential adopter, when these have already been adopted by a large number of people. All this has to do with the network externalities that accompany the application of this type of innovation (Katz and Shapiro, 1985, 1986). This has already been briefly discussed in Section 2.2.

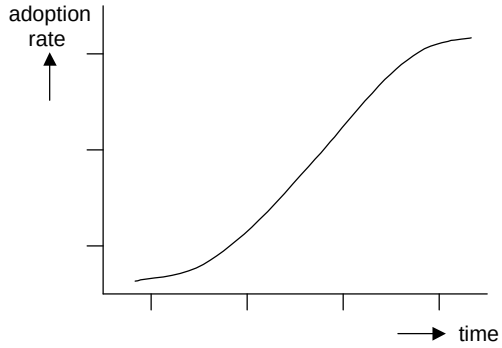


Figure 8: The adoption rate of an innovation over time

According to Rogers (1995), the adoption rate of an innovation in a social system is determined by the following aspects:

- The characteristics of the social system;
- The characteristics of the communication channels;
- The promotional efforts of the intermediary change agents;
- The perceived characteristics of the innovation;
- The type of decision-making concerning innovation.

The first three aspects relate in particular to the interface between the demand and supply sides of the information provision concerning an innovation towards a group of potential adopters. The other two aspects mainly relate to the situation surrounding the adoption process of the individual potential adopter. These will be discussed somewhat further in Section 4.3. Attewell (1992) points out that, from an economic point of view, the moment of take-off of the adoption rate is often the result of a decline in the price of the new technology, which causes a sharp increase in demand. According to Attewell (1992), however, the above-mentioned moment indicates that the barriers that prevent or obstruct the acquisition of knowledge and skilled employees and the in-company innovation training have been broken down.

In the case of diffusion research into complex, advanced technologies, the classic diffusion models (cf. Rogers, 1995) prove to have shortcomings, because issues related to the specific innovation context cannot be taken into account and studied (cf. Tornatzky and Fleischer, 1990; Attewell, 1992; Preissl, 1995). In these situations, delineation problems are encountered with respect to the boundaries of the technological innovation, the classification of the potential adopters, the communication channels functioning simultaneously at different levels, the market structure, and so on. According to Tornatzky and Fleischer (1990) and Preissl (1995), it is not only the relations with the individual potential adopter that are important with respect to the diffusion of complex technological innovations, but also, and perhaps even more so, the context. Moreover, aspects such as the boundaries of the technological innovation, the characteristics and classification of the potential adopters, the characteristics of the innovation deployers, and the characteristics of the communication and transaction mechanisms between deployers and potential adopters also play a considerable role. The matters mentioned by Tornatzky and Fleischer (1990) are in principle, and among other things, an extension to, and broadening of, Rogers' generic concepts. Some aspects have already been discussed in Section 3.2.3; those that have not yet been discussed will be treated in Sections 4.2.3 and 4.2.4.

4.2.3 The social system

Social system is a broad concept and therefore needs to be defined precisely. Rogers (1995: 23) defines a social system as 'a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal'. This definition can be used at various research levels. As regards innovation research with a national orientation, Marceau (1994) distinguishes three research levels, namely clusters, supply chains and so-called complexes[1], each level encompassing a specific set of actors (units). The present study is aimed at the diffusion and adoption of information technology in a part of the Dutch SME sector, and, consequently, the research level relates to a combination of supply chains and complexes. With respect to diffusion research, Davies (1979) mentions three angles: the diffusion differences between countries, the diffusion differences between sectors or branches of industry and the diffusion in a certain sector. Concerning the second angle, Davies (1979) points out that the diffusion rate of innovations is not equal in each sector (or branch of industry) (Table 3 in Section 3.5.1). This has to do with the number of enterprises in the sector, the size distribution of the enterprises in the sector, the labour intensity in the sector and the expansion of the sector itself.

The innovation literature also focuses on research into inter-organisational networks, for example, within a certain sector or branch of industry. The use of the term *networks* is often problematic, because there are a multitude of definitions of it (Robertson et al., 1996). Alter and Hage (1993: 46) define networks as '(unbounded or bounded clusters of organizations that) constitute a basic social form that permits inter-organizational interactions of exchange, concerted actions and joint production'. In Section 2.5, we have already gone somewhat deeper into this. The presence of organisations or enterprises in inter-organisational networks reduces the risks and uncertainty, and provides means, expertise and information so that the potential adopters have the ability to learn about new technologies via external contacts (Robertson et al., 1996). This field is closely related to terms such as supply chain integration and reversal, and horizontal integration. The study of Midgley et al. (1992) indicates that the structure of a network can have a substantial effect on the way in which innovations are diffused. In addition, the so-called weak ties between individuals and interpersonal networks form an important factor in the diffusion of innovations (cf. Rogers, 1995). Weak ties relate to infrequent contacts between different specific individuals in certain networks, as a result of which entirely new ideas that are unfamiliar to the network may be transmitted by them during these sporadic contacts, which can strongly influence the perception of certain innovations. Dierckx and Stroeken (1999) describe the use of techno-economically oriented scenario methods and the actor-oriented SCOT (Social Construction of Technology) method to analyse developments in the strategic application of information technology in a branch of industry. Robertson et al. (1996: 336) summarise the process we have sketched as follows: 'individuals who are involved in networking are engaged both in the construction and also in the diffusion of knowledge'.

Within the social system various types of actors, such as suppliers, branch organisations, and the national government, are interwoven with SMEs in so-called inter-organisational networks. The various actors in the environment of the enterprise can be represented in a so-called layer model (Figure 9). In the first layer, we have the actors with which the enterprise has frequent and/or intensive contact. Often these are close partners in the supply chain. The next layer comprises actors with which the enterprise has less frequent and/or intensive contacts. The final layer represents the actors with which the degree of interaction is limited. The mutual communication between the various actors depends on the number of actors that are part of the social system (or inter-organisational network), the relative dimension of the actors (e.g. expressed as turnover or number of employees), the characteristics of the relations (expressed in terms of hierarchical position, dominance and communication intensity), and so on (cf. Preissl, 1995).

[1] According to Marceau's description (1994), complexes are particularly aimed at the analysis of R&D activities (innovation development) and within this context they are related to the formal and informal cooperation between the following four important groups of actors: producers, public research institutes, users and government. Yet the concept of complexes may possibly also be used for the analysis of certain aspects of the diffusion process of innovations.

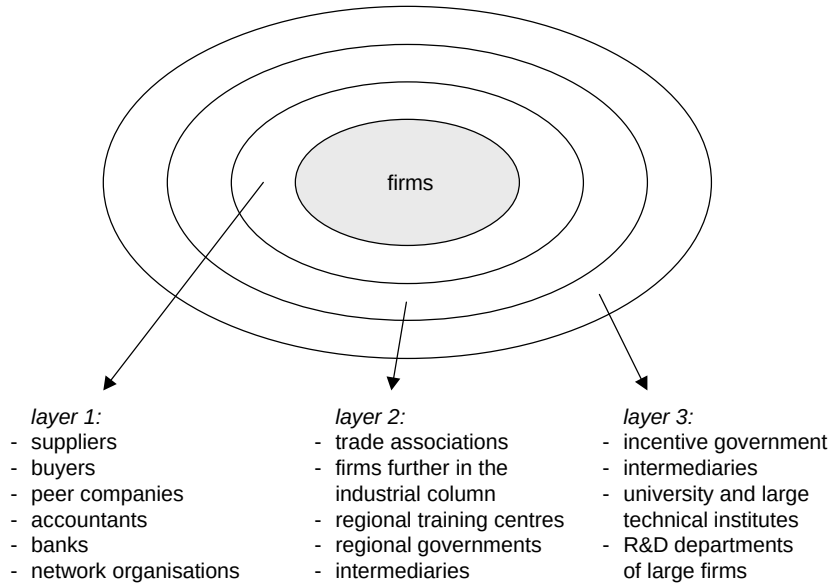


Figure 9: The layer model (B&A group, 1997)

The diffusion process centres round the companies that can be labelled as potential adopters. As regards the stimulation of diffusion and adoption of innovation in SMEs, it is important to recognise the heterogeneity of these enterprises (Kelly and Brooks, 1991; Nooteboom et al., 1992), as the degree of homogeneity of the potential adopters in the social system influences the diffusion rate of an innovation (Davies, 1979). In connection with this, and on the basis of their relative degree of innovativeness, Rogers (1995) classifies potential adopters into five adoption categories: the *innovators* (2.5%), the *early adopters* (13.5%), the *early majority* (34%), the *late majority* (34%) and the *laggards* (16%). Innovativeness can be viewed as 'the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members in a social system' (Rogers, 1995: 261). Figure 10 represents the normal distribution of these categories of adopters. This categorisation is also applicable to the adoption of information technology in SMEs. At the sector level the so-called technology-driven SMEs (bio-industry and information technology) can be described as the innovators, while non-technological firms (hotel and catering industry, and the retail trade) display behaviour common to the late majority. The categorisation can also be applied to groups of enterprises within a specific branch of industry.

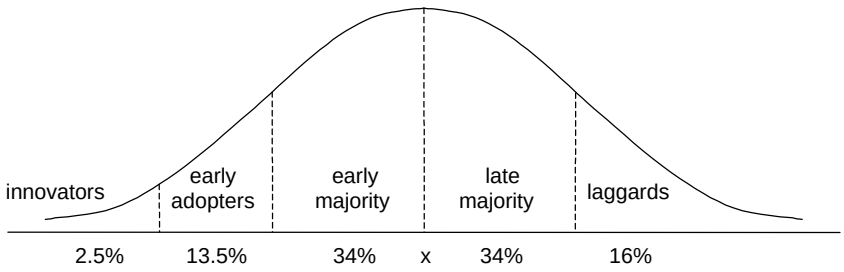


Figure 10: Adoption categories (Rogers, 1995)

The above-mentioned division makes it possible to segment groups of potential adopters[1] at different aggregation levels, for example, at the national level, the sector level or the industry level. Segmentation creates possibilities for communicating more directly with the potential adopters. An example of segmentation is the target group delineation with regard to the Dutch small and medium-sized enterprises for the Syntens organisation by Nooteboom et al. (1992), in which they make use of seven variables (Table 5) and Pavitt's (1984) four industrial classification groups: supplier-dominated firms, scale-intensive firms, specialized firms and science-based firms.

Segmentation variables concerning the target group of InnovatieCentra
• The innovative potential of the SME • The relevance of tacit knowledge in the firm • The extent to which the adoption of technology relates to the process or product innovation • The enterprise's ability to seek external information • The enterprise's ability to use its network for the acquisition and evaluation of external information • The vertical position of the firm • The absorption capacity of the firm

Table 5: Segmentation variables (Nooteboom et al., 1992)

The contacts between small and medium-sized enterprises and actors from the first, second and third layer (Figure 9) constitute an important element in the diffusion process of innovations. Studies by Von Hippel (1988), Kelley and Brooks (1991), the OECD (1993), Preissl (1995), Swan and Newell (1995) and Igbaria et al. (1997) confirm this. Particularly the actors in the first layer play an important role in the diffusion process, because these actors maintain very frequent formal and informal contacts with potential adopters with regard to various essential business aspects such as general market and industry developments, business commitments (strategic alliances, joint ventures and outsourcing), wishes of customers, product range, financial status of the enterprise, developments in information technology in the industry, et cetera. For example, studies by Brown (1981), Robertson and Gatignon (1987), Frambach (1993), and Tornatzky and Fleischer (1990) point out that the supply side of product and process innovations play an essential role in the diffusion process of innovations. And yet suppliers are sometimes less suitable agents to stimulate the adoption of innovations, because they tend to have a certain pro-innovation bias, which makes that the information they provide to potential adopters is too much focused on the application of the innovation and not enough on its strategic aspects (Preissl, 1995; Robertson et al., 1996). Nooteboom et al. (1992) also describe the place of public intermediary institutions such as Syntens in the process of diffusion of knowledge concerning technological developments and applications in the Dutch small and medium-sized enterprises. The regional character of these institutions is of particular importance in this respect. Swan and Newell (1995) conclude that professional associations such as the Canadian Association of Production and Inventory Control play a considerable role in the collection of knowledge concerning technological innovations, but that their role in the actual diffusion of these innovations is modest due to their limited size and the fact that they maintain only limited contacts with the relatively smaller enterprises. Contacts between the SME sector and knowledge institutes such as universities also stimulate the innovation process (cf. OECD, 1993; Preissl, 1995; La Rovere, 1996). In short, communication lays the foundation for the relations between various groups of actors from the three layers and small and medium-sized enterprises.

4.2.4 Communication and communication channels

Communication between the various groups of actors in the social system concerning innovations influences the adoption of innovations by the individual adopter and, at a higher aggregation level, also the diffusion of the innovation in the social system. Tornatzky and Fleischer (1990) indicate that, in the context of the diffusion of technological innovations in a social system, communication channels can hardly be differentiated and defined as they function simultaneously at the various levels. Communication encompasses the following four elements:

[1] In marketing, segmented groups of individual potential adopters are denoted by the term markets.

a source (or sender), a receiver, a communication channel and a message. Rogers (1995: 194) describes a communication channel as 'the means by which a message gets from the source to the receiver'. As regards the diffusion of innovations, Rogers (1995) distinguishes two kinds of communication channels, i.e. mass media channels and interpersonal channels. Mass media channels are, for example, radio, television, newspapers, journals and the Internet. Interpersonal channels involve, for example, conferences, salespeople, advisers and acquaintances.

Nilakanta and Scamell (1990) indicate that the effectiveness of the communication about an innovation depends on the specific characteristics of the communication sources and channels used. Thus, the various communication sources and channels influence the degree to which an innovation is diffused in a social system. At the individual level, it also proves that different sources and channels influence different phases in the adoption process (cf. Nilakanta and Scamell, 1990; Rogers, 1995) (we will go deeper into this in Section 4.3.2). Attewell (1992) states in relation to this that the classic diffusion models do not differentiate between the different types of communication involved in the diffusion process. Attewell (1992) distinguishes two forms of communication, i.e. communication aimed at the introduction of innovation (signalling information) and communication focused on content (know-how information). Classic diffusion models such as Rogers' generic concepts explain the diffusion process by concentrating on the communication focused on the introduction of the innovation (e.g. through magazines, professional journals, and trade fairs). This is insufficient to explain the diffusion of complex technological innovations. Complex innovations make it necessary for potential adopters to obtain content knowledge about innovations. In the case of information technology this involves knowledge of strategic, technical and organisational aspects of the innovation (cf. RMK, 1997a; Stroeken and Coumans, 1998; Stroeken and Knol, 1999) (5.3). The traditional method of content knowledge transfer from the supply side to the demand side is less effective for complex technologies, as the time-consuming learning aspect is of prime importance for the adoption and implementation of complex innovations (cf. Attewell, 1992). This learning aspect will be discussed in more detail in Section 4.3.3. According to Attewell (1992), this makes it necessary to review the diffusion of complex technologies with regard to organisational learning, the development of skills, and knowledge barriers. Diffusion of information technology therefore relates to the external communication between actors in the social system and internal learning capacities. Specific communication about the innovation and its strategic application possibilities is essential (Bessant and Rush, 1995).

4.2.5 Bottlenecks in the diffusion of information technology

On the basis of the theoretical approaches sketched so far, a number of bottlenecks can be recognised with regard to the diffusion of information technology in Dutch small and medium-sized enterprises. Communication is of central importance in the diffusion process, in which it is desirable to reach the individual potential adopters and provide them with specific information. However, small and medium-sized enterprises form a very heterogeneous group, which makes segmentation of the group of potential adopters rather complicated. Moreover, information technology is a complex technological innovation, particularly for the entrepreneurs in the SME sector. The classic diffusion models do therefore not suffice, because it is precisely the context of the information technology application that forms an important aspect in the diffusion process. As individual and specific communication is essential, diffusion and adoption cannot be separated and it is crucial for the analysis of diffusion mechanisms to fathom the adoption mechanisms at the microeconomic level as well.

4.3 The adoption of information technology

The adoption of information technology is largely determined by the decision-making of the individual potential adopter with regard to the technological innovation. In this section we will describe how the adoption process of an innovation and specific information technology takes place at the microeconomic level according to certain theoretical viewpoints.

4.3.1 The adoption context

The adoption of an innovation such as information technology is considered at the level of a single SME in this research. A necessary condition for innovation is an observed need that often arises as a result of external pressure, a threat to continuity, or a drop in performance (Nooteboom, 1998). Many aspects implicitly or explicitly influence decisions taken with regard to the adoption of an innovation. These aspects collectively form the context of the adoption process. A description of the adoption process will be given in the next section. In the adoption context of an innovation, Tornatzky and Fleischer (1990) distinguish three main elements: the environment, the technology and the organisation. In addition, Iivari (1993) gives a description of an adoption framework that depicts the context regarding the adoption of information systems. This framework can be found in appendix 3. The framework is an enumeration of possibly relevant adoption aspects and as such it cannot be used as an analytical model. The framework of Tornatzky and Fleischer (1990) is more suitable for this. It should also be mentioned that, in comparison with the adoption context of Tornatzky and Fleischer (1990), the environmental aspects in Iivari's framework appear to be relatively less profound. The three main elements of the adoption context will be briefly explained below. Often the context does not determine the adoption process, but merely creates the limiting conditions and facilities that enable the adoption process.

The environmental context

According to Tornatzky and Fleischer (1990), the environmental context of the adoption of innovations is related to three aspects. The first aspect concerns the characteristics of the industry and market structure. These characteristics determine to a large extent the innovative behaviour of enterprises on account of such matters such as the facets and intensity of mutual competition, the relations with buyers and suppliers, the life cycle in which the sector finds itself, et cetera (cf. Porter, 1980). The attitude of an enterprise towards its position in the environment depends heavily on its size and, partly because of this, also on its political and financial ability to influence the characteristics of the industry and the market structure. The second aspect is aimed at the availability and quality of sources that are consulted (information about the innovation, suitable labour force, access to services related to the adoption and implementation of the innovation). The government policy, and therewith the government regulation, forms the third aspect and plays an important role in the stimulation of the adoption process. Section 3.5.3 gives some examples of initiatives, projects and documents in which the Netherlands Ministry of Economic Affairs is or was involved to some extent.

Scenario methods are instruments for presenting possible developments in the environmental aspect (industry, supply chain and technology) at the management level (cf. Porter, 1980; Millet, 1988; Van der Heijden, 1996; Bood and Postma, 1998; Gausemeier et al., 1998). Thus, scenarios can support entrepreneurs in SMEs with the learning processes related to business strategies and innovation (Bood and Postma, 1998; Stroeken and Knol, 1999). These will be discussed in Section 5.2.

De technological context

The technological context encompasses the availability of the innovation and the characteristics of the innovation. The availability of the innovation is obviously essential for the adoption by the potential adopter. The actors from the layer model (Figure 9) can operate as change agents in this. The aspects concerning the characteristics of the innovation have already been discussed in Section 3.2.3. For an adequate analysis of the adoption and application of information technology in an enterprise, it is necessary to link the technological and organisational contexts.

The organisational context

Tornatzky and Fleischer (1990) distinguish three areas in the organisation context, namely the formal and informal internal organisation structure, the communication processes and the size of the enterprise. With regard to the first area, i.e. the organisation structure, two ideal types of organisations can be distinguished: the mechanistic type and the organic type (Burns and Stalker, 1966; Fairtlough, 1994). These types can be characterised in terms of the degree of decentralisation in management, the extent of lateral communication between individuals and departments, et cetera. Studies suggest that the decision-making on the adoption of an

innovation is relatively better attuned to the features of organic structures, whereas the implementation route is relatively better completed in a mechanistic organisation structure (cf. Zaltman et al. 1984). The internal communication processes and associated management culture, i.e. the second area, can create a positive atmosphere with regard to the decision to adopt an innovation, in which various key figures play a crucial role, for example, idea generators, change agents, innovation champions, opinion leaders, and gatekeepers (Tornatzky and Fleischer, 1990; Rogers, 1995). The third area relates to the size of the enterprise in terms of turnover, number of employees, et cetera. The term slack is often used in this connection, which relates to the availability of freely employable means (funds, knowledge, etc.) as a limiting condition for the development of innovative activities. In the case of the adoption and implementation of information technology, the mutually related technological and organisational contexts can be described in greater detail by means of so-called IT- organisation frameworks. These frameworks will be discussed in Section 5.3.1.

4.3.2 The adoption process

The adoption process encompasses the decision processes related to the adoption of an innovation and is generally given in stages. One of the first divisions into stages was presented by Thompson (1965), in which the innovation process includes the stages of initiation, adoption and implementation. Zaltman et al. (1984), Hanna et al. (1995) and Rogers (1995) have made other proposals for a division into stages. One of the weak points of these divisions is that they are based on the assumption that there is a natural order of events. However, the adoption process is not a linear or sequential process, and entails many different forward and backward links (cf. Kline and Rosenberg, 1986; Clark and Staunton, 1989; Tornatzky and Fleischer, 1990). With respect to the various models that describe the decision-making processes concerning the adoption of an innovation, Dean (1988) distinguishes four groups, namely the rational models, limited rational models, political models and so-called garbage can models. Cohen et al. (1972) describe the principles of the last model. Which model is implicitly or explicitly used by the potential adopter(s) depends heavily on the adoption context represented in the previous section.

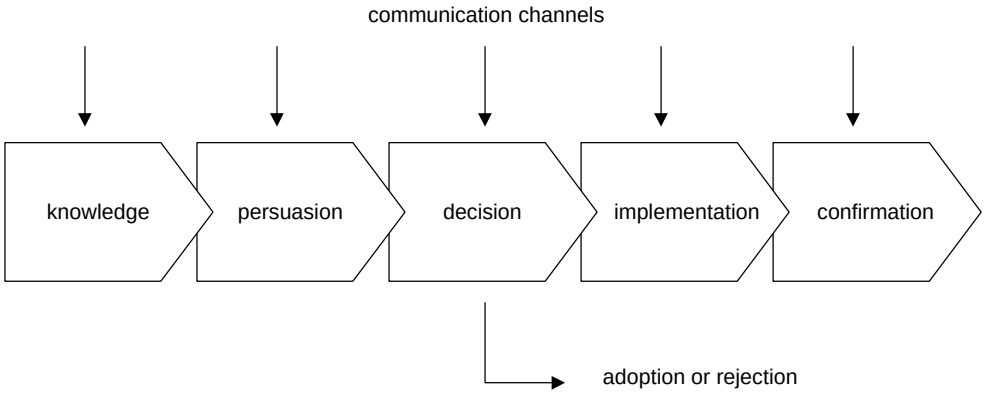


Figure 11: Adoption process of Rogers (1995)

Rogers (1995: 20) defines the adoption process of an innovation as 'the process through which an individual (or other decision unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision'. Rogers (1995) distinguishes five stages in the adoption process (Figure 11). The first stage, i.e. knowledge, starts when a decision unit is exposed to the existence of an innovation through communication channels and then gains some idea about how it works. A passive exposure can sometimes lead to an innovation need on the part of the decision unit. An innovation need that is already present can lead to active search behaviour to obtain more knowledge about the innovation. In the persuasion stage, the decision unit forms a positive or negative attitude with respect to the innovation on the basis of the perceived characteristics. The reduction of uncertainty is characteristic for this stage. The next stage, decision, occurs if the decision unit starts activities that lead to the choice of adopting or rejecting an innovation. Implementation occurs when the decision unit starts to use the

innovation. For complex innovations like information technology, the adaptation of the innovation (i.e. its reinvention) for the personal needs and wishes of the users is an important part of the implementation trajectory. In the confirmation stage, the decision unit will look for positive confirmation concerning the decision to adopt for a given period of time. During this period the decision unit will try to avoid or reduce dissonance regarding the decision. Communication channels have an impact on each stage in the adoption process. According to Rogers, it is more or less essential to go through all five stages. The first three stages are mental processes of the potential adopters, while the other two are physical processes. The emphasis in this research mainly lies on the first two stages of the adoption process of Rogers (1995), i.e. knowledge and persuasion.

It is necessary to first raise the awareness of the entrepreneur regarding the innovation to stimulate its adoption (cf. Nooteboom et al., 1992; Bessant and Rush, 1995; Rogers, 1995). This means influencing the phases of knowledge and persuasion in Rogers' adoption process by the provision of information and creation of learning effects, particularly through experience, which reduces the uncertainty and unpredictability as far as the innovation is concerned. The corresponding communication cannot always be perfect, due to the presence of filters. This has to do with such phenomena as bounded rationality, subjective preferences and cognitive limitations of the communicating individuals. The essence of communication is to reach a converging level of knowledge via mutual understanding. The most effective communication, which leads to a converging level of knowledge, occurs between two individuals, in which a degree of homophily is present regarding background, education, social status, religion, etc. (Rogers, 1995). As a result, the stages of the adoption process depend on the information processing characteristics of the decision taker and the available information (Frambach, 1993).

The information processing by the decision taker

According to Frambach (1993), the information processing by the decision taker is largely determined by the available time, expertise of the receiver and the resistance to information reception. All this is closely connected with the so-called *absorptive capacity* of the innovation-adopting organisation (Cohen and Levinthal, 1990). Cohen and Levinthal (1990: 128) describe absorptive capacity as 'the ability of a firm to recognise the value of new, external information, assimilate it, and apply it to commercial ends' and it is based on the absorptive capacities of the individual members of the organisation. The absorptive capacity depends heavily on prior related knowledge according to Cohen and Levinthal. The more the entrepreneur is capable to process the information received, the higher the chance that adoption of an innovation will be considered.

Available information

The available information on the innovation can be linked to the elements of quality, value, and amount (Frambach, 1993). The quality of the information is related to the degree to which the information is capable of reducing the uncertainty of the potential adopter about the innovation. This is a subjective matter and depends on the completeness, accuracy and reliability of the information as observed by the decision taker. The value of the information is the relative advantage produced by the information, such as the increase of knowledge and ability of the enterprise. For information technology this implies making available information in the field of the aspects of strategy, technology, and organisation (Stroeken and Coumans, 1998; Stroeken and Knol, 1999).

The available information is communicated via communication channels and it is found that the various channels (e.g. interpersonal or mass media channels) influence the adoption phases of knowledge and persuasion in the adoption process of an innovation to different degrees (cf. Nilakanta and Scamell, 1990; Rogers, 1995). Due to the relatively restricted interaction options, mass media channels have less influence on the persuasion phase than interpersonal means of communication, but they do offer ample means to provide signalling information to potential adopters in the knowledge phase (Attewell, 1992). However, Nooteboom et al. (1992) indicate that, due to the high degree of tacit knowledge in SMEs, the adoption phase is better served by interpersonal contacts. Lind and Zmud (1991) state that the communication channels that are capable of transferring a higher degree of information richness have more impact on the innovativeness of the potential adopter. According to Lind and Zmud (1991: 198), the richness of information is related to 'the potential for information being communicated through a channel to overcome different frames of reference held by communication partners or to clarify ambiguous issues such that joint understanding between the partners is

enhanced.' According to Lind and Zmud (1991), the intervening variable in this relational process between information richness and innovativeness is the degree of convergence between the communicating individuals, which has already been represented as the degree of mutual understanding. Communication channels with a potentially high information richness are, for example, face-to-face meetings or telephone conversations; these channels have a larger convergence potential. Typed documents or e-mail messages, on the other hand, represent means of communication with a relatively lower richness. The convergence potential of these means is smaller. The cognitive aspects of the adoption process will be discussed in greater detail in the following section.

4.3.3 Cognitive aspects at the individual and organisational levels

Cognitive aspects play an important role in the adoption process of complex innovations. As far as the stimulation of the diffusion and adoption in small and medium-sized enterprises is concerned, it is in the first instance the adoption phases of knowledge and persuasion that are important (cf. Nooteboom et al., 1992; Rogers, 1995), and with that, awareness in connection with uncertainty and receptiveness. In the adoption process of a complex, technological innovation such as information technology the aspects of uncertainty and awareness are not only related to innovation, but also to the context of the innovation (Tornatzky and Fleischer, 1990). The bounded rationality of the individual places restrictions on rounded arguments in the adoption process (Simon, 1955, 1959, 1990). In relation to this bounded rationality, Polanyi (1962, 1966, 1969) indicates that a large part of our knowledge is situated in the subsidiary awareness and that a rational consideration is therefore mainly based on that part of that knowledge which is temporarily stored in the focal awareness. Thus, according to Polanyi, a major part of human knowledge is tacit and that is why it is difficult, if not impossible, to make this tacit knowledge explicit or to move it to focused awareness. Tacit knowledge is obtained through learning by doing (cf. Polanyi, 1962, 1966, 1969; Nonaka, 1991). Nooteboom et al. (1992) list two reasons why knowledge in small enterprises is more tacit than in large enterprises. In the first place, internal and external communication is generally informal and oral, and secondly, the formal and abstract knowledge of entrepreneurs in SMEs is generally limited. As regards the communication with potential adopters in small and medium-sized enterprises for the purpose of stimulating the diffusion and adoption of technology, Nooteboom et al. (1992) state that it is essential to take into account the so-called tacit knowledge of these potential adopters. In Section 4.2.4, we have already indicated that mass-media channels can be effective in the provision of introductory information for the benefit of the adoption phase. However, Nooteboom et al. (1992) indicate that, due to the considerable degree to which tacit knowledge is present in small and medium-sized enterprises, this knowledge phase might be better served by interpersonal contacts. Information technology is a complex innovation, which makes it hard to influence firm-specific learning processes and strategic innovation routines. In this way insights in the field of cognitive processes offer a clearer view of the diffusion and adoption process of complex technological innovations (Attewell, 1992; Nooteboom et al., 1992; Howell, 1994).

Learning at the individual level

Learning processes can be described at the individual and organisational levels. According to Attewell (1992: 6), individual learning about a specific technology is related to 'the distillation of an individual's experience regarding a technology into understandings that may be viewed as personal skills and knowledge'. To compensate for the limited process capacity concerning the knowledge of complex choices, individuals store experiences in cognitive structures from a cognitive psychological perspective; these are also referred to as *mental models*. These models are personal descriptions of situations formulated in abstract terms as opposed to concrete descriptions of specific situations (Johnson-Laird, 1983) and are shaped by the social and cultural backgrounds, experience and education of the person in question. Other terms for these cognitive structures are *schemata* (Neisser, 1976), *scripts* (Abelson, 1976; Schank and Abelson, 1977) and *causal maps* (Weick, 1979).

Individuals learn when they change their perception after researching and evaluating the results of their actions. Kolb's learning cycle (Kolb, 1976, 1995) provides more insight into the nature of these learning processes (Figure 12). This cycle has two dimensions, i.e. a dimension consisting of concrete versus abstract notions and a dimension consisting of active versus relative notions, in which Kolb (1976, 1995) distinguishes four steps: concrete experience, observation and reflection, formation of abstract concepts and theories, and the

testing of implications of theories in new situations. Together these steps form a learning cycle. By going through these steps implicitly or explicitly, individuals gain insight and knowledge regarding known situations, incidences and situations they are yet to be confronted with. The degree to which a learning cycle can be gone through therefore touches upon the degree of innovativeness of a person. The latter depends heavily on such aspects as background, education, social status, etc. (Rogers, 1995) and thus are partially conditional for going through the various learning cycles.

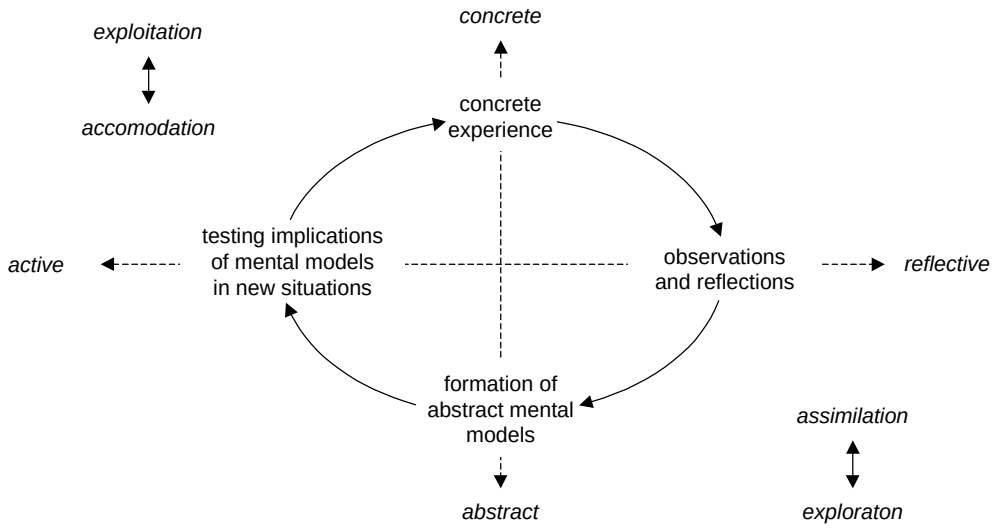


Figure 12: The learning cycle of Kolb (1976, 1995)

Kolb's learning cycle (Kolb, 1995) can be related to Piaget's theoretical approaches (Piaget,1936, 1937; Flavell, 1968) towards the aspects of *assimilation* and *accommodation* (Nooteboom, 1997, 1998; Bood and Postma, 1998). According to Piaget, assimilation is the process in which individuals force their mental models on the environment (world) in which they live; the process of accommodation is the exact opposite, in which individuals adapt their mental models to their environment. Bood and Postma (1998) reason that two steps from Kolb's learning process, i.e. active implementation and concrete experiences, stimulate accommodation, and that the steps of reflective observations and abstract conceptualisations stimulate assimilation. To optimise the learning process accommodation and assimilation must be in equilibrium (Bood and Postma, 1998).

Learning at the organisational level

The adoption and implementation of a complex new technology requires learning at an individual and organisational level according to Attewell (1992). The concepts sketched at the individual level can be compared to March's approach towards the aspects of *exploration* and *exploitation* (March, 1991). Exploration is related to matters such as searching, discovering, variation, flexibility, risk taking, experimenting, and innovation, while exploitation encompasses matters such as selection, implementation, efficiency, refinement, production and execution. In March's view (1991) both aspects are required in an enterprise for it to survive and flourish. Exploitation generally leads to a higher degree of certainty in the short term, because the implications of exploitation become visible more clearly and more rapidly. Exploration is more focused on the long term and encompasses a lot of uncertainty due to unpredictable developments on the market, relations, technologies, etc. Change processes within an enterprise are more likely to focus on exploitation than on exploration. This leads to risky situations because the mental models of the individual members of the enterprise tend to converge towards routines (Nelson and Winter, 1982) related to the phenomenon of exploitation, which means that the knowledge that the members possess is no longer homogeneous. Thus, a link can be made between the individual and organisational level. Nelson and Winter (1982: 14) describe the term routines as 'all regular and predictable behavioural patterns of firms' and can be projected on aspects such as production, policies regarding investment,

R&D, advertising, and business strategy'. The dominance of exploitation over exploration in an organisation leads to the dominance of assimilation over accommodation and vice versa (Bood and Postma, 1998). An explorative attitude calls people to focus on renewal and innovation, but forms of exploitation should not be abruptly abandoned for exploration if there are no motives or opportunities (Nooteboom, 1998). Furthermore, it is of importance in the long run that exploitation and exploration are balanced again at the organisational level (March, 1991; Nooteboom, 1998).

Nooteboom (1998) indicates there may be a general logic of learning that is mirrored on the individual, organisational, and sectorial level. As a result, Nooteboom analyses the phenomena of innovation, learning and organisation from a broader perspective, in which he takes an integrated approach to evolutionary economics, the transaction-costs approach, the resource/competence view of the firm and cognitive psychology. A coherent development or learning model is drawn from this, which consists of the following stages: generalisation, assimilation, differentiation, reciprocity, accommodation and consolidation (Nooteboom, 1998) (Figure 13).

- The *generalisation* stage concerns the generalisation of a successful execution or practice concept, which makes it possible to transform and apply it in a possibly successful and new context.
- *Assimilation* is the stage at which the generalised practice concept is exploited in the new context.
- The *differentiation* stage starts when the limits of exploitation become apparent in the previous stage and encompasses a differentiation of the practice towards the specific local circumstances.
- The *reciprocity* stage relates to the further differentiation and adjustment of the specific practice concept on the basis of inspirations obtained through comparisons with concepts of similar practices in other contexts. This eventually causes the situation to become inconvenient and inefficient due to loss of standardisation, less scale advantages and increased complexity.
- Th above-mentioned intolerable situation subsequently leads to *accommodation*, in which the elements from the previous stage are restructured and reintegrated to form a new concept. Knowledge of this concept is still predominantly tacit and experience is necessary to improve and optimise the concept.
- The *consolidation* stage starts when a dominant design comes to the fore and is implemented and operationalised as a standard execution concept. The generalisation of this concept marks the beginning of the next cycle.

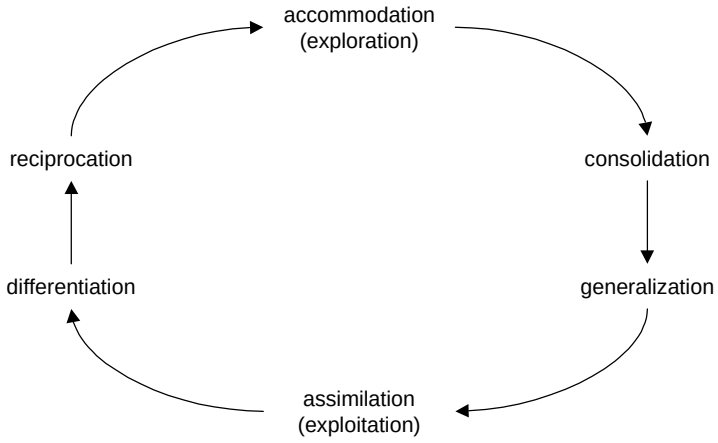


Figure 13: The learning model of Nooteboom (1998)

In comparison with the concepts of Kolb (1976, 1995) and March (1991), Nooteboom concretises his learning model by making use of *scripts* to indicate which changes occur at each stage or should occur with regard to learned insights and actions. Thus, the model provides more insight into the way in which individuals, organisations or enterprises and even sectors develop by following a path of exploration and exploitation, resulting in learning and innovation. However, Nooteboom (1998) does indicate that the learning model has yet to be verified empirically.

The concepts of Kolb (1976, 1995), March (1991) and Nooteboom (1998) form a plausible basis to fathom the process of awareness, learning and strategic innovation. The concepts provide insight into the diffusion and adoption mechanisms concerning innovations in SMEs. In other words, the adoption of information technology is a form of exploration provided that economic opportunities and motives present themselves in the environment. This can be initiated if the members of the enterprise are more able to focus on accommodation than assimilation. Returning to Kolb's learning model (Kolb, 1976, 1995), this means the members (e.g. the managers and entrepreneur) must come into contact with the strategic implications of the innovation through experience and testing to raise their awareness of an innovation. At the management level this works as follows: the learning cycle starts with the acquisition of concrete experiences in the field that provide individuals specific insights that are retained in the shape of mental models. On the basis of these insights the manager or entrepreneur will implicitly or explicitly formulate policy and undertake strategic action at a strategic level. The implications of these strategic actions will become visible in the long run, after which the manager links these new experiences to his mental models (testing). Nevertheless, Bood and Postma (1998) note that the cycle has three shortcomings at the strategic level. In the first place, individuals possess a certain degree of *cognitive inertia* so that they are not immediately inclined to allow new experiences to have an impact on their mental models. This was indicated above by the differences between assimilation and accommodation. In the second place, the length of the *time span* of the cyclical management process prevents us from relating and testing experiences, activities and implications concerning a particular strategic aspect (e.g. innovation) during the course of time (loss of overview and insight). As a result this delayed feedback makes a smaller contribution to the process of organisational learning. Finally, the degree to which *variations* are present in the mental models of the various managers involved at the group level can lead to problems in determining the strategic policy. This is related to views on the balance between exploration and exploitation. According to Van der Heijden (1996), Bood and Postma (1998) and others, the three shortcomings mentioned can be resolved by using scenarios.

4.4 Summary and conclusion

The application rate of information technology in small and medium-sized enterprises is relatively low. That is the reason why the diffusion and adoption of information technology in small and medium-sized enterprises is the central theme in the present study. Diffusion and adoption mechanisms cannot be separated due to the fact that the degree of diffusion of an innovation in a social system actually depends on the individual adoption behaviour of the potential adopters who are part of that social system.

Diffusion

Chapters 2 and 3 have shown that the diffusion of information technology in Dutch small and medium-sized enterprises plays a valuable role in improving the general competitive position of the Netherlands in the global economy. In this chapter we used innovation theory to briefly discuss various aspects that have some influence on the diffusion of innovations in a social system. Diffusion research is generally aimed at the analysis of the spread of innovations in a social system, in this case a certain part of the Dutch SME sector. Communication with the potential adopters is the core aspect in the diffusion process as this reduces the entrepreneurs' uncertainty about information technology. Homogenisation of the group of potential adopters is a necessary prerequisite for optimising the effectiveness of communication. The environment of the group of potential adopters has thus considerable influence on the rate of adoption of an innovation in that social system. Matters such as concrete diffusion projects concerning information technology and industry-specific diffusion aspects fell more or less outside the scope of this discussion. In short, goal-oriented communication with small and medium-sized enterprises on the possible strategic applications of the innovation is essential. It is important in this respect to homogenise the companies that need to be reached by dividing the social system into branches of industry and, if possible, to divide these branches into sub-branches or types of companies. To do so insight into the adoption process at the microeconomic level is required.

Adoption

In relation to this study, the phases of knowledge and persuasion in the adoption process are in the first instance particularly important as precisely these phases relate to the awareness raising with regard to the innovation of information technology. It may generally be stated that the awareness of the role and possible applications of information technology is relatively low among entrepreneurs in small and medium-sized enterprises. This is, however, a crucial aspect of the adoption process of an innovation. All this has to do with the constantly changing dynamics of the adoption context, which make it particularly difficult for small enterprises to gain and maintain insight into this context. Uncertainty is therefore rampant. Knowledge depends heavily on the present bounded reality, is primarily tacit and is acquired through learning by doing. It is therefore difficult to exchange explicit knowledge via non-interpersonal communication channels in the adoption process of a complex technological innovation such as information technology. In addition to communication, learning is an important element in the awareness-raising process. Learning encompasses various stages that together constitute the mental model of an individual or organisation. On this basis a mental model contains the ideas and knowledge required to deal with the new situations that necessarily need to be anticipated or demand a better proactive response. Learning takes place through a cyclic interaction between exploitation and exploration, in which the necessary experiences and insights are acquired. Thus, the entrepreneur as a potential adopter will experience that innovation may provide the desired opening for establishing a certain strategic policy. At the management level, three shortcomings can be distinguished with regard to the learning processes. In the first place, individuals always possess a certain degree of *cognitive inertia* so that they are not immediately inclined to allow new experiences to have an impact on their mental models. In the second place, the length of the *time span* of the cyclical management process prevents us from relating and testing experiences, activities and implications concerning a particular strategic aspect (e.g. innovation) during the course of time. Finally, in the third place, the degree to which *variations* are present in the mental models of the various managers involved at the group level can lead to problems in determining the strategic policy. Adoption-related subjects such as the types of decision-making processes and implementation aspects were not really discussed in full in this chapter. Summarising, it may be stated that the adoption of information technology can be linked to the awareness of, and learning about, the dynamic environment in relation to the role of information technology.

This chapter represented the diffusion and adoption problems from an abstract and theoretical angle. Chapters 5 and 6 will concretise these problems with regard to the so-called IT-scenario model. Aspects such as homogenisation, environment dynamics, uncertainty, awareness, communication and learning form the basis for the IT-scenario model to be developed. The next chapter describes a few concepts that may function as a bridge between the above-mentioned, theoretical points and the practice in which entrepreneurs should be approached with the use of the IT-scenario model in an easily accessible and understandable yet profound and stimulating way.

Chapter 5
From innovation theory to IT scenario model

5.1 Introduction

As a result of the increasing importance of information and knowledge as economic commodities, not only the development of knowledge as in R&D, but also the diffusion and adoption of it deserve more attention. Small and medium-sized enterprises in particular lag behind in terms of knowledge of the knowledge economy and its modern technologies. The rapidly progressing and uncertain developments at the macroeconomic and mesoeconomic levels pass them by because they spend most of their attention on operational business activities. The central objective of this study is therefore to develop an IT scenario model as an instrument to stimulate the diffusion and adoption of information technology in a part of the SME sector by raising the awareness of the strategic usefulness of information technology.

In Chapters 2, 3 and 4, the theoretical concepts with regard to the model to be developed have been discussed from various perspectives. Chapter 2 showed that information, knowledge and information technology play a key role in the economic order of today. The use of information technology has profound economic implications as information technology is *the* technology for storing, processing, replicating and transporting information. This has far-reaching consequences for innovations in processes, products and services. Thus, information technology has influence on market structures, supply chains and individual enterprises, while such aspects as standardisation, differentiation and specialisation create favourable conditions for forms of integration. Either explicitly or implicitly, the above-mentioned elements lay the socio-economic and technological foundations for the model. By this we mean that these elements form the framework and guidelines for the components of the model.

Chapter 3 gave a further explanation of information technology, the SME sector and policy regarding the stimulation of the adoption of information technology in small and medium-sized enterprises. It clearly indicated that the relations between enterprises change, because a cross-border application of information technology in an enterprise has an integrative effect on interactive parties, particularly in the industrial column. It is obvious that this integration process will not take place immediately, but involves a number of stages or phases. This viewpoint lies at the heart of the IT scenario model. Compared to large firms, the adoption rate of information technology in small and medium-sized enterprises is relatively low. This has to do with various characteristics, including vision, knowledge and structure. Moreover, the SME sector is a very large and heterogeneous group, which makes it necessary to design the model in a way that is as industry-specific as possible.

The mechanisms as far as the diffusion and adoption of a technological innovation are concerned, have been discussed in Chapter 4. Diffusion concerns the spread of an innovation and the knowledge thereof among the members of a social system such as a small or medium-sized enterprise. Entrepreneurs are very uncertain when it comes to innovations and their strategic use. Targeted communication geared to the specific dynamic adoption context of enterprises is essential for reducing this uncertainty. This is an argument in favour of designing the IT scenario model in an industry-specific way. In relation to the adoption phases, the model should in the first instance be aimed at the phases of knowledge and persuasion in order to stimulate or stretch the current mental models of entrepreneurs. Thus, such essential aspects as awareness raising and learning processes with regard to the application of information technology are influenced.

The foregoing shows that IT scenario model should incorporate many viewpoints and aspects regarding the diffusion and adoption of information technology in small and medium-sized enterprises. This chapter will discuss a number of concepts that can function as a bridge in the creation of a practical model encompassing the above-mentioned aspects. It is for this reason that Section 5.2 describes a scenario method that may be used to provide the entrepreneur with some insight into environmental uncertainties. This method comprises a manner of

communication for diffusing general information about developments and technologies in small and medium-sized enterprises. In Section 5.3, the so-called IT growth-phase models are explained. These describe the evolutionary process concerning the adoption of information technology in supply chains and enterprises. Regarding the theoretical approaches towards the adoption of innovations, it may be stated that an IT growth-phase model represents the possibilities for providing the individual potential adopter per phase (stage) with the required insight into his specific adoption context. In this way the division in phases may have a positive influence on the entrepreneur's awareness of the strategic possibilities of information technology. In this chapter the following tripartition is used to concretise the above-mentioned division in phases: strategy, technology and organisation. This tripartition can play an important role in making the merits of information technology, in terms of increase in productivity and economic growth, measurable at the mesoeconomic and microeconomic levels. Summarising, it may be stated that the diffusion and adoption of information technology should be approached from a broad perspective. Many facets are applicable, including economic and business characteristics of information technology, communicative aspects in a social system and cognitive aspects such as awareness raising and learning. Scenarios and IT growth phases function in this study as a bridge in order to translate relevant theoretical facets and approaches to a practical IT scenario model.

5.2 Scenarios

In this study scenarios are considered a way to link the theoretical approaches from the previous chapters to a concrete practical model for stimulating the diffusion and adoption of information technology in small and medium-sized enterprises. Scenarios are instruments for supporting the strategic management process and this section therefore looks at how these scenarios are applied in this process. This involves a description of the role of scenarios in companies and the methods for developing scenarios.

5.2.1 The role of scenarios in companies

The term *scenario* is defined and used in various ways in the literature. For example, Van der Heijden (1996) makes a distinction between external and internal scenarios. *Internal scenarios* unfold in the minds of individuals and have something in common with the cognitive models mentioned in Section 4.3.3 (e.g. scripts and schemata). An *external scenario* is a scenario that presents a range of possible future developments and outcomes as far as the environment is concerned and can be described as 'a description (not statistical projection) of consistent sets of trend outcomes expected by a target year' (Millet, 1988: 61). External scenarios form the main subject in this section. The first application of the term scenario in an economic and managerial context can be found in Kahn and Wiener (1967). During the oil crisis in the seventies, the application of scenarios was extensively researched by enterprises such as Shell, General Electric and Lockheed to provide higher management insight into possible global and sectorial developments. It should be noted that scenarios are not the same as traditional forecastings. Forecastings attempt to exclude any uncertainty by using the *predict-and-control* principle to give exact answers to standard questions. However, drawing up scenarios gives rise to crucial questions such as *what if* .... ? Scenarios leave room for environmental uncertainties by presenting various fundamental future perspectives in a qualitative way. This does not, or hardly ever, occurs in forecastings. As regards the application of scenarios in recent decades, Bood and Postma (1998) distinguish two generations. The first generation of scenarios is mainly a tool for the evaluation and identification of future opportunities for organisations. The second generation of scenarios makes managers aware of environmental uncertainties, broaden the mental models of the managers, and activate and speed up the processes of organisational learning (Table 6).

Original functions of the first-generation scenarios
• Evaluation and selection of strategies • Integration of various kinds of future-oriented data • Exploration of the future and identification of future possibilities
The second-generation scenarios: more recently added functions
• Evaluation and selection of strategies • Integration of various kinds of future-oriented data • Exploration of the future and identification of future possibilities

Table 6: Two generations of scenarios (Bood and Postma, 1998)

Scenarios are tools in the strategic thinking process of managers or entrepreneurs (cf. Porter, 1985; Millet, 1988; Van der Heijden, 1996; Bood and Postma, 1998; Gausemeier et al., 1998) and reduce the three shortcomings of the learning cycle at the strategic level. The *time span* between experience, activity and implications is reduced by simulating and communicating specific uncertain situations that can occur in reality over a brief period of time. In this way scenarios stretch the mental models of the people involved, so that the *degree of cognitive inertia* is reduced. Moreover, scenarios stimulate creativity and are a way to promote the internal communication of ideas, so that the variations in mental models of the people involved can become more balanced. This provides collective insight into the opportunities and threats that accompany particular uncertainties. All this makes it possible for scenarios to develop, simulate and execute strategies in order to offer support to the strategic learning process in the enterprise.

5.2.2 The creation and construction of scenarios

The creation and construction of scenarios is a practical matter and many methods are listed in the literature, e.g. in Porter (1985); Mercer (1995), Van der Heijden (1996); Schwartz (1996) and Gausemeier et al. (1998). Mostly, scenarios are not constructed according to a standardised process and there are therefore various differences between the scenario methods. However, it should be noted that the basic structure is often is the same. The development process of scenarios often involves an iterative process, in which managers or entrepreneurs should be involved during the entire process (Mercer, 1995; Bood and Postma, 1998). Table 7 gives the scenario method of Schwartz (1996) as an example.

Scenario method of Schwartz (1996)	
step	**description**
1	problem identification
2	description of current situation and relevant factors
3	classification, valuation and selection of scenario elements
4	construction of scenarios
5	analysis, interpretation and selection of scenarios
6	supporting strategic decision-making with scenarios

Table 7: A scenario method

The first step in the Schwartz method (1996) involves defining the focus on the scenario planning process. This usually means the scenarios are related to the *business* of an enterprise. With this the process of scenario planning already starts out with a focus on the positive influencing of an enterprises's strategy (Mercer, 1995). In step two the present situation is described, in which, for example, various relevant factors are identified by means of a SWOT analysis. Relevant factors are related to the most crucial and most relevant developments in society, and in the sector or industry; in the literature they are referred to as *causal factors* (Porter, 1985), *driving forces* (Schwartz, 1996) or simply *drivers* (Mercer, 1995). The third step is related to the classification, weighing and selection of *drivers* and these can be classified as constant, predetermined or uncertain elements (Porter, 1985):

- *Constant elements* are elements that are not likely to change.
- *Predetermined structure elements* are the areas where the structure will change, but where the change is largely predictable. Examples are the coming of the Euro or the developments regarding the introduction of a uniform tax system at a European level.

- *Uncertain structure elements* are the aspects of the future structure that depend on unsolvable uncertainties (customer demands, partnerships and market developments).

An example of possible scenario drivers is given in appendix 4. An artificial variation in the important uncertain structure elements determines the various scenarios in this step, in which the constant and predetermined elements in each scenario seem unchanged. Step four goes on to construct and work out scenarios, after which they can be applied in the strategic management process of an organisation. This happens in steps five and six.

Scenarios have a reputation of being complex and costly, but Mercer (1995) indicates that scenarios can also be simple. The simpler a scenario and the simpler the process to construct scenarios, the stronger the scenarios are at broadening the mental models of the people involved regarding their content and time horizon. Scenarios have to be comprehensible, feasible, and internally consistent. It is essential to find a balance between the degree to which the horizon is broadened and the degree of credibility of the scenario. Mercer (1995) notes that convincing managers to use the constructed scenarios is the hardest part of the scenario planning process and he speaks of selling the scenarios to the organisation. Usually scenarios and scenario planning is related to the management process in large enterprises, but Bood and Postma (1998) state that scenarios can also be significant in the strategic process of SMEs. Considering the use of scenarios in SMEs is first related to the expansion of the mental models and the raising of awareness concerning strategic changes, it is more attractive to offer a standard scenario for the knowledge and insight level of SMEs instead of going through the entire scenario process. In this study we assume that the philosophy and methods surrounding scenario planning are also applied to provide SMEs insights into the strategic application of technological innovations. In other words, the scenarios can also be applied to influence the learning process regarding adoption, absorption, and the application of strategically valuable innovations. Managers and entrepreneurs can obtain more insight into the possible environmental developments via scenarios focusing on the strategic role of information technology. Dierckx and Stroeken (1999) worked out a first example for the car disassembly sector. We want to take things a step further through the development of an IT scenario model. In this it is of importance to take a closer look at the relation between the enterprise, strategy, and information technology from a managerial evolutionary perspective.

5.3 IT growth-phase models

The so-called IT growth-phase models make the evolutionary developments of the strategic use of information technology in an enterprise transparent. The present models of Venkatraman (1991), Tan (1995) and Stroeken and Coumans (1998) originate from the concepts of Churchill et al. (1969), Nolan (1973, 1977, 1979), McFarlan et al. (1983), and many others. IT growth-phase models are often composed of different stages, which are also referred to as phases or levels. From an innovation perspective, continuous follow-up adoptions of an ever-increasing level, or advanced or refined forms of technological innovations take place during the course of time. IT organisation frameworks and measurement variables concerning the IT application level are two subjects that are closely connected with the subject of IT growth-phase models.

5.3.1 The IT organisation frameworks

The role of information technology in an individual enterprise can be made visible by means of IT organisation frameworks. Descriptions of such frameworks are, for example, the consistency model of Scott Morton (1991) and the strategic alignment model of Venkatraman (1991). These concepts describe various dimensions and aspects related to the strategic embedding of information technology in an enterprise and are very similar to the ideas and concepts from innovation literature as described in Section 4.3.1. The *consistency model* of Scott Morton (1991) (Figure 14) contains five complementary basic aspects (strategy, technology, structure, individuals and management), which all are continuously subject to, or initiate, change. In addition, the framework contains two external aspects: the socio-economic and technological environments.

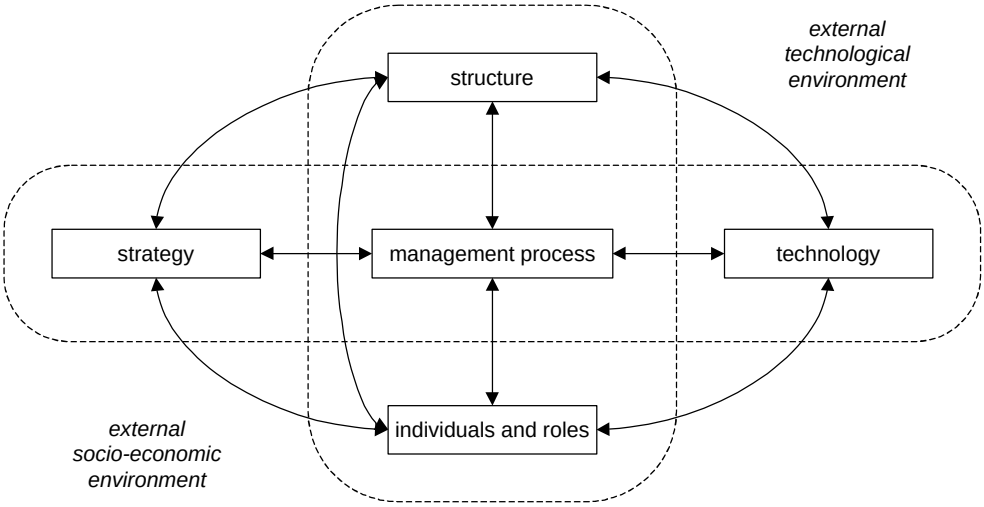


Figure 14: The consistency model of Scott Morton (1991)

- The *strategy* aspect refers to the objectives of the organisation, the way in which these are to be achieved, the choice of markets and products, and the choice of marketing mix.
- The *technology* involves the layout of technologies applied in business processes.
- The *structure* encompasses the organisation structure, decision-making procedures, and planning and control systems.
- The *individuals* and their roles are related to such aspects as knowledge, skills, ambitions and attitudes, and the social relations between various individuals in and outside the organisation.
- The *management* is responsible for the choice of the *overall* strategy and its realisation through the harmonisation of the four aspects mentioned above.
- The *socio-economic environment* relates to the macroscopic developments in, for example, globalisation and international competition, the education system and social security system.
- The *technological environment* encompasses the technological developments in hardware, software and communication, particularly within the information technology sector.

The *strategic alignment model* of Venkatraman (1991) consists of two typical domains, i.e. a business domain and an information technology domain (Figure 15), in which the following four interacting perspectives meet: business strategy, infrastructure and processes of the organisation, IT strategy and infrastructure and processes of the information systems.

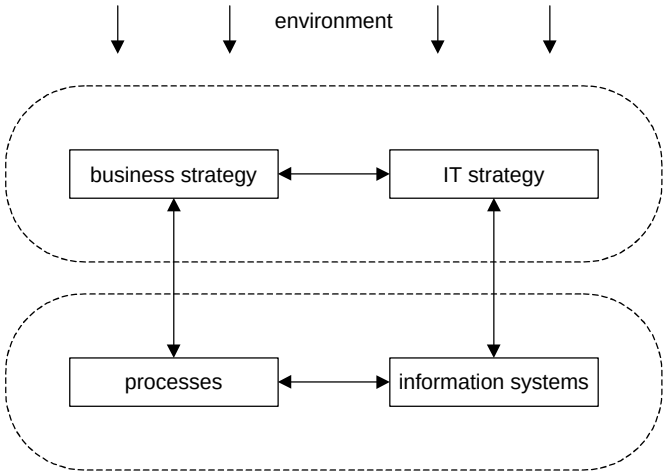


Figure 15: The strategic alignment model of Venkatraman (1991)

From both concepts we can deduce that it is essential to unite or even integrate business aspects with IT aspects at the strategic level. One example is the bookstore that embraced the Internet as a direct channel for sales (e.g. *www.amazon.com*); thus using information technology innovatively to provide the individual customer with added value in the shape of information and advice. The IT organisation frameworks give insight into the power elements and their relations from a non-evolutionary perspective and how they influence the strategic embedding of information technology in an organisation. However, they do not represent the developments over time of the role of information technology. These developments are represented by the IT growth-phase models. In the literature, several variables are used to make the developments in the application of information technology in a supply chain or enterprise visible and measurable.

5.3.2 Measurement variables and the adoption or implementation degree of IT

For the description of the adoption or implementation degree of information technology in an industry, supply chain or enterprise, whether or not by means of IT growth-phase models, many researchers use many different measurement variables. Before describing a number of individual IT growth-phase models, we will briefly discuss some of the measurement variables to show that the adoption degree of information technology in an industry, supply chain or enterprise can be measured in many different ways, both quantitatively and qualitatively.

Quantitative measurement variables concerning the adoption or implementation degree of information technology in enterprises were first introduced in the seventies and mainly served a descriptive purpose in those days. They were primarily meant to represent the status of automation, without taking into account the specific preconditions for implementation or the extent of integration of the technology in the enterprises. For example, Nolan (1973, 1977, 1979) used the IT budget as an indicator for the degree of automation. There are also indicators that focus on, for example, the number of available computers in the enterprise or the number of users of a certain type of computer program. Table 8 gives a summary of a number of variables from the literature that are measured quantitatively. From a scientific point of view, quantitative research makes it possible to prove interesting connections between possible determinants of the adoption of information technology in small and medium-sized enterprises in order to accentuate and expand the theoretical framework. This quantitative approach is generally less suitable for supporting the strategic choices of entrepreneurs in small and medium-sized enterprises. Information technology is a generic technology and this entails that the outcomes of quantitative measurement variables are difficult to translate into strategy points aimed at the improvement of both efficiency and effectiveness through information technology.

Quantitative measurement variables concerning the adoption of information technology in enterprises
• Nolan (1973, 1977, 1979) mainly focuses on the quantitative ratio between the IT budget and the total turnover as a measurement variable. The following more qualitative aspects also feature in Nolan's concepts, though to a lesser degree: the scope of the application portfolio, orientation of the automation organisation, planning and control of automation and involvement of the users. • Delone (1988) studied various measurement variables, including the number of years of experience with computers, the number of available computers and the number of applications. • Ein-Dor and Segev (1991) put emphasis on the application of IT using such variables as the system use in time units or the system use in terms of the number of users. • Cragg and Zinatelli (1995) studied the evolution of information systems in small enterprises by measuring the number of computers purchased, the number of applications, changes in the hands-on use of applications and the use of systems expressed in time units. • Igbaria et al. (1997) studied the acceptation of PCs using such variables as the perceived convenience and perceived usefulness.

Table 8: Quantitative measurement variables

Qualitative measurement variables, on the other hand, make it possible to influence the communication and awareness concerning the strategic application of information technology as they provide room for a broader explanation and interpretation. Qualitative measurement variables are more aimed at the characteristics of the way in which information technology is applied in and around the enterprise. These characteristics can be approached from different angles, for example, by referring to business processes, products and services, the user, the management or the supply chain. Table 9 gives a summary of a number of qualitative measurement variables from the literature.

Qualitative measurement variables concerning the adoption of information technology in enterprises
• Churchill et al. (1969) emphasise the 'sophistication of computer use' in an organisation, in which the attention shifts from the automation of basic activities to automation related to strategic decision making. • Venkatraman (1991) focuses on the explanation of the added value of IT from a strategic point of view, in which technology push and competitive pull are central. • Tan (1995) describes mainly the development of the application of IT in organisations from the perspective of the IT domain, in which the following seven balanced subsystems can be distinguished: IT strategy, information systems, technological infrastructure, IT organisation, users, IT specialists and IT management. • RMK (1997a) and Stroeken and Coumans (1998) use the following categorisation for small and medium-sized enterprises: IT strategy, technological infrastructure, IT organisation and IT management in branches of industry.

Table 9: Qualitative measurement variables

The foregoing relates mainly to the application of information technology in enterprises. However, the qualitative measurement variables represented in Table 9 can also be applied at the supply chain or industry levels. This makes these measured values more interesting, also from the strategic point of view, as they can be used in the support and execution of incentive projects concerning the diffusion and adoption of information technology in certain industries. This means that these qualitative measurement variables can also play a considerable role in indicating the qualitative improvement of the information technology service in the knowledge economy. Thus, for example, the tripartition of strategy, technology and organisation of Stroeken and Coumans (1998) can be used as an alternative measuring instrument to further examine the productivity relation between information technology and economy (2.7).

5.3.3 The IT growth-phase model of Nolan

The first versions of the IT growth-phase model of Nolan (1973) were mainly focused on a descriptive approach to the relative computing costs of an organisation in the course of time. Graphically, these cumulative costs form a sigmoidal (S-shaped) curve. In the later versions, the model (Nolan, 1977, 1979), consisting of six phases (Table 10), has a more normative and prescriptive nature so that statements could be made about the direction an organisation must take regarding computerisation. Nolan's model was often applied in consultations to determine the phase an organisation was in with regard to computerisation and subsequently make proposals for desirable future developments.

Phase model of Nolan (1979)	
phase	**description**
1	initiation
2	contagion
3	control
4	integration
5	data administration
6	maturity

Table 10: Phase model of Nolan (1979)

- In the first phase, the first automation applications are introduced and planning and control are virtually non-existent.
- In phase two, the use of new application is further encouraged and there is still no well-considered planning. This usually leads to an inconsistency between the various automation systems, the so-called partial automation principle.
- The third phase relates to a confrontation of the management with the sharply increasing automation expenses; control systems are introduced to get more grip on the developments.
- In phase four, the use of automation increases further and developments are now considered from a more integrated perspective, in which database and network systems are central.
- Phase five represents a full integration of the systems and data administration.
- In the last phase, the applications reflect the information flows within the organisation.

Some critical notes can be made about Nolan's growth-phase model, in which some points of criticism also apply to the models and concepts to be discussed below. Nolan's IT growth-phase model is mainly oriented towards larger organisation and its use is limited to administrative computer applications and applications meant to support management tasks in the organisation (Earl, 1989; Saarinen, 1989). However, computerisation applications have become more and more strategic, and thus more external, since the early nineties. The market, branches of industry and supply chain developments make it necessary for enterprises to strategically implement information technology (e.g. the Internet and complex data warehouses) and to realise such principles as, for example, one-to-one marketing (Peppers and Rogers, 1997). Nolan's model describes only one growth trajectory, while there are many different types of organisations in various branches of industry. If we look at the organisational characteristics, for example, we see that SMEs constitute an extremely heterogeneous group (3.4.1). Up until the early nineties the model had not been tested on SMEs. Cragg and King (1993) doubt whether one phase model could be applicable to all types of SMEs. In addition, from a methodological viewpoint, there is criticism about the limitations to testing and validating the model empirically (Benbasat et al., 1984; King and Kraemer, 1984; Boonstra and Van Dissel, 1992). Despite the criticisms of Nolan's model, Saarinen (1989) considers it to be a general framework for the analysis of the evolution of IT use in organisations. Through its simplicity, the model forms a powerful means of communication between managers or entrepreneurs and experts. Considering the relatively low knowledge level in SMEs, the presence of only one perspective for the future can be viewed as a positive point. Choosing a computerisation trajectory is made far simpler for the entrepreneur.

5.3.4 The reconfiguration model of Venkatraman

The *IT-induced reconfiguration model* of Venkatraman (1991), another growth-phase model, provides insight into the evolutionary role of information technology in an enterprise from a clearly strategic perspective. It consists of five levels (Table 11). Venkatraman emphasises that level one always leads to level two, but that from level three onwards the levels do not have to follow each other sequentially, i.e. follow an evolutionary path.

Reconfiguration model of Venkatraman (1991)	
level	**description**
1	localised exploitation
2	internal integration
3	business process redesign
4	business network redesign
5	business scope redefinition

Table 11: Reconfiguration model of Venkatraman (1991)

- The first level relates to the use of information technology in such business functions as administration, production and marketing. The primary goal is to realise efficiency advantages in the shape of cost reductions. The implementation of information technology requires practically no changes in the organisation.
- The second level is an extension of the first level, meaning that information technology is used integrated in various business functions. For the implementation of information technology, the departments made new agreements about procedures, forms and suchlike. This concerns a technological as well as organisational integration.
- Level three has to do with the transformation of the organisation on the basis of a maximum use of the technological infrastructure. With the introduction of information technology the activities of various departments have changed so much that the organisation of the company needs to be adjusted accordingly, for example, by creating new jobs or setting up new departments.
- At level four, the focus is on the reconfiguration of the strategic network in which the organisation or enterprise operates. Information technology has led to an entirely new way of working.
- Level five involves a redefinition of the *business scope* of the enterprise; as a result of information technology, an entirely different company has come into being. Thanks to the new way of working, new products and services have been developed and an entirely new organisation has been set up.

The strategic focus of Venkatraman's model fits in well with the mesoeconomically oriented developments that have been discussed in Section 2.3. Stroeken (1999) gives a recent description of the role of the model in relation to such phenomena as supply chain reversal and company network formation. However, it is not clear how intensively the model has been tested empirically. Moreover, the descriptions of the various phases are strongly oriented towards situations relevant to larger enterprises. This does not alter the fact that the concept can be tailored to an individual SME or to a cluster of SMEs at the industry level.

5.3.5 The models of Tan, and Stroeken and Coumans

To expand the IT growth-phase models somewhat further, Tan (1995) and Stroeken and Coumans (1998), *inter alia*, added extra dimensions with regard to the adoption and implementation characteristics of information technology in large organisations and small and medium-sized enterprises respectively. These extra dimensions can be derived from the consistency model of Scott-Morton (1991) and the strategic alignment model of Venkatraman (1991). Tan's IT growth-phase model encompasses five levels and the following seven aspects per level: information strategy, information systems, technical infrastructure, organisation of the provision of information, users, computer specialists, and information management (Tan, 1995) (Table 12). It turns out that the level model of Tan is focused on a component aspect within larger organisations, i.e. matters related to computerisation. From the perspective of companies or SMEs, this level model may be too one-sided, since all sorts of market and supply chain developments are rarely, if at all, mentioned. Tan does indicate that the model can also be operationalised in situations of collaborating organisations or coalitions. Tan does not mention empirical verification of the model.

Level model of Tan (1995)	
level	**description**
1	functional integration
2	cross-functional integration
3	process integration
4	business process redesign
5	business scope redefinition

Table 12: Level model of Tan (1995)

Stroeken and Coumans (1998) developed an IT growth-phase model specifically for SMEs. They distinguish four aspect areas (i.e. IT strategy, technological infrastructure, IT organisation and IT management in branches of industry) and use Tan's five development phases. The model's main function is to provide an inventory of the computerisation of the four aspect areas at the industry level. It was empirically tested in three Dutch branches of industry with a large number of SMEs, i.e. the automobile industry, the machine-building sector and the textile industry (RMK, 1997a). The test proved to be very informative for the participating companies and the trade associations. This implies that the practical application of the model may raise the awareness of entrepreneurs in SMEs as far as information technology is concerned so that in the long run the diffusion and adoption of strategically applied information technology will be stimulated.
The concepts of Venkatraman (1991), Tan (1995) and, to a lesser degree, Stroeken and Coumans (1998) relate mainly to a signal function with regard to the automation level of an enterprise or industry. The present study is aimed at the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises, which makes it more desirable to employ the model to be developed more proactively in certain industries in order to raise the enterpreneurs' awareness of the strategic application of information technology. In Section 4.3.3, this awareness has been related to learning processes at the individual and organisational levels.

5.4 Conclusion

The previous three chapters highlighted various theoretical approaches concerning the relation between economy, information technology and small and medium-sized enterprises, and the diffusion and adoption of information technology in small and medium-sized enterprises. These approaches delineated the frameworks of the IT scenario model to be developed. The concepts treated in this chapter such as scenario planning and IT growth-phase models serve as bridges to link the theoretical approaches from chapters 2, 3 and 4 to the IT scenario model.

At the strategic level, three shortcomings could be distinguished with regard to learning processes, namely cognitive inertia, problems with linking learning stages due to the length of the time span of the learning cycle, and vision-related problems due to variations in the mental models of the parties involved. Scenarios reduce these imperfections and can therefore be used as instruments to support and influence the strategic management process. Regarding the use of scenarios in relation to the main themes in this study, i.e. information technology and small and medium-sized enterprises, two matters came to the fore. *In the first place*, scenarios usually focus on *large enterprises* as these 'industry leaders', because of their size in terms of knowledge, capital and labour, cannot afford *not* to concentrate on the uncertain, crucial developments in and around the sector they operate in. Individual small and medium-sized enterprises, on the other hand, can generally be labelled as 'followers' because of their limited economic scope, which makes it less necessary for them to enter an elaborate scenario planning trajectory. Given the elaborate and complex method of scenario planning and the lack of knowledge and attention, it is advisable to gear the scenarios in small and medium-sized enterprises more towards awareness raising through a standard scenario and less through a process of development and creation. *In the second place*, the focus of regular scenario methods is *not* on the possible applications of *information technology* in relation to environmental developments. With regard to these possible applications, the so-called IT growth-phase models provide insight into the layout and enabling role of information technology in an enterprise and also include aspects of the developments in supply chains and industries. Thus, elements of recent IT growth-phase models also form an alternative measuring instrument for the further examination of the productivity relation between information technology and economy. The IT growth-phase models described, have mainly a signal function with regard to the automation level of an enterprise or industry. The present study

is aimed at the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises, which makes it more desirable to employ the model to be developed more proactively in certain industries in order to raise the enterpreneurs' awareness of the strategic application of information technology. By 'integrating' scenarios and IT growth-phase models, the IT scenario model becomes an instrument that can influence learning processes regarding the strategic use of information technology through the formulation of an IT scenario. The concepts sketched in this chapter in relation to scenarios and IT growth-phases provide clear starting points for the transformation of the theoretical approaches concerning the economic aspects and diffusion and adoption aspects of information technology and for their application in the IT scenario model to be developed.

Chapter 6
The IT scenario model

This chapter is entirely dedicated to the IT scenario model. The model is defined in Section 6.1 and its structure and components is explained in Section 6.2. The method of operationalisation of the IT scenario model is described in Section 6.3. In the context of this study, this operationalisation concerns two branches of industry and this choice will be explained in Section 6.4. The industry-specific operationalisation and testing of the model will be discussed in Sections 6.5 and 6.6. This chapter ends with a summary and conclusion (Section 6.7).

6.1 Introduction

The IT scenario model provides a concept to translate techno-economic developments at the macroeconomic and mesoeconomic levels into a practical environment in order to stimulate the diffusion and adoption of information technology in a demarcated part of the SME sector. The model has been developed on the basis of the theoretical approaches described in the previous chapters. Within the context of this study, an IT scenario model can be described as *'a structure that integrates economic and business aspects concerning developments in industries, supply chains and information technology into an industry-specific scenario translated to the situation of entrepreneurs in the SME sector'*. The term *scenario* relates to the general description of the environment and phase with regard to the possible applications of information technology. As regards the model, the following starting points apply:

- The model must be applicable to a demarcated part of the Dutch SME sector and should focus on small enterprises in particular.
- The model should in the first instance aim at stimulating the entrepreneur's awareness of the possible strategic use of information technology in the organisation of the enterprise.
- By representing matters related to developments in the industries, supply chains and information technology from a broad perspective, the above-mentioned awareness will be stimulated. The implications of the various applications of information technology in the enterprise will also be indicated.
- The question of whether or not information technology should be applied in the enterprise in the current situation is of no importance.

After the industry-specific operationalisation, the model can be used in the form of a scenario to provide the individual entrepreneur with information about developments in the industry, supply chain and information technology. This will increase the awareness and knowledge level concerning the strategic application of information technology and influence the learning process, so that the adoption process will take place gradually. In this way the model may play a significant role in the diffusion and adoption of information technology in small and medium-sized enterprises.

6.2 The components of the IT scenario model

The IT scenario model is an instrument for SMEs that provides insight into the strategic application of information technology from a broader meso-perspective. The role of the model is to raise the awareness of people concerning information technology by stimulating learning processes that will positively influence mental models. The IT scenario model contains three main components: the environment, six phases, and three aspect areas (Figure 16).

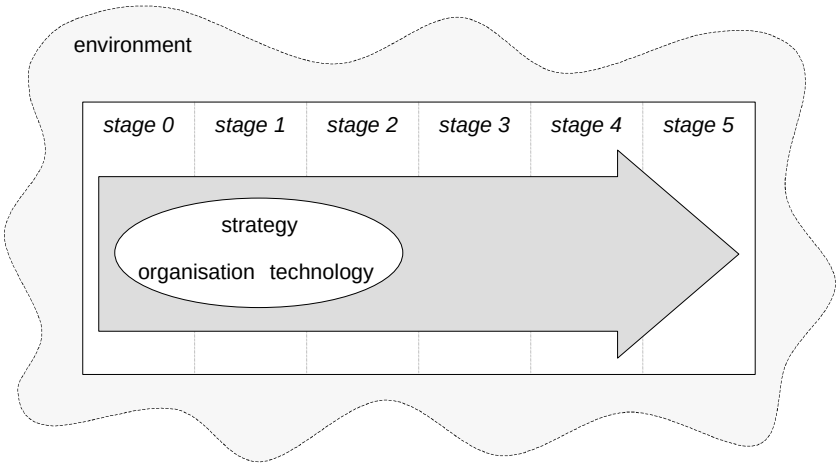


Figure 16: The IT scenario model

The environment component

The contents of the environment component is mainly derived from the scenario planning method and is related to uncertain developments that occur at the macro- and meso-levels. This concerns such matters as macro-economic, technological, demographic, sector, and market developments. The communication of relevant environmental developments increases the awareness of the entrepreneur concerning the contextual environment. Specific development at the industry or supply chain level are dealt with in the phases component.

The phases

The division of phases is an essential part of the model as this provides the basis for the evolutionary nature of the application of information technology in relation to external business aspects. Matters such as vertical and horizontal integration and supply chain reversal are dealt with here. The IT scenario model encompasses six phases (Table 13) that were taken from the IT growth-phase models of Venkatraman (1991), Tan (1995), and Stroeken and Coumans (1998). This provides the opportunity to compare operationalised versions of the different models. For a targeted communication of the contents of the phases to entrepreneurs in SMEs, the recognisability and distinctive capacity of the six phases are very important.

The phase division of the IT scenario model	
phase	**description**
0	no usage of information technology
1	internally oriented functional integration
2	internally oriented multifunctional integration
3	externally oriented process integration
4	business process redesign
5	business scope redefinition under influence of information technology

Table 13: The phase division of the IT scenario model

- Phase zero is related to situations in which no form of information technology is used in the enterprise, with the exception of simple variants such as a fax machine. A considerable portion of Dutch SMEs can be placed in this category.
- Phase one is aimed at the computerisation of existing activities to improve efficiency. As a result, the emphasis is placed on internally oriented integration of existing activities. Often programs are used to register, wholly or partly, the information flows from the primary process. In larger companies this is done by ERP packages; in SMEs, generally standard integrated programs are used.

- In phase two the improvement in effectiveness is realised through internally oriented multifunctional integration. This lends more depth and breadth to the integration mentioned in phase one. The programming from phase one is applied in a more advanced and refined way.
- Phase three is aimed at the improvement of the present product-market combination through a type of process integration, in which a greater emphasis is placed on the externally oriented improvement of business processes. This means that the strategic position of the enterprise in the market and supply chain is the focal point of attention. Information technology is implemented in such a way that it makes a fundamental contribution to the customer approach and supply chain integration.
- Phase four encompasses the redesign of business processes to extend the external orientation. As a result, the enterprise has the ability to orient itself towards innovative product-market combinations. Information technology functions more as *enabling technology* in this phase.
- Phase five is related to the revision of business goals under the influence of information technology so that the enterprise undergoes a complete external re-orientation.

Moving through the six phases can be viewed as a cyclical innovation movement. Before an enterprise can focus on a new innovation cycle, or higher phase, it must meet certain phase-specific limiting conditions. These limiting conditions are given in three aspect areas. It is assumed that the provision of information regarding the three aspect areas leads to the adoption and implementation of IT in these three areas.

The aspect areas

The aspect areas are related to the elements of content or limiting conditions that hold for each phase. The elements are related to three aspect areas in the model: strategy, technology, and organisation. They are taken from the *consistency model* of Scott-Morton (1991), the *strategic alignment model* of Venkatraman (1991), the IT growth-phase models described and the concepts from innovation literature described in Tornatzky and Fleischer (1990). In the three tables below the elements are given for each aspect area (table 14, 15 and 16). The three aspect areas are complementary, which means that the contents of the aspect areas cannot be clearly delimited.

The aspect area of strategy	
Element	**Description**
Main feature of the strategy The function of IT The IT plan	• The main feature of the strategy indicates what the essence of the business strategy is in a particular phase: efficiency improvement, effectiveness improvement, improvement of the product-market combination, renewal of the product-market combination or a totally new business orientation. • This point is related to the above point and covers the support of existing functions, the integration of existing functions, and the redesign or redefinition of functions. • An IT plan gives the strategic vision in relation to the use of IT. The degree of attunement between the IT plan and the business plan can be divided into various stages.

Table 14: The aspect area of strategy

The aspect area of technology	
Element	**Description**
The business processes The data structure The IT applications	• The strategic vision has various implications in each phase for the technical and organisational structure of the business processes. One important point of departure is the data structure. • For each phase we can indicate which information flows can be supported by IT in the data structure. • In relation to above two points, the IT applications are specifically named.

Table 15: The aspect area of technology

The aspect area of organisation	
Element	**Description**
Organisation and tasks, authorities and responsibilities Schooling Management of technology Management and users	• The implementation of IT brings about changes in the internal and external organisation. This has implications for the relations between business processes. With this, changes occur in accompanying tasks, authorities, and responsibilities. • Schooling plays an essential part in the acceptance and actual use of IT and employees must become familiar with the strategy and operational aspects of IT. • Once the technology has been adopted, the management of the technology has to be organised. • As regards the above points, the attitude of the management is crucial to success. Clear definitions have to given of the roles and relations between the management and the users.

Table 16: The aspect area of organisation

Table 17 represents the phases and aspect areas of the IT scenario model. An enterprise has completed a phase only if all the requirements concerning the aspect areas of strategy, technology and organisation of that phase have been met. However, it may be the case that certain aspect areas of an enterprise have already been classified in a higher phase. This will usually occur in the aspect area of technology. For example, it may happen that technology is classified in phase three, while strategy and organisation belong in phase one. Phase five is not the absolute final goal and depending on the environment and circumstances, the product-market combination and the use of information technology, enterprises may get stuck in the lower phases. To some extent, it is also possible to skip certain phases (certainly per aspect area).

aspect area	**phases**					
	phase 0	phase 1	phase 2	phase 3	phase 4	phase 5
strategy						
technology						
organisation						

Table 17: Phases and aspect areas of the IT scenario model

6.3 Method of operationalisation of the IT scenario model

The approach to operationalise parts of the IT scenario model is based on four steps. The first step concerns the *environment* component of the IT scenario model and encompasses the construction of a generic industry scenario. In the second step, the six *phases*, as kinds of subscenarios, are elaborated in which the insights gained from the generic industry-specific scenario are applicable. In the third step the *aspect areas* of strategy, technology and organisation are elaborated. The final step encompasses the transformation from the industry-specific operationalised phases to a practical and feasible communication concept. As such it can be implemented as a concrete instrument to inform a clearly defined group of entrepreneurs about developments in the market, industry, supply chain and information technology, and about what opportunities there are for the strategic application of information technology in the enterprise. Thus, the concept can be used as an instrument to stimulate the diffusion and adoption of information technology in a well-founded way. Unlike the scenario methods mentioned in the literature, the IT scenario model is industry-generic in character.

Step 1: A generic scenario

A general scenario can be seen as an industry-generic scenario that briefly represents the developments in and around the branch of industry. Such a general scenario is drawn up on the basis of various scenario planning methods (5.2). The following four steps are applicable:

- The first step concerns the acquisition of insight into the culture of the industry and the mental models of the average entrepreneur in the industry. This will make clear how the entrepreneurs in the industry can be reached.
- In step two, the current situation in and around the industry is studied and an inventory is made of relevant scenario elements, also known as *drivers*. These scenario elements relate to visible and invisible, certain and uncertain developments that are initiated by certain actors or factors in and around the industry.
- In step three, the focus is on the classification, estimation and selection of scenario elements (drivers), after which they are integrated into a framework. Within the context of this study, this third step is not executed so strictly as in the scenario methods mentioned in the literature.
- Step four involves the construction of the scenario on the basis of the framework of *drivers*.

In Section 5.2.2, we have already stated that the number of scenarios to be constructed depends heavily on the number of environmental uncertainties. Through artificial variation of important uncertainties, each scenario paints a different future situation. Within the context of this study, the various environmental uncertainties are integrated into a single scenario in order to limit the information supply to the entrepreneur somewhat. This limitation has in principle no significant consequences for the function of the scenario, as it may be assumed that, given the relatively low level of knowledge in SMEs, one general scenario will already suffice to expand the mental models of the entrepreneurs.

Step 2: The elaboration of the phases

In the second step, the six *phases*, as kinds of subscenarios, are elaborated, also incorporating the insights gained from the generic industry-specific scenario. These phases can be traced back to the IT growth-phase models of Venkatraman (1991), Tan (1995) and Stroeken and Coumans (1998). For each phase, the external and internal changes are charted with regard to the market, supply chain relations, products and services, and business processes. A more thorough elaboration of the six phases takes place in the following step.

Step 3: The elaboration of the aspect areas of strategy, technology and organisation

The phases are elaborated through the aspect areas of strategy, technology and organisation, largely on the basis of the IT organisation models of Scott-Morton (1991) and Venkatraman (1991) and the IT growth-phase models of Tan (1995) and Stroeken and Coumans (1998). For the elements of these aspect areas, please refer to Tables 14, 15 and 16. The classification thus obtained is transformed into a practical communication concept in the next step. Within the context of this study, the IT scenario model is operationalised for two branches of industry up to and including this step. The transformation into a communication concept in the shape of, for example, a CD-ROM or website application will take place at the end of 1999.

Step 4: Transforming the classification into a communication concept

In this last step, the industry-specific, operationalised phase classification is transformed into a concrete, applicable communication concept. This means that this concept can be used as an instrument to inform the delineated group of entrepreneurs in the SME sector about developments in the market, industry, supply chain and information technology, and about the possible strategic use of information technology in their enterprises. The instrument can be given shape through multimedia communication channels such as CD-ROMs and websites or through interpersonal communication channels (e.g. advisers). The provision of strategic, technological and organisational information about information technology to entrepreneurs thus becomes part of the diffusion and adoption process of information technology in SMEs. It may be assumes that the provision of information about the above-mentioned three aspects will also lead to the adoption and implementation of information technology in these three aspect areas. In this way the instrument contributes directly to the stimulation of the diffusion and adoption of information technology in the smaller enterprises in the Dutch economy.

6.4 The selection of two branches of industry for the operationalisation

The IT scenario model represents a theoretically based structure for informing entrepreneurs in small and medium-sized enterprises about developments concerning the strategic role of information technology in the supply chain and enterprise. In the long term, the practical use of this model will stimulate the adoption of information technology and, consequently, increase the diffusion rate of information technology in a certain part of the Dutch business community. Within the context of this study, the IT scenario model was operationalised and tested to some extent in two branches of industry. In Chapters 3 and 4, we have already stated that it is advisable to approach entrepreneurs in small and medium-sized enterprises as specific as possible, as small and medium-sized enterprises constitute a very heterogeneous group. The selection of the two branches of industry is based on the following substantive and pragmatic points:

- The target group in this project is that of the small and medium-sized enterprises that, seen from the information technology perspective, do not belong to the industries with a relatively high degree of automation (see Table 3 in Section 3.5.1). The degree of automation is 'the number of companies with computers that cost at least NLG 500 and/or employing automation staff, as a percentage of the total number of companies' (CBS, 1999a).
- The emphasis is on small firms (firms with fewer than ten employees) as the level of knowledge concerning information technology and the adoption rate of information technology is generally low in this group of enterprises. This means that preference is given to those industries in which relatively many small enterprises are operating (see Table 1 in Section 3.4.1).
- The IT scenario model had to be operationalised for those branches of industry that are widely represented in the Dutch economy. We therefore gave preference to those branches in which relatively many small and medium-sized enterprises were operating (see Table 1 in Section 3.4.1).
- It was essential within the context of this study that the trade associations would be prepared to support the research with information and advice on the operationalisation and testing of the model. For research reasons, it was desirable that the industries to be selected would differ in terms industry, business and automation characteristics. This would enable us to analyse the model from multiple points of view and test it for a higher degree of generality.

On the basis of the evaluation of these points, the following two branches of industry were found to be suitable: the *hairdressing branch* and the *furnishing branch*. Both branches represent a relatively large group of small enterprises in which the degree of automation is also relatively low (see Tables 1 and 2 in Section 3.4.1 and Table 3 in Section 3.5.1). The last point mentioned above, i.e. the desired diversity in the industry, business and automation characteristics of the industries to be selected, was not met entirely.

6.5 The operationalisation of the IT scenario model

Operationalisation of the IT scenario model took place through an iterative process. First of all, various experts in the branch gave feedback with regard to the industry-specific operationalised version of the model.

The operationalisation of the model for the hairdressing branch

To operationalise the model in an industry-specific way, it was desirable to obtain information from many different sources concerning the way in which the parts of the model were given substance. This meant, among other things, that we had to approach various industry-relevant organisations and hairdressers. The operationalisation process of the IT scenario model for the hairdressing branch was realised through interviews with the following bodies:

- The trade association of the hairdressing branch that promotes the collective and individual interests of the entrepreneurs in this branch of industry.
- A knowledge centre for the cosmetic sector. The core activities of this organisation are the development of qualification structures and vocational training programmes for the sector, as well as examining and providing courses.

- An IT supplier that develops, installs, and maintains software products specifically tailored to the hairdressing branch.
- Two regional training centres that provide SMEs with information about computerisation through their so-called knowledge-transfer points.
- Some SMEs in the hairdressing branch.

The IT scenario model for the hairdressing branch was drawn up on the basis of the insights gained. The operationalised version of the IT scenario model for the hairdressing branch will be discussed in Chapter 7.

The operationalisation of the model for the furnishing branch

The operationalisation of the model for the furnishing branch is largely based on the same knowledge, experiences and sources as found in the hairdressing branch. The operationalisation process of the IT scenario model for the furnishing branch was realised through interviews with the following bodies:

- The trade association of the furnishing branch that protects the collective and individual interests of entrepreneurs with respect to product liability, shopping hours, certification, and supply chain-oriented computerisation protocols.
- Two large retail organisations in the Netherlands. Core activities of these organisations include supply, retail trade activities, and commercial and business services to independent entrepreneurs concerning market research, sales concepts, promotional activities and computerisation services.
- Some IT suppliers who develop, install, and maintain hardware and software products specifically for the furnishing branch.
- Two regional training centres that provide SMEs with information about computerisation through their so-called knowledge-transfer points.
- Some small and medium-sized enterprises in the furnishing branch.

The IT scenario model for the furnishing branch was drawn up on the basis of the insights gained. The operationalised version of the IT scenario model for the furnishing branch will be discussed in Chapter 8.

6.6 Testing the model

In order to test the operationalised model, it was used as a frame of reference in some of the enterprises participating in the 'Get more out of your computer' project in Rotterdam. This pilot project focused on raising the entrepreneurs' awareness of the application of information technology through advice from teachers and the regional training centres involved, modules about branch and computerisation developments, and an industry-specific, informative CD-ROM with a diagnostic component that could generate a concise IT plan. In this project, no use was made of some kind of phase classification. However, the tripartition of strategy, technology and organisation was used as a starting point to inform and advise the entrepreneurs involved about information technology. The project was aimed at a group of about thirty entrepreneurs in the hairdressing, clothing and furnishing industries.

In a number of hairdressing salons and furnishing shops, the industry-specific operationalised IT scenario models as a frame of reference to analyse to what extent the phases correspond with the actual situations of the enterprises concerned. We did not examine to what extent the IT scenario model actually influenced the awareness of the strategic application of information technology in the enterprise, but merely the validity of the model as an instrument for informing and advising entrepreneurs about the relevant developments in the industry, supply chain and information technology, and the strategic application of information technology.

Testing the model in the hairdressing branch

From April to June 1999, seven entrepreneurs in the hairdressing industry were involved in the implementation stage of the 'Get more out of your computer' project. This stage included a workshop and a number of company visits, in which a teacher from the regional training centre and an informative CD-ROM functioned as knowledge transmitters. During the company visits, the operationalised model was used as a frame of reference to enable the teacher to determine the place of the hairdressing salon in the development process concerning the strategic application of information technology. This also helped the teacher to attune the exchange of knowledge much

better to the current, and possibly future, situation of the enterprise. Hairdressing salons are usually not strongly integrated in the supply chain, so that, comparatively speaking, the three aspects should be approached from a more internal orientation. Table 18 gives a brief summary of the hairdressing salons approached.

salon	turnover (Euro [a])	number of employees	phase strategy	phase technology	phase organisation	overall phase
1.	180.000 or more	4 - 9	1	1	1	1
2.	180.000 or more	10 - 19	3	3	3	3
3.	45.000 – 90.000	1 - 3	1	2	1	1
4.	90.000 – 180,000	1 - 3	0	0	0	0
5.	90.000 – 180,000	1 - 3	1	1	1	1
6.	45.000 – 180,000	1	0	0	0	0
7.	180,000 or more	4 - 9	2	3	2	2
8.	less than 22.500	1	0	0	0	0

Table 18: Visited hairdressing salons in the 'Get more out of your computer' project

The visits to the hairdressing salons show that a considerable number of them can be placed in phases zero and one and that the enterprises particularly need non-technical information about the possibilities of information technology. It may be concluded that the industry-specific operationalised IT scenario model offers clear starting points for goal-oriented communication with hairdressers on the aspects of strategy, technology and organisation. The teacher from the regional training centre and the informative CD-ROM can be regarded as two different types of communication channels. As the regional training centres (ROCs) are well known and trusted, the ROC teacher plays an important role in the knowledge and persuasion process concerning the possible strategic applications of information technology in the hairdressing industry. The CD-ROM mostly functions as an information source and frame of reference in this process.

Testing the model in the furnishing branch

The model was tested in the furnishing branch in the same way as this was done in the hairdressing branch. In four furnishing shops, the model was used as a frame of reference for the exchange of knowledge between the ROC teacher and the entrepreneur. As the furnishing shops in comparison with the hairdressing salons were more embedded in the supply chain, the phase division, in which the orientation shifted from internal to external, provides a clear frame of reference for interpreting the evolutionary developments in the industry and supply chain. In this, clear information on cross-boundary information technology applications such as the Internet and EDI is also important. The company visits show that a considerable number of the furnishing shops can be placed in phases zero and one and particularly need non-technical information about the possibilities of information technology. Table 19 gives a brief summary of the furnishing shops involved.

furnishing shop	turnover (Euro [a])	number of employees	phase strategy	phase technology	phase organisation	Overall phase
1.	less than 135.000	1-3	0	1	0	0
2.	more than 680.000	more than 19	3	3	3	3
3.	less than 135.000	1 - 3	0	1	0	0
4.	more than 680.000	more than 19	1	1	1	1

Table 19: Visited furnishing shops in the 'Get more out of your computer' project

The IT scenario model offers clear starting points for specifically informing and advising entrepreneurs in the furnishing industry about the strategic, technological and organisational aspects of the use of information technology. Also in the furnishing branch, the ROC teacher plays an important role in the knowledge and persuasion process concerning the possible strategic applications of information technology and does the CD-ROM mostly function as an information source and frame of reference.

Conclusion

The company visits show that the IT scenario model is a useful frame of reference for structuring the knowledge exchange process concerning the strategic application of information technology. By this we mean that it contains those elements that are important to start off the goal-oriented communication process with regard to

information technology in the hairdressing and furnishing industries. The phase division is particularly valuable as it provides the opportunity to classify enterprises with regard to the aspects of strategy, technology and organisation, and thereby specifically advise them on how they can enter a higher phase. All in all, the IT scenario model is a model that can be used to provide insight into the strategic application of information technology in companies and supply chains per phase in a concrete way. Within the context of the transformation of the industry-specific operationalised model into a concrete communication concept (step 4), the combination of communication channels, such as an ROC teacher and a multimedia application (e.g. a CD-ROM), can be very effective in informing and advising entrepreneurs.

6.7 Summary and conclusion

The IT scenario model discussed in this chapter can be described as *'a structure that integrates economic and business aspects concerning developments in industries, supply chains and information technology into an industry-specific scenario translated to the situation of entrepreneurs in the SME sector'*. The term *scenario* relates to the general description of the environment and phase with regard to the possible applications of information technology. The concept of the IT scenario model consists of three main components, i.e. the environment, six phases and three aspect areas.

The industry-specific operationalisation of the three main components takes place in four steps. The environment component relates to the description of the general techno-economic developments in and around a specific branch of industry. By means of a scenario method (step one), this component is concretised for a branch of industry. The phases go deeper into the specific meso-developments in the industry and are further defined and worked out in step two. Per phase, three aspect areas can be distinguished: strategy, technology and organisation. The operationalisation of these aspect areas takes place in step three. Within the context of this study, the IT scenario model has been operationalised for two branches of industry. In the next step, the whole of operationalised components is transformed into a concrete communication concept, for example, in the shape of a website. With the use of this concept, well-founded and specific information on the strategic, technological and organisational aspects of information technology can be communicated to the entrepreneurs. Thus, this instrument contributes to the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises.

On the basis of various criteria, the hairdressing and furnishing industries were selected for the operationalisation. The hairdressing industry consists of enterprises with fewer than ten employees and is characterised by a relatively low degree of automation. The furnishing branch is part of the retail sector. This group is also characterised by a relatively low degree of automation. By operationalising the IT scenario model for these industries, it becomes a practical instrument for stimulating the diffusion and adoption of information technology through goal-oriented communication. The model was operationalised in the form of IT scenarios on the basis of interviews with trade associations, buying organisations, knowledge institutions and entrepreneurs. Chapters 7 and 8 represent respectively the model for the hairdressing and the furnishing industry.

To test the model, the industry-specific IT scenarios were used as a frame of reference in the incentive project called 'Get more out of your computer'. This pilot project aimed to stimulate automation in a dozen enterprises in the hairdressing, furnishing and clothing industries in the Rotterdam region through workshops, ROC teachers as business consultants and an informative, industry-specific CD-ROM with a diagnostic component that automatically generated a business-specific IT plan. The IT scenario was used as a frame of reference for classifying the enterprises involved into phases, which made it subsequently possible to communicate specifically on the phases that they still had to go through and the corresponding aspect areas of strategy, technology and organisation. The company visits show that the IT scenario model is a useful frame of reference for structuring the knowledge exchange process concerning the strategic application of information technology. The combination of communication channels (such as an ROC teacher and a multimedia application) can be very effective in this respect.

Chapter 7
The IT scenario model for the hairdressing branch

In the previous chapter we discussed the operationalisation and testing of the IT scenario model. What the final industry-specific model for the hairdressing branch looks like will become clear in this chapter. Furthermore, we will give a brief description of the hairdressing branch and the hairdressing salon so the operationalised IT scenario model for the hairdressing branch can be placed more adequately.

7.1 Description of the hairdressing branch

The IT scenario model was operationalised for the hairdressing branch, because it is part of a sector that represents a substantial part of the total number of enterprises in the Dutch economy and also has a relatively low computerisation level (OECD, 1995; ANKO, 1997; HBA, 1997a, 1997b). Hairdressing salons generally focus on the treatment of hair, including such activities as the washing, cutting, colouring, perming and drying of hair. The sale of articles such as hair-care products constitutes only a small part of the turnover. Management is mainly characterised by a direct interaction between producer and customer, initiated by a clear demand on the part of the customer. Most customers are loyal and keep going to the same hairdresser's, usually because they are rather satisfied with the service provided or because it is quite near where they live. Within the Dutch hairdressing branch, four types of enterprises can be distinguished: the barber's, the ladies' hairdresser's, the unisex hairdresser's with a local orientation and the unisex hairdresser's with a specific orientation. In the Dutch hairdressing branch, the number of enterprises and establishments has grown continuously over the past ten years and, as a result of the relaxation of establishment laws, this number will continue to grow (especially one-man enterprises). The branch operates mainly on a small scale and therefore has some difficulty with meeting the demand of customers for innovation. This does not so much concern the hairdressing skills as such (cutting, colouring, etc.) as the management, the introduction of new products and services, the layout of the salon and the compliance with legislation. The hairdressing branch has many small-scale enterprises though the expectations are that the smaller barbers' will disappear in the long run. A recent development is the growth in the number of franchise chains and the rise of new forms of cooperation. HBA (1997a) and Stroeken (1999) give a more extensive description of the hairdressing branch. A number of essential macroscopic developments that have some influence on small and medium-sized enterprises in general and the hairdressing industry in particular, will be briefly described below. Together, these descriptions form the environmental aspect component of the IT scenario model. The other components such as the six phases and the three aspect areas will be treated in Section 7.3.

Socio-economic developments

Economic growth is a very important element with regard to the developments in the national business community and, consequently, also affects the hairdressing industry. Forecasts show that the increase in volume of the gross domestic product (GDP) of the Dutch economy will amount to 2 per cent in the year 2000. At the European level, this will also be 2 per cent (CPB, 1999). The increase in employment (expressed as the number of people employed) in the Netherlands is estimated to be 1 per cent in the year 2000 (CPB, 1999). Economic stability entails that consumers are willing to spend money. According to the estimates, the private consumption in the Netherlands will increase by 2.75 per cent in the year 2000 (CPB, 1999). A further European integration will lead to a more accessible European market and an increase in mobility in the European Union. In line with this, new developments such as electronic money and uniform remuneration and tax systems will take place at the European level. These developments can have a profound effect on small and medium-sized enterprises in general.

Demographic developments

The size, composition and life-style of the population constitute another macroscopic element. Regarding the size and composition of the Dutch population, we can state the following. First of all, over the coming 30 years, the Dutch population will increase by 1.7 million (CBS, 1999b). Furthermore, the number of elderly people in society will also increase in the coming years. Now, in 1999, 13.5 per cent of the Dutch population are 65 or older. If no dramatic changes occur in the birth, death and migration rates, this will be 23 per cent in forty years (CBS, 1999b). In the year 2030, senior citizens (aged 55 or over) will be better educated and rather independent financially (Eilander and Van Kraling, 1995). Trade and industry will therefore pay more attention to products and services with a high added value concerning such aspects as comfort, convenience, safety and health. Another issue is the multicultural composition of the population, which means that a large group of people with different cultural backgrounds is living in the Netherlands. As a result of internal growth and the expansion of the European Union, this group will become larger in the coming years. Because of these different backgrounds, these groups represent large variations in the demand for products and services. This in turn will give entrepreneurs in the hairdressing industry the opportunity to focus on niche markets (Afro haircuts, etc.). The life-style of the population in general expresses itself nowadays in an increase in individualisation. Individualisation is an umbrella term for many different developments, including the process in which the family as a basic unit is gradually replaced by the individual (a decrease in the average size of households in the Netherlands) and other types of emancipation and liberalisation. For example, in the coming 20 years, the number of households will increase from 6.6 million in 1997 to 7.8 million in 2017 (CBS, 1999b). These developments will create opportunities for changing and expanding the provision of services in the hairdressing industry.

Developments in the public sphere (legislation, agreements and covenants)

Developments in legislation, agreements and covenants concerning the public sphere are usually initiated by the government and other coordinating bodies. These developments relate to such matters as the liberalisation of shop opening times (Shop Hours Act), the relaxation of regulations concerning the professional competence of entrepreneurs who wish to establish a business (Establishment of Businesses Act), the stricter regulations concerning environmental management and sustainability (covenants) and the new regulations concerning working conditions (ARBO). For example, the above-mentioned new Shop Hours Act enables the hairdressing industry to provide a better service, especially to people who work full-time. Particularly hairdressing salons that get many customers on Saturday are now better able to spread the workload more evenly. In addition, regulations such as those governing official recognition also have an influence on the number of hairdressing salons of a certain level of quality. Innovative collective bargaining agreements also play a role in this as many older employees have been replaced by cheaper younger ones in the last few years. In the long run, this will lead to fiercer competition, because some of the former employees will set up their own business or provide their hairdressing services in the black economy. All this depends to a large degree on the policies that trade associations, trade unions and other official bodies will pursue in the coming years.

Industry-specific developments

More and more forms of despecialisation and overlapping can be observed in and around the hairdressing industry, leading to the creation of various product and service clusters. As far as the hairdressing industry is concerned, it is realistic to expect that contiguous branches of industry as those of clothing and cosmetic care will also partly determine the package of products and services provided by hairdressing salons. Another issue in the hairdressing industry is that of the high labour costs. The less favourable return profile of the hairdressing industry therefore demands an adequate cost control. This also involves curtailing absenteeism due to allergic eczema. Enterprises will have to take the necessary preventive measures. Many of the above-mentioned developments lead to a changing and more flexible demand for products and services from the hairdressing industry. This means that, in addition to professional skills, such elements as customer relations and advisory services deserve the necessary attention. Entrepreneurs will have to inventory and respond to the wishes of their

customers. Skilled entrepreneurs will have to distinguish themselves in terms of quality. The hairdressing industry remains individually oriented, but various developments do influence the composition of certain types of enterprises in this branch of industry. The percentage of unisex salons has grown in the past few years and will probably continue to do so. The number of small men's and ladies' hairdressers, on the other hand, will decrease. Upgrading with the use of information technology is essential for keeping up the competition with the informal circuit and the number of small one-man businesses that is expected to grow as a result of the relaxation of the regulations for establishment.

7.2 Description of the hairdressing salon

In this section we will briefly outline the specific aspects of the hairdressing business such as strategic aspects, business processes, the relation to information technology and the organisational aspects of the adoption of information technology in the hairdressing salon.

Strategic aspects of the hairdressing salon

The business strategy is in principle the main starting point for the operational activities in a hairdressing salon. It is therefore essential that entrepreneurs try to gain insight into the many strategic aspects of their enterprise in order to guarantee and control its continuity. At the abstract level, this involves specialisations and differentiations with respect to the package of products and services. More concretely, this means that the hairdresser should reflect on such matters as:

- The target group and the appropriate type of salon (men's, ladies', local or specific, etc.);
- The legal form and the degree of organisation (e.g. as part of a chain of salons);
- The package of products and services (segment, range, pricing, quality, etc.);
- The size of the enterprise in terms of the number and quality of employees;
- The location, opening hours, PR and marketing;
- The internally and externally oriented automation;
- The consequences of new legislation.

However, within the context of the IT scenario model, the focus is mainly on the possibilities that exist regarding the strategic application of information technology in the hairdressing salon.

Business processes concerning the use of information technology

The application of information technology in the hairdressing salon is becoming increasingly relevant and offers hairdressing salons many opportunities for professionalisation and reorientation, which may have far-reaching strategic effects. However, fundamental changes in this branch of industry as a result of the application of information technology are generally few. The use of information technology offers opportunities for improving the supply of products and services, quantitatively as well as qualitatively. Nevertheless, the hairdressing industry remains a handicraft sector. The following five major types of automation can be observed in the hairdressing salons:

- A salon program for the registration of hair treatments, customers and sales of articles;
- An accounting program as an aid in financial accounting;
- A simulation program which projects different hair styles over the customer's computer image;
- Electronic communication via the Internet and e-mail;
- Electronic means of payment such as PIN cards and chip purses.

The business processes that are most common in the hairdressing salon and the possible role that information technology can play in these, are listed below.

- The *salon process* is the key process in the hairdressing salon and encompasses such professional activities as giving advice, washing, cutting, colouring, drying, sales of articles and billing. The following types of automation can be applied in this process: salon programs, electronic cash registers, bar-code scanners, point-of-pay terminals and hair-style simulation facilities.

- The *marketing process* is aimed at finding, approaching and retaining customers with the use of the following five marketing elements: product, price, location, promotion campaigns and personnel. The following types of automation may support this business process: e-mail, websites on the Internet, salon programs (customer files) and word processors.
- The *personnel process* relates to such matters as coaching and guidance, job demarcation, registration and schooling. The following types of automation can be applied in this process: salon programs, accounting programs, the Internet and CD-ROMs containing course material.
- The *management process* concerns the steering of operations, in which information is an essential element. The following types of automation may be important: salon programs, accounting programs and the Internet.
- The *accounting process* includes the following activities: time recording, payroll accounting, payments, bookkeeping, maintaining the contacts with banks, accountants and the tax office, etc. Applicable types of automation are: salon programs, accounting programs, telebanking and electronic communication with accountants and the tax office.
- The *purchasing process* mainly concerns the purchase of goods, including products (hair-dyes, shampoos, varnishes, etc.) and tools (scissors, clippers, etc.). The following types of automation may be applicable: salon programs, fax machines, e-mail and the Internet.
- The *stocking process* involves keeping stocks of the above-mentioned products and tools. Possible applications are: salon programs and bar-code scanners.

Organisational aspects concerning the use of information technology in the hairdressing salon

The use of information technology in the hairdressing salon makes it necessary to reorganise such matters as business processes, job content and schooling. This applies both to employers and employees. For example, the employer should expand his strategic planning process by incorporating strategic considerations regarding information technology. This means that information technology should also play a part in the strategic planning process. For employees, the adoption of information technology may involve changes in job content. This means that the tasks, competencies and responsibilities of employees need to be redefined in accordance with the new situation. In addition, schooling is an important element in the management of a hairdressing salon. It guarantees that employees maintain the quality of their performance and also contributes to the salon's professionalisation trajectory. This does not only refer to professional skills or knowledge, but also to such matters as customer service and stock management. Schooling is also essential for the use of information technology in the hairdressing salon. This does not so much concern the technological aspects of information technology as the strategic and organisational ones.

7.3 The IT scenario model for the hairdressing branch

In this section we will discuss the version of the IT scenario model that was operationalised for the hairdressing branch, particularly the six phases and three aspect areas. The environmental aspect component of the model corresponds with the developments in and around the branch as sketched in Section 7.1. As far as the six phases are concerned, phases zero to three are particularly important for the hairdressing industry as most of the hairdressing enterprises will find themselves in one or more of these phases. Compared to the term *information technology*, the term *computerisation* seems to better match the frame of reference of the entrepreneur in the hairdressing industry and therefore computerisation is used consistently in the phases below.

Phase zero is related to the situation in which the hairdresser's does not make use of computerisation. This means the entrepreneur has made an implicit or explicit strategic choice not to professionalise the enterprise through computerisation. Many enterprises in the hairdressing industry fall into this phase and should therefore be informed about the first steps they can take to reach phase one. Phase one mostly involves small enterprises that pay limited attention to the strategic position of the enterprise in relation to the application of forms of computerisation, due to their limited knowledge, lack of complexity, lack of coordination, and limited means.

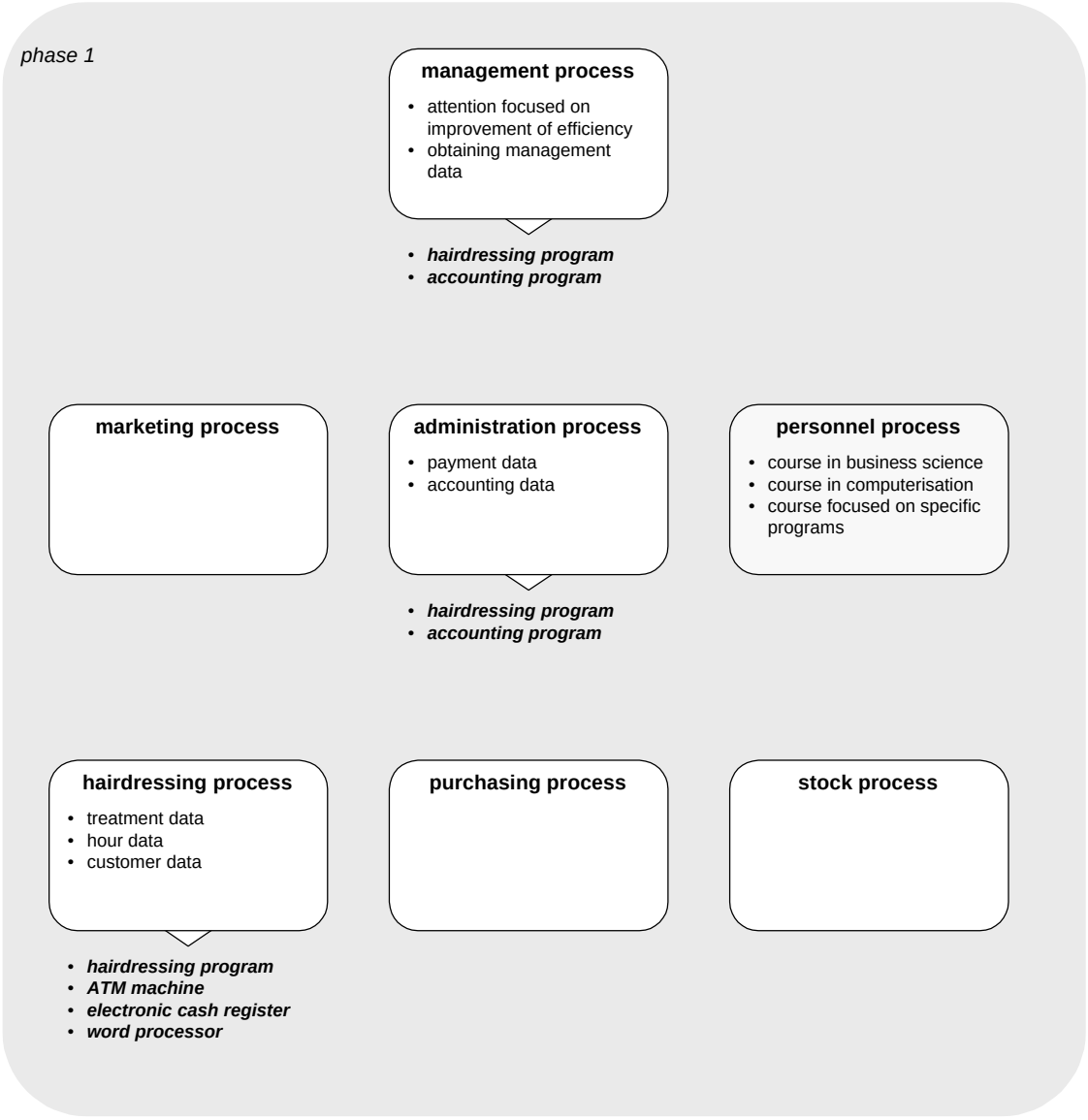
Phase 1: Computerisation aimed at a functional, internally oriented integration

Strategy

The strategy of the enterprise in this phase is focused on raising the efficiency within the hairdresser's. The function of computerisation is especially focused on the support of existing functions. One example is the recording of treatments on customer cards in the hairdressing program. The role of the IT plan is generally limited in this phase. If there is an IT plan, it is not tuned to the business plan or the business strategy.

Technology

The computerisation in this phase is especially related to the internal data structure of the following business processes: management, administration, personnel and the hairdressing process. The following computer applications may be mentioned with regard to this phase: hairdressing programs, accounting programs, ATM machines (Automated Teller Machines), electronic cash registers (not in all types of companies), and word processing programs. The hardware consists of separate computers and peripheral equipment. There are hardly any or no data links between the computer applications mentioned above. The figure below gives an overview. For each relevant business process, information is given about the computerisation data and the accompanying type of computerisation.



Organisation

The use of computerisation has implications for the organisation of the hairdresser's structure, functions, and schooling). The structure of the organisation changes because the application of computerisation alters the shape of the business processes. In the hairdressing process the hairdressing program is used to register matters like treatment data, working hours, and customers treated, and as a result the program has an important role in the business process. This means that tasks, authorities, and responsibilities have to be organised regarding regular activities and activities related to the use of computers. The same applies to the technical operational maintenance of the computers (installing, updating, copying, and making back-up copies). The management of computers is an important subject and is nearly always organised by the entrepreneur in this phase. The role of the user in the adoption process of computerisation in this phase is limited and management in particular needs to gain insight into the strategic role of computerisation. The following schooling is required: an introductory course in business science (business strategy, organisation, business processes, and customer services), an introductory and general course about the strategic use of computerisation, a course about the operational use of computerisation, and a course about specific applications (hairdressing program, accounting program, etc.). For more information, the following parties can be consulted: the accountant, the trade association, regional training centres, and IT suppliers.

Phase two is a deepening and broadening of the contents of phase one, aimed at the improvement of the effectiveness of the enterprise.

Phase 2: Computerisation aimed at a multifunctional, internally oriented integration

Strategy

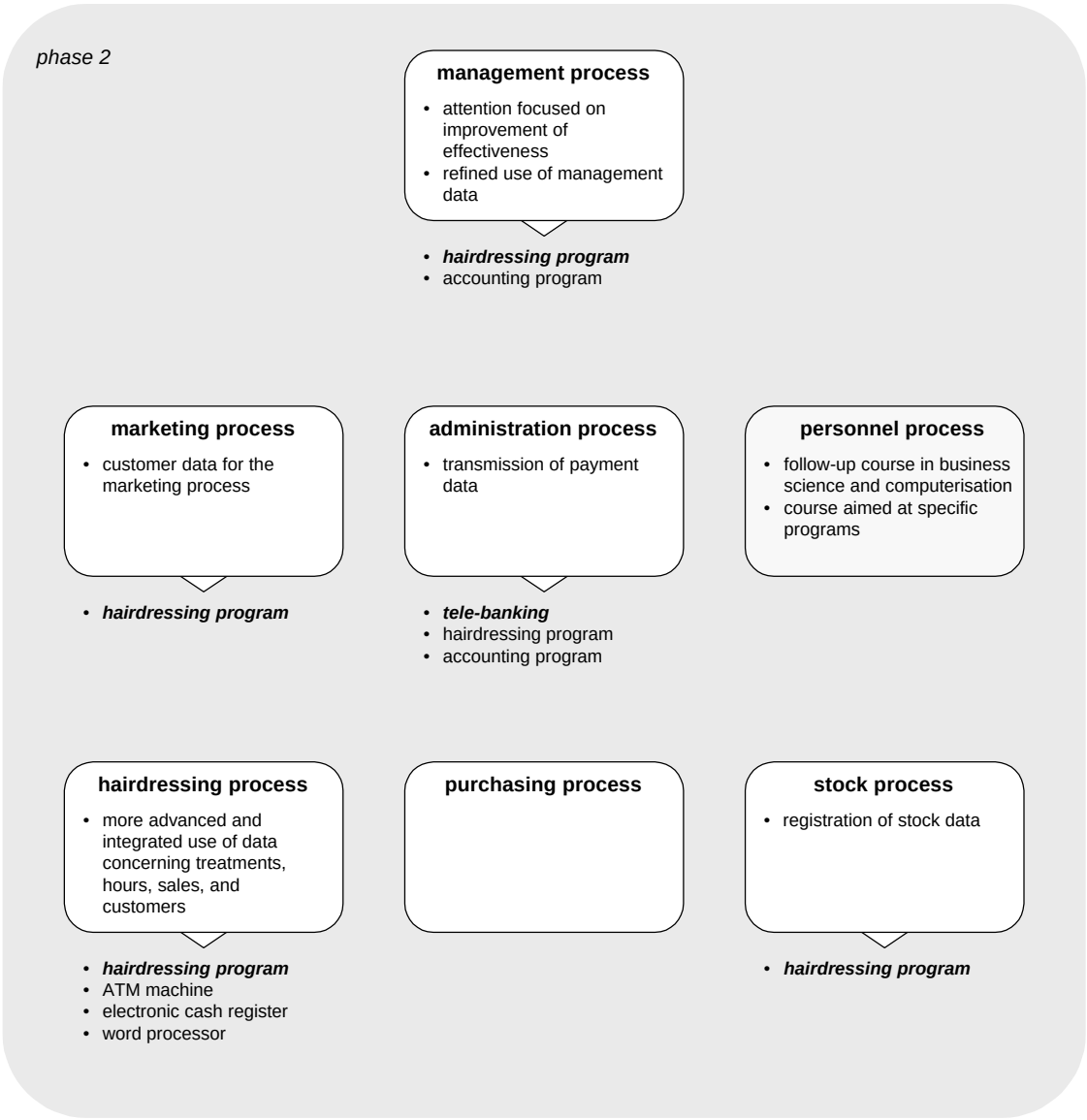
The strategic attention in this phase is focused on the effectiveness of the enterprise through the use of computerisation. This is accomplished, among other things, by obtaining more insight into the turnover, treatments, customers, and sales of articles. The corresponding function of computerisation is to support, improve, and integrate existing business functions. If there is an IT plan, this is usually not, or only partly, related to the business plan.

Technology

The use of computerisation is related to nearly all the business processes in this phase, but the degree of use will differ from process to process. In the last phase some business processes were mentioned that are related to the use of computerisation. In this phase some new business processes are added and some processes are extended or renewed regarding the use of computerisation. We are dealing with the following new and renewed business processes: management, marketing, administration, personnel, and hairdressing process. The following extra computer applications can be mentioned in this context: a more extensive application of the hairdressing program and tele-banking facilities. The programs and equipment now have closer links. In the figure below the computerised data and accompanying types of computerisation are depicted per relevant business process in bold type and italics. Types of computerisation from the previous phase are given in the standard letter setting.

Organisation

As a result of the application of computerisation in the four business processes mentioned earlier, the structure of the organisation will change. Tasks, authorities, and responsibilities concerning the regular and computer-related activities must be adapted to the new situation. The computer management is often in the hands of the entrepreneur, though it can also be in the hands of the second person in charge, the IT supplier (via leasing contracts and other contracts), or a part-time manager (a very costly option). Considering the increasing complexity of the computerisation to be used, schooling becomes increasingly important. The following types of schooling are needed in this phase: a follow-up course in business science (business strategy, organisation, business processes, and customer service), a follow-up course concerning the strategic role of computerisation in and around the enterprise, and specific courses aimed at the use of specific computer applications, such as the hairdressing program and tele-banking. The following parties can be consulted for information and advice: branch organisations, banks, regional training centres, and IT suppliers.



Phase three is related to enterprises that have advanced applications of computerisation. The smaller enterprises have to strongly reconsider their strategic position in this phase.

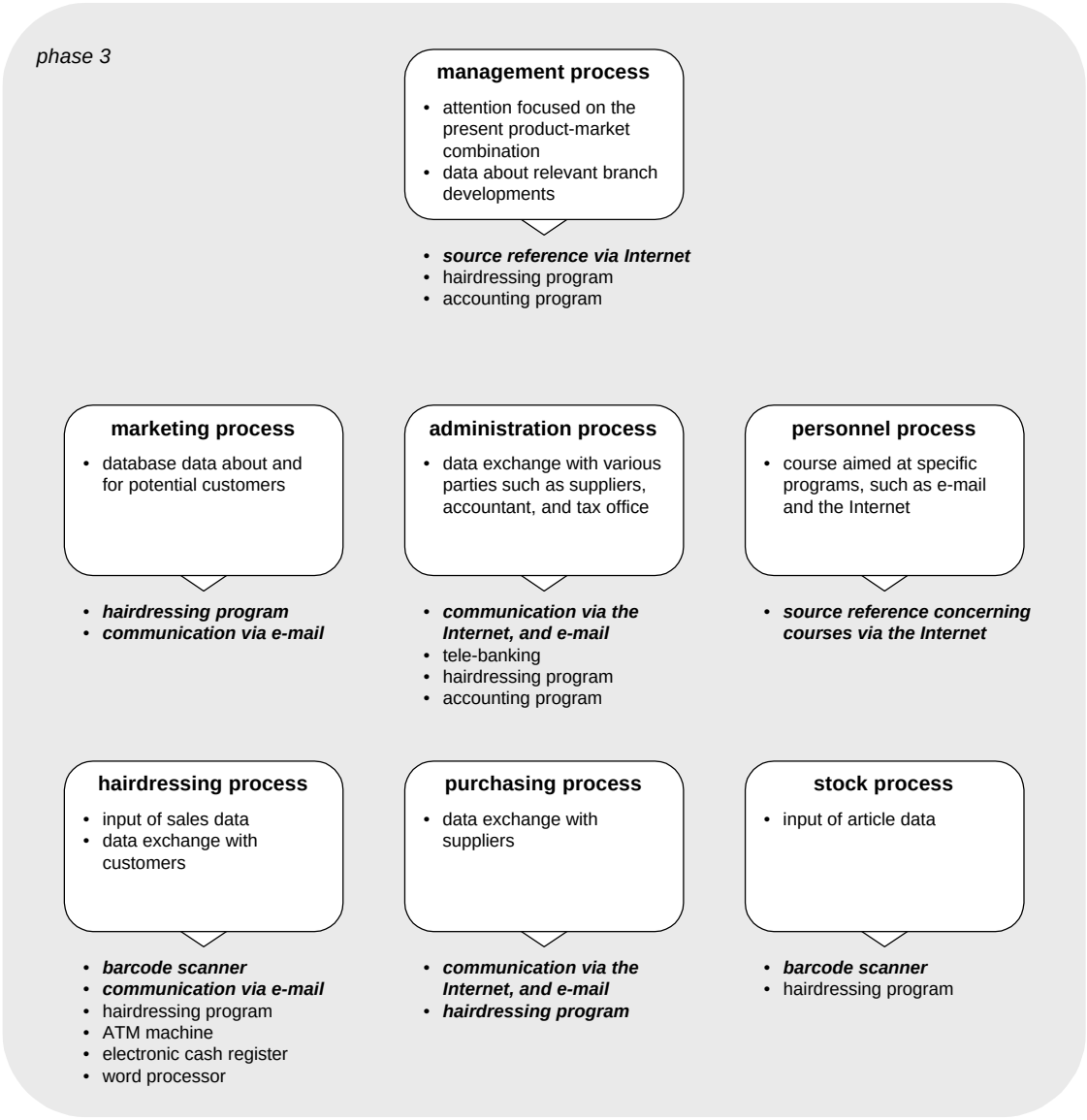
Phase 3: Computerisation concerning externally oriented process integration

Strategy

Compared to the previous phases, phase three and higher are more related to the external orientation of the enterprise, in which forms of integration in the business sector (intensification of the relations with suppliers and customers) in relation to the branch and market developments are of major importance. As a result, the strategic attention is focused on the creation of an advantage with the present product-market combination and raising the effectiveness of the external communication with customers and suppliers, among others. A strategic option relevant in this phase is the franchise construction. In addition, it is wise for the smaller hairdresser's to reconsider their strategic position, in which options like scale enlarging, segmentation, and specialisation can be important points of attention. The function of computerisation is to support and improve existing business functions for the creation of added value within the present products and service package. The IT plan is largely based on the business plan.

Technology

The computerisation is aimed at practically all business processes and in comparison with the previous phase, the degree of computerisation per business process is intensified in this phase. Some business processes are extended or undergo renewal. The following new business processes are of importance: management, marketing, administration, personnel process, hairdressing process, purchasing, and stock. In this phase we deal with the external data structure in relation to parties like our present customers, prospects, suppliers, the accountant, and tax office. The hardware consists of linked computers in a LAN configuration (Local Area Network). The following extra computer applications can be mentioned: Internet, e-mail, and barcode scanner. In the figure below the computerised data and accompanying types of computerisation are depicted per relevant business process in bold type and italics. Types of computerisation from the previous phase are given in the standard lettering.



Organisation

In this phase we can assume that the organisation of the enterprise has been reasonably adapted to the use of computerisation and that tasks, authorities, and responsibilities are reasonably organised. The computer management is mainly in the hands of the entrepreneur, though it can also be in the hands of a close employee, the IT supplier (via leasing contracts and other contracts), or a part-time manager. Schooling is strongly oriented towards supply chain developments and specific computer application of an external nature, such as forms of electronic communication via e-mail, and the Internet. The following parties can be consulted for further information: branch organisations, banks, regional training centres, and IT suppliers.

Phases four and five focus on the larger hairdresser's with possible outlets. For smaller hairdresser's phases four and five are less relevant, with the exception of innovative enterprises.

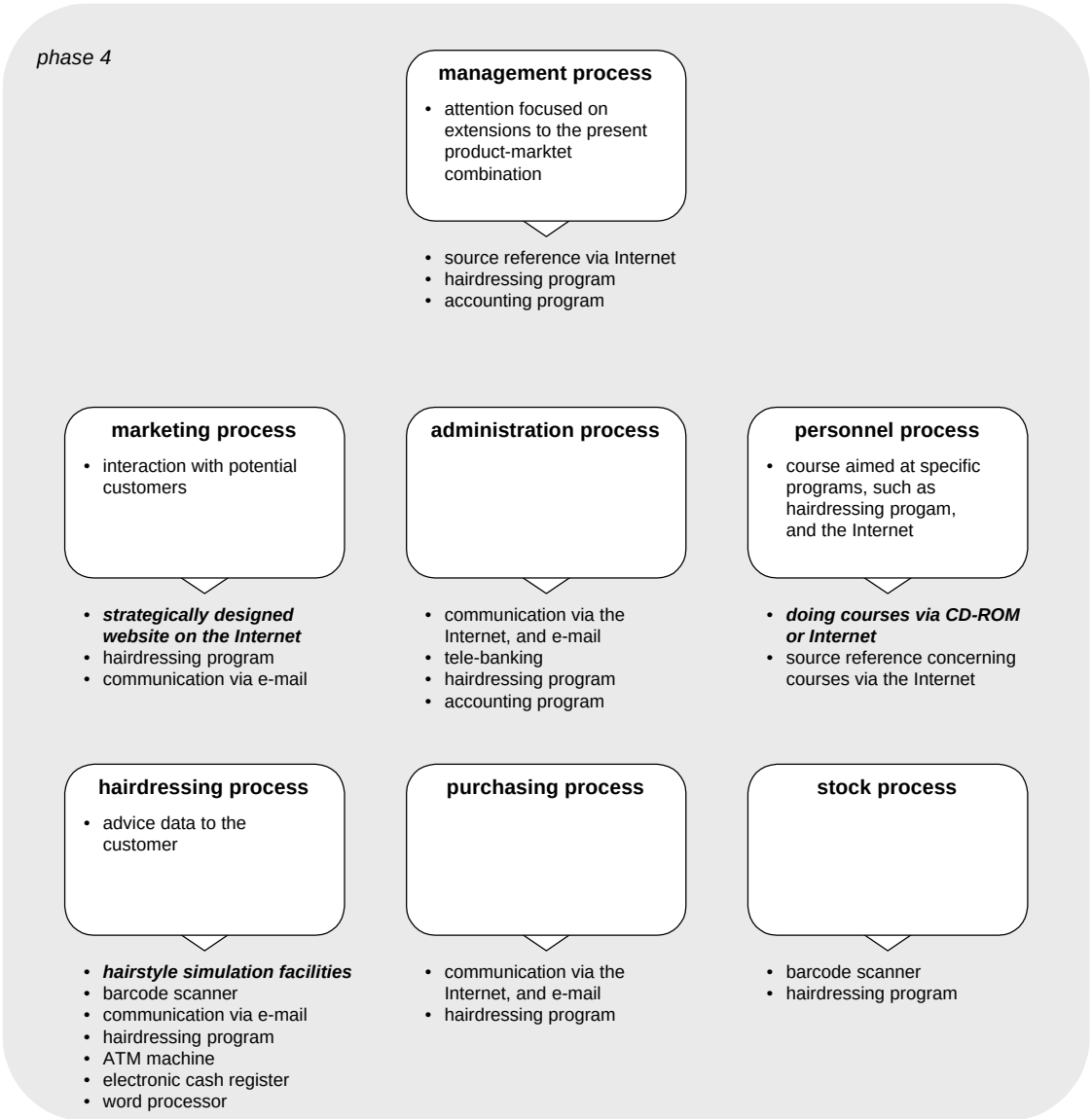
Phase 4: Computerisation and the externally oriented redesign of business processes

Strategy

The strategic attention in this phase focuses on the creation of extensions to the product-market combination. This minimally entails the creation of new forms of service through the application of computerisation. The marketing aspect is extremely important; entering into a franchise construction can be a strategic option in this phase. The function of computerisation is to realise added value to the one-to-one service to be created. In this phase the IT plan must be derived from or integrated with the business plan.

Technology

The applicable computerisation is aimed at all business processes and in comparison with the previous phases there is a further increase in the degree of computerisation. The following new and renewed business processes are of importance: marketing, personnel process, and hairdressing process. The attention is strongly focused on the externally oriented data structure. The hardware consists of linked computers in a LAN configuration and there are many software links between business processes within and outside the enterprise (suppliers, customers, service industries, etc.) The following extra computer applications can be mentioned: learning applications via CD-ROM and/or the Internet, a strategically designed website on the Internet, and hairstyle simulation facilities. In the figure below the computerised data and accompanying types of computerisation are depicted per relevant business process in bold type and italics. Types of computerisation from the previous phase are given in the standard lettering.



Organisation

In this phase the organisation of the enterprise is adapted to the use of computerisation. The tasks, authorities, and responsibilities concerning regular and computer-related activities usually are organised. The computer management is in the hands of the entrepreneur or an expert employee, in which the IT supplier or part-time manager can lend support. Considering the increasing complexity of the computerisation required, schooling remains essential: a course about the strategic use of specific forms of computerisation, such as a website, and hairstyle simulation facilities. Information can be obtained from the following parties, among others: branch organisation, regional training centres, and IT suppliers.

Phase five indicates that entirely new product-market combinations can be created under the influence of computerisation. Numerous combinations are possible; two examples are given in the phase description below. Phase five is less applicable to small, specialised hairdressers, with the exception of innovative enterprises.

Phase 5: Revision of business goals under the influence of computerisation

Strategy

The strategic attention in this phase is focused on the creation of new product-market combinations by using computerisation among other things. The function of computerisation is to create new products and services and to this purpose the IT plan has to be integrated with the business plan. Below two examples are given of new product-market combinations:

1. The care salon. This enterprise provides services centred on cosmetic care, in which service elements of the beauty salon and hairdresser's are integrated. This is a strong way of winning customers and retaining them. The role of IT is related to the changed and new business processes.
2. The trade info-shop. This enterprise focuses on providing data about customer characteristics (e.g. taste and planning) to service trades (e.g. the hairdresser's). This type of enterprise is extremely innovative, since the trade aspect is gone and the enterprise only focuses on coordination and processing of information flows for the customer and the service trade. The role of information technology is mainly related to linking and interpreting information flows of customer characteristics and service options of trades.

Technology

Computerisation plays a considerable role in the example businesses mentioned and supports the integration of the business processes. Particularly the company in the second example has many links to the business process of other organisations (suppliers, partners, customers, third parties, and others). This can involve the following integrated computerised applications: an interactive website that has relevant business processes (front office), back-office software to control the many business processes via databases, management and on-line communication links with business relations, such as customers and trade companies.

Organisation

In this phase the organisation of the enterprise is completely tuned to computerisation, as computerisation is the enabler for the business strategy (particularly for the second example enterprise). Computerisation has a strongly integrative function in the enterprise, which means the tasks, authorities, and responsibilities must be clearly agreed upon. The computer management is in the hands of a very expert employee, in which the IT supplier or part-time manager can offer support. Schooling must focus on the way to operate in new markets, the redefinition and design of new business processes, and functions and strategic application and use of specific computer applications. Information can be obtained from the branch organisation, regional training centres, and IT suppliers.

These six phases present a clear picture as to the internal and external developments in the strategic application of information technology in the hairdressing industry. Summarising, it may be stated that phases zero, one and two are primarily internally oriented, which means that such matters as efficiency and effectiveness are given attention. Phase three and the following phases become more externally oriented. By this we mean that effective communication with buyers, suppliers and third parties (banks, accountants, trade associations, etc.) receive primary attention.

Chapter 8
The IT scenario model for the furnishing branch

8.1 Description of the furnishing branch

In this chapter we describe the furnishing branch and the furnishing shop and present the final industry-specific IT scenario model for this branch of industry. The IT scenario model for this part of the retail trade[1] was operationalised because the retail trade represents a considerable proportion of the total number of enterprises in the Dutch economy, and also because these SMEs are characterised by a relatively low degree of automation and mainly produce goods on order, which makes the exchange of information and knowledge in the supply chain very important (OECD, 1995; CBW, 1996, 1997; HBD, 1997, 1998; EIM, 1998). The furnishing industry focuses mainly on the sale of furniture, kitchens, carpets, and lamps. In the Dutch furnishing branch, five types of enterprises can be distinguished, namely the furniture shop, the bedroom-furnishing shop, the specialist shop for textiles and carpets, the non-specialist shop and other shops such as those of the kitchen specialist and the cork and parquet specialist. The last two specialists fall outside the scope of this study. The Higher Industry Board for the Retail Trade (HBD, 1997, 1998) and EIM (1998) give a more detailed description of the retail trade and the furnishing industry.

A brief description of a number of essential macro- and meso-developments in and around the furnishing industry is given below. These developments usually involve the entire SME sector, including the furnishing industry. The descriptions given in Chapter 7 therefore also apply to a large extent to the furnishing industry. The developments sketched below provide opportunities with regard to the composition of the package of products and services of enterprises in the furnishing industry. Together, the descriptions constitute environmental aspect component of the IT scenario model. The other components such as the six phases and three aspect areas will be discussed in Section 8.3.

Socio-economic developments

Economic growth is a very important element with regard to the developments in the national business community and, consequently, also affects the hairdressing industry. Forecasts show that, in the year 2000, the economic developments in the gross domestic product (GDP) and the employment and private consumption in the Netherlands will remain stable or show a slight decrease (7.1). In addition, at the European level, various developments are expected, of which the introduction of the Euro and the development of uniform remuneration and tax systems are just two examples.

Demographic developments

Demographic changes manifest themselves as changes in the size, composition and life-style of the population. Some figures have already been given in Section 7.1. Some of the trends expected in the coming decades are an increase in the Dutch population, an increase in the number of immigrants, an increase in the number of elderly people and a further individualisation of society resulting in an increase in the number of households.

Developments in the public sphere (legislation, agreements and covenants)

Developments in legislation, agreements and covenants concerning the public sphere are usually initiated by the government and other coordinating bodies. These developments relate to such matters as the liberalisation of shop opening times, the relaxation of regulations of the Establishment of Businesses Act, the stricter regulations

[1] The retail trade can be defined as 'that part of the total economic industry that concerns itself with the direct sale of goods to consumers' (Van der Kind, 1996).

concerning environmental management and sustainability, and the new regulations concerning working conditions (ARBO). Developments in this sphere depend to a large extent on the policies pursued by the government, trade associations, trade unions and other bodies.

Industry-specific developments

A number of specific developments that are taking place in the furnishing industry have a great influence on its structure and composition. The number of large-scale retailers in the shape of gigantic furniture supermarkets and furnishing centres has increased considerably over the past few years. This leads to a weaker competitive position for the independent retailers. It is therefore necessary that these will begin to cooperate on a local scale to be able to offer a complete product range. One recent development concerns the extension of the number of chains and the creation of various forms of collaboration. In 1995, the trade association of the furnishing industry introduced a recognition regulation for the entire branch, which made it possible to give an indication of the level of quality of the associated enterprises. Most enterprises in the furnishing industry produce on order. Given the diverse wishes of consumers and the relatively long delivery times, the industry needs to realise certain types of supply chain integration and reversal through more effective communication. This may be achieved with the use of an information technology application such as EDI (Electronic Data Interchange), which makes it possible to send customer-specific orders fast, reliably and relatively easy to the manufacturer by electronic means. In addition, it also offers the opportunity to send data concerning production and delivery times of the manufacturer to the retailer, who in turn can inform the end consumer.

8.2 Description of the furnishing shop

In this section we will briefly describe the specific aspects of furnishing shops such as the strategic aspects, business processes, relation to information technology and the organisational aspect of the adoption of information technology in the furnishing shop.

Strategic aspects of the furnishing shop

The business strategy is in principle the main starting point for the operational activities in a furnishing shop. It is therefore essential that entrepreneurs try to gain insight into the many strategic aspects of their enterprise in order to guarantee and control its continuity. At the abstract level, this involves specialisations and differentiations with respect to the package of products and services. More concretely, this means that the hairdresser should reflect on such matters as:

- The target group and the appropriate type of shop (furniture shop, the bedroom-furnishing shop, the specialist shop for textiles and/or carpets, the non-specialist shop, etc.);
- The legal form and the degree of organisation (e.g. association with a purchasing combine or chain);
- The package of products and services (segment, range, pricing, brands, stocks, customising, delivery times, provision of information, service, etc.);
- The size of the enterprise in terms of the number and quality of employees;
- The location, opening hours, PR and marketing;
- The internally and externally oriented automation;
- The consequences of new legislation.

However, within the context of the IT scenario model, the focus is mainly on the possibilities that exist regarding the strategic application of information technology in the furnishing shop.

Business processes concerning the use of information technology

Given the developments in supply chain integration and reversal, the application of information technology in the furnishing shop is becoming increasingly relevant and offers furnishing shops many opportunities for professionalisation and reorientation, which may have far-reaching strategic effects. The use of information technology offers opportunities for improving the supply of products and services, quantitatively as well as qualitatively. The following five major types of automation can be observed in the furnishing shops:

- An order-processing program for the processing of data concerning product range, suppliers, stocks, orders, customers, etc.;
- An accounting program as an aid in financial accounting;
- A multimedia computer to provide customers with information about the product range, products and product variations;
- Electronic communication via the Internet, e-mail and EDI;
- Electronic means of payment such as PIN cards and chip purses.

The business processes that are most common in the furnishing shop and the possible role that information technology can play in these, are listed below.

- The *sales process* is the key process in the furnishing shop and encompasses such professional activities as giving advice, the sales of articles and billing. The following types of automation can be applied in this process: order-processing programs, electronic cash registers, bar-code scanners, point-of-pay terminals and electronic communication via e-mail or EDI.
- The *marketing process* is aimed at finding, approaching and retaining customers with the use of the following five marketing elements: product, price, location, promotion campaigns and personnel. The following types of automation may support this business process: e-mail, websites on the Internet, order-processing programs (customer files) and word processors.
- The *personnel process* relates to such matters as coaching and guidance, job demarcation, registration and schooling. The following types of automation can be applied in this process: order-processing programs, accounting programs, the Internet and CD-ROMs containing course material.
- The *management process* concerns the steering of operations, in which information is an essential element. The following types of automation may be important: order-processing programs, accounting programs and the Internet.
- The *administration process* includes the following activities: order administration, turnover registration, payments, bookkeeping, maintaining the contacts with banks, accountants and the tax office, etc. Applicable types of automation are: order-processing programs, accounting programs, telebanking and electronic communication with accountants and the tax office.
- The *purchasing process* mainly concerns the purchase of ordered goods and parts. The following types of automation may be applicable: order-processing programs, fax machines, e-mail, EDI and the Internet.
- The *service process* involves mainly the processing of complaints. The following types of automation may be important: order-processing programs and word processors.
- The *process of stock and supply* involves keeping stocks of the above-mentioned products and tools. Possible applications are: order-processing programs and bar-code scanners and portable point-of-pay terminals.

Organisational aspects regarding the usage of information technology in the furnishing shop

The use of information technology in the furnishing shop makes it necessary to reorganise such matters as business processes, job content and schooling. This applies both to employers and employees. For example, the employer should expand his strategic planning process by incorporating strategic considerations regarding information technology. This means that information technology should also play a part in the strategic planning process. For employees, the adoption of information technology may involve changes in job content. This means that the tasks, competencies and responsibilities of employees need to be redefined in accordance with the new situation. In addition, schooling is an important element in the management of a furnishing shop. It guarantees that employees maintain the quality of their performance and also contributes to the enterprise's professionalisation trajectory. This does not only refer to professional knowledge, but also to such matters as customer service and stock management. Schooling is also essential for the use of information technology in the furnishing shop. This does not so much concern the technological aspects of information technology as the strategic and organisational ones.

8.3 The IT scenario model for the furnishing branch

In this section we will discuss the version of the IT scenario model that was operationalised for the furnishing branch, particularly the six phases and three aspect areas. The environmental aspect component of the model corresponds with the developments in and around the branch as sketched in Section 8.1. As far as the six phases are concerned, phases zero to three are particularly important for the hairdressing industry as most of the furnishing businesses with fewer than 10 employees will find themselves in one or more of these phases. Comparatively speaking, the shops with more than 10 employees have a greater chance of reaching one of the higher phases. In the phases below, the term *computerisation* is used instead of *information technology*, because this term is more in line with the frame of reference of the entrepreneur in the furnishing branch.

Phase zero is related to the situation in which the furnishing shop does not make use of computerisation. This means the entrepreneur has made an implicit or explicit strategic choice not to professionalise the enterprise through computerisation. Phase one entails mostly small enterprises that pay limited attention to the strategic position of the enterprise in relation to the application of forms of computerisation, due to their limited knowledge, lack of complexity, lack of coordination, and limited means.

Phase 1: Computerisation aimed at a functional, internally oriented integration

Strategy

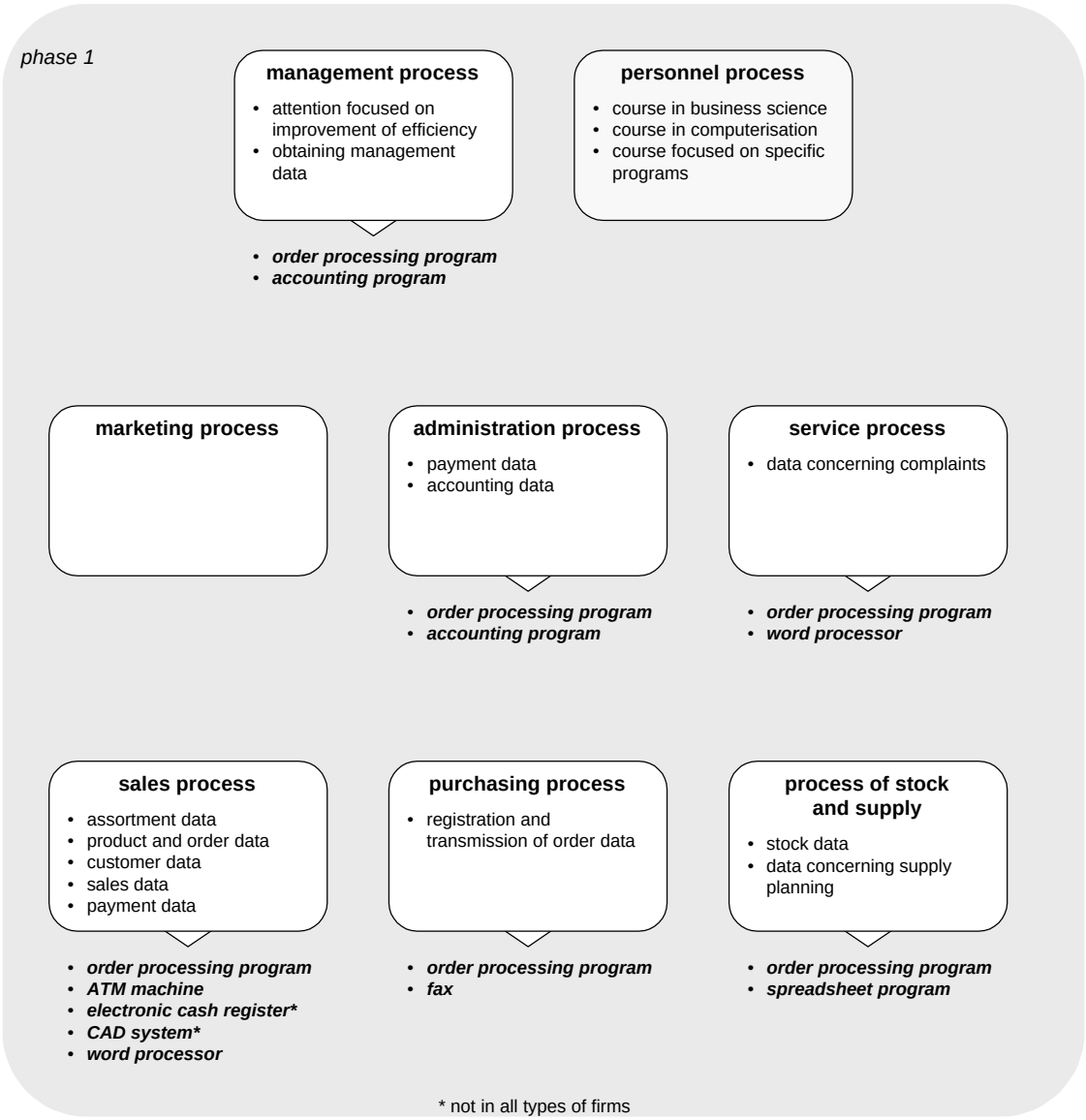
The strategy of the enterprise in this phase is focused on raising the efficiency within the furnishing shop. The function of computerisation is especially focused on the support of existing functions. One example is the structural registration of order data with an order-processing program. The role of the IT plan is generally is limited in this phase. If there is an IT plan, it is not tuned to the business plan or the business strategy.

Technology

The computerisation in this phase is especially related to the internal data structure of the following business processes: management, personnel, administration, service, sales, purchasing, stock and supply. The following computer applications can be mentioned for this phase: an order processing program, accounting program, word processing program, ATM machine (Automated Teller Machine), electronic cash register (not in all types of companies), a CAD system (i.e. Computer Aided Design; not for all types of businesses) and a fax, and spreadsheet program. The hardware consists of separate computers with peripheral equipment. There are hardly any or no data links between the computer applications mentioned above. The figure below gives an overview. For each relevant business process, information is given about the computerisation data and the corresponding type of computerisation.

Organisation

The use of computerisation has implications for the organisation of the furnishing shop (structure, functions, and schooling). The structure of the organisation changes because the application of computerisation alters the shape of the business processes. In the sales process, for example, the order-processing program is used to register matters like product data, orders, and customers, and therefore this program holds an important position within the business process. This means that tasks, authorities, and responsibilities have to be organised regarding regular activities and activities related to the use of computers. The same applies to the technical operational maintenance of the computers (installing, updating, copying, and making back-up copies). The management of computers is an important subject and is nearly always organised by the entrepreneur in this phase. The role of the user in the adoption process of computerisation in this phase is limited and management in particular needs to gain insight into the strategic role of computerisation. The following schooling is required: an introductory course in business science (business strategy, organisation, business processes, and customer services), an introductory and general course about the strategic use of computerisation, a course about the operational use of computerisation, and a course about specific applications (order processing program, accounting program, CAD program, etc.). For more information, the following parties can be consulted: the accountant, the branch organisation, the purchasing combinations, regional training centres, and IT suppliers.



Phase two is a deepening and broadening of the contents of phase one, aimed at the improvement of the effectiveness of the enterprise.

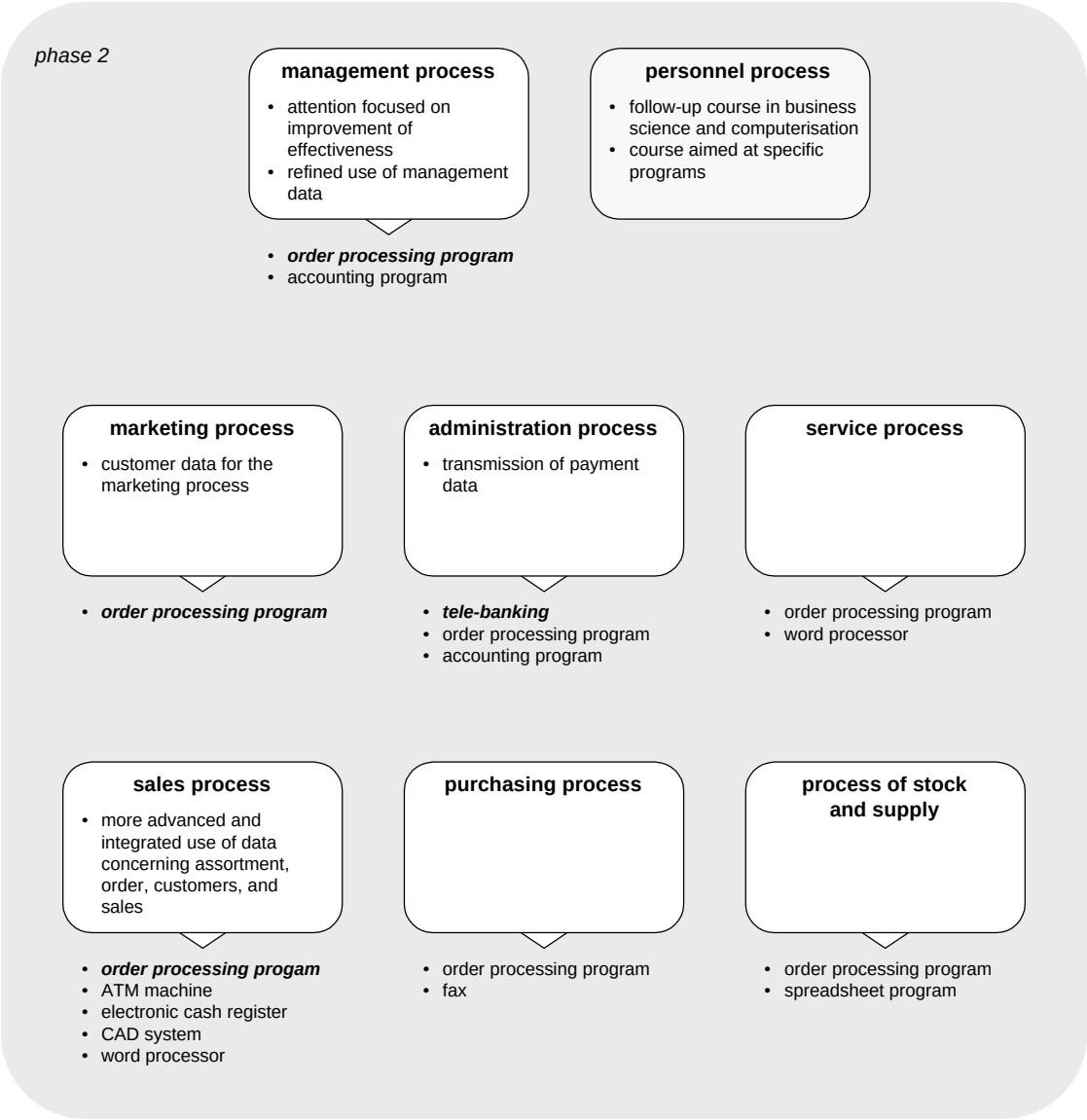
Phase 2: Computerisation aimed at a multifunctional, internally oriented integration

Strategy

The strategic attention in this phase is focused on the effectiveness of the enterprise through the use of computerisation. This is realised, among other things, by obtaining more insight into turnover per product, product group, manufacturer, period, or floor surface. The corresponding function of computerisation is to support, improve, and integrate existing business functions. If there is an IT plan, it is only partly tuned to the business plan.

Technology

The use of computerisation is related to nearly all the business processes in this phase, but the degree of use will differ from process to process. In the last phase some business processes were mentioned that are related to the use of computerisation. In this phase some new business processes are added and some processes are extended or renewed regarding the use of computerisation. We are dealing with the following new and renewed business processes: management, personnel, marketing, administration, and sales. The following extra computer applications can be mentioned in this context: a more extensive application of the order-processing program and tele-banking facilities. The programs and equipment now have closer links. In the figure below the computerised data and accompanying types of computerisation are depicted per relevant business process (in bold type and italics). Types of computerisation from the previous phase are given in normal type.



Organisation

As a result of the application of computerisation in the four business processes mentioned earlier the structure of the organisation will change. Tasks, authorities, and responsibilities concerning the regular and computer-related activities must be adapted to the new situation. The computer management is often in the hands of the entrepreneur, though it can also be in the hands of the second person in charge, the IT supplier (via leasing contracts and other contracts), or a part-time manager (a very costly option). Considering the increasing complexity of the computerisation to be used, schooling becomes increasingly important. The following types of schooling are needed in this phase: a follow-up course in business science (business strategy, organisation, business processes, and customer service), a follow-up course concerning the strategic role of computerisation in and around the enterprise, and specific courses aimed at the use of specific computer applications, such as the order processing program and tele-banking. The following parties can be consulted for information and advice: branch organisations, banks, purchasing combinations, regional training centres, and IT suppliers.

Phase three is related to enterprises that have advanced applications of computerisation. The smaller enterprises have to strongly reconsider their strategic position in this phase.

Phase 3: Computerisation concerning an externally oriented process integration

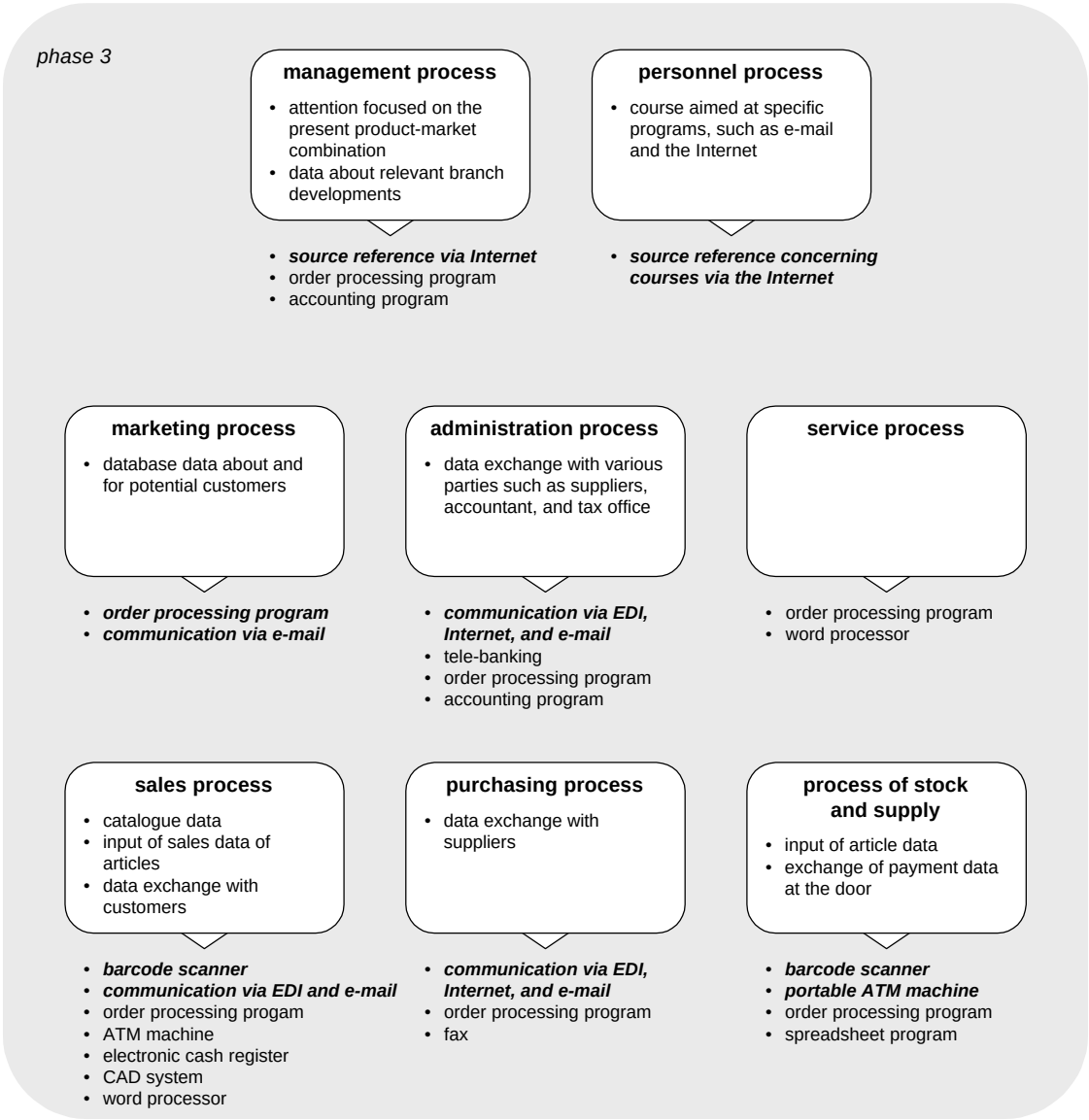
Strategy

Compared to the previous phases, phase three and higher are more related to the external orientation of the enterprise, in which forms of integration in the business sector (intensification of the relations with suppliers and customers) in relation to the branch and market developments are of major importance. As a result, the strategic attention is focused on the creation of an advantage with the present product-market combination and raising the effectiveness of the external communication with

customers and suppliers, among others. A strategic option relevant in this phase is the franchise construction. In addition, it is wise for the smaller furnishing shops to reconsider their strategic position, in which options such as enlargement of scale, segmentation and specialisation can be important points of attention. The function of computerisation is to support and improve existing business functions for the creation of added value within the present products and service package. The IT plan is largely based on the business plan.

Technology

The computerisation is aimed at practically all business processes and in comparison with the previous phase, the degree of computerisation per business process is intensified in this phase. Some business processes are extended or undergo renewal. The following new business processes are of importance: management, personnel process, marketing, administration, sales, purchasing, stock and supply. In this phase we deal with the external data structure in relation to parties like our present customers, prospects, suppliers, the accountant, and tax office. The hardware consists of linked computers in a LAN configuration (Local Area Network). The following extra computer applications can be mentioned: Internet and e-mail, EDI (Electronic Data Interchange), barcode scanner, and a portable ATM machine. In the figure below the computerised data and accompanying types of computerisation are depicted per relevant business process. Types of computerisation from the previous phase are given in italics.



Organisation

In this phase we can assume that the organisation of the enterprise has been reasonably adapted to the use of computerisation and that tasks, authorities, and responsibilities are reasonably organised. The computer management is mainly in the hands of the entrepreneur, although it can also be in the hands of the second person in charge, the IT supplier (via leasing contracts and other contracts), or a part-time manager (a very costly option). Schooling is strongly oriented towards supply chain developments and specific computer application of an external nature, such as forms of electronic communication via EDI, e-mail, and the Internet. The following parties can be consulted for further information: branch organisations, banks, purchasing combinations, regional training centres, and IT suppliers.

Phases four and five focus on the larger furnishing stores with possible outlets. For smaller shops phases four and five are less relevant, with the exception of innovative enterprises.

Phase 4: Computerisation and the externally oriented redesign of business processes

Strategy

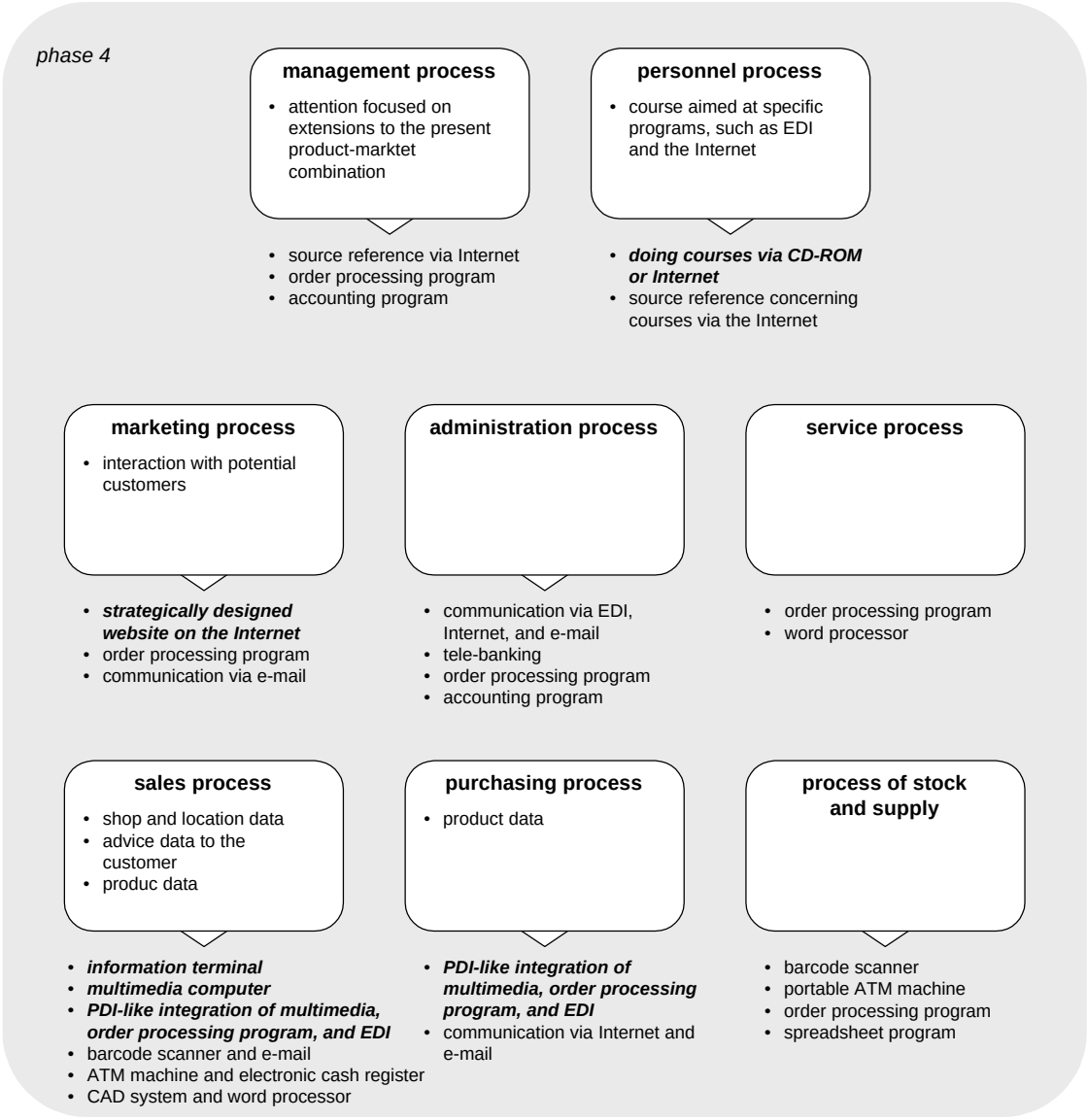
The strategic attention in this phase focuses on the creation of extensions to the product-market combination. This minimally entails the creation of new forms of service through the application of computerisation among other things. The marketing aspect is extremely important; entering into a franchise construction can be a strategic option in this phase. The function of computerisation is to realise added value to the one-to-one service to be created. In this phase the IT plan must be derived from or integrated with the business plan.

Technology

The applicable computerisation is aimed at all business processes and in comparison with the previous phases there is a further increase in the degree of computerisation. The following new and renewed business processes are of importance: personnel, marketing, sales, and purchasing. The attention is strongly focused on the externally oriented data structure. The hardware consists of linked computers in a LAN configuration and there are many software links between business processes within and outside the enterprise (suppliers, customers, service industries, etc.) The following extra computer applications can be mentioned: learning applications via CD-ROM and/or the Internet, a strategically designed website on the Internet, an information terminal, multimedia computer for the visualisation of products and PDI-like structures (Product Data Interchange; integration of the order processing program, multimedia and EDI). The figure below gives an overview.

Organisation

In this phase the organisation of the enterprise is adapted to the use of computerisation. The tasks, authorities, and responsibilities concerning regular and computer-related activities usually are organised. The computer management is in the hands of the entrepreneur or an expert employee, in which the IT supplier or part-time manager can lend support. Considering the increasing complexity of the computerisation required, schooling remains essential: a course about the strategic use of specific forms of computerisation, such as a website, multimedia computer, and PDI-related matters. Information can be obtained from the following parties, among others: branch organisation, purchasing combinations, regional training centres, and IT suppliers.



Phase five indicates that entirely new product-market combinations can be created under the influence of computerisation. Numerous combinations are possible; two examples are given in the phase description below. Phase five is less applicable for small, specialised furnishing shops, with the exception of innovative enterprises.

Phase 5: Revision of business goals under the influence of computerisation

Strategy

The strategic attention in this phase is focused on the creation of new product-market combinations by using computerisation among other things. The function of computerisation is to create new products and services and to this purpose the IT plan has to be integrated with the business plan. Below two examples are given of new product-market combinations:

1. An enterprise completely oriented towards the Internet, in which the products and/or services are offered and sold exclusively on the Internet. This means that business processes such as sales, purchasing, marketing and services are mainly dealt with through the Internet. This example is in principle less suitable for the furnishing branch as the purchase of furnishings is based on emotions; potential customers want to touch and feel the articles.
2. The enterprise as 'turn-key furnishing coordinator'. This type of enterprise is specialised as a kind of project integrator and turns customer demands regarding the complete furnishing of a house into projects for manufacturers and service providers such as interior decorators, plasterers, furniture manufacturers, carpet layers, paperhangers, and lighting experts. Computerisation supports the structural coordination of the projects with the use of PDI-like communication protocols.

Technology

Computerisation plays a considerable role in the example businesses mentioned and supports the integration of the business processes. There exist many links with the business processes of other organisations (suppliers, partners, customers, third parties and others). As regards the company in the first example, the following integrated computer applications are relevant: interactive website in which the relevant business processes are present and integrated (front office), back-office software to control and manage the many business processes through databases and on-line communication lines with suppliers. As regards the company in the second example, the following integrated computer applications are relevant: database applications to determine the product range of the various suppliers, multimedia software for the sales process (advice, tender and order), on-line communication lines with the many suppliers and software to coordinate the project management.

Organisation

In this phase the organisation of the enterprise is completely tuned to computerisation, as computerisation is the enabler for the business strategy. Computerisation has a strongly integrative function in the enterprise, which means the tasks, authorities, and responsibilities must be clearly agreed upon. The computer management is in the hands of a very expert employee, in which the IT supplier or part-time manager can offer support. Schooling must focus on the way to operate in new markets, the redefinition and design of new business processes, and functions and strategic application and use of specific computer applications. Information can be obtained from the branch organisation, purchasing combinations, regional training centres, and IT suppliers.

These six phases present a clear picture as to the internal and external developments in the strategic application of information technology in the furnishing industry. Summarising, it may be stated that phases zero, one and two are primarily internally oriented, which means that such matters as efficiency and effectiveness are given attention. Phase three and the following phases become more externally oriented. By this we mean that effective communication with buyers, suppliers and third parties (banks, accountants, trade associations, etc.) receive primary attention.

Chapter 9
Conclusions and recommendations

Small and medium-sized enterprises do not apply information technology very quickly and it is therefore necessary to stimulate the diffusion and adoption of this technology in this sector. As we have already stated in the first chapter, the purpose of this study was to relate theoretical approaches at the meso- and micro-levels to each other in order to develop an instrument, the so-called IT scenario model, which might be used to stimulate the diffusion and adoption of information technology in small and medium-sized enterprises. In this chapter we will present the conclusions and recommendations with regard to this study.

9.1 Conclusion

The conclusions with regard to this study are linked to the questions in Chapter 1. The *central question* in this study was:

> *'Which aspects are important for the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises?'*

Six subquestions were formulated on the basis of this central question. Four of these subquestions were aimed at examining theoretical concepts and approaches relevant to the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises. The other two questions had more to do with the empirical aspect of the IT scenario model. Below, we present our conclusions per subquestion.

Economy and information technology

To be able to stimulate the diffusion and adoption of information technology in small and medium-sized enterprises, it was first necessary to look at the characteristics and implications of the development of information technology from a broader perspective. *Subquestion one* therefore refers to the relation between economy and information technology.

Knowledge and information can be regarded as economic commodities that are not scarce and not competitive. Information technology has gradually led to a situation in which information as a major source of knowledge can be transported over large distances in a quick and cheap way, and thus has become an important stimulus in the knowledge economy. Consequently, the knowledge economy plays an important role in the diffusion, adoption and implementation of technological knowledge in business processes. Network externalities with regard to the application of information technology are widely available. Apparently, the influence of information technology should primarily be analysed at the level of the application in the supply chain, while developments in the supply chain under influence of information technology can be indicated with the use of such terms as standardisation, differentiation and specialisation. Information technology enables parties to function more efficient and the customer can be provided with a quicker, more personal or more reliable product or service. Furthermore, the improvement of information flows creates different relations between such actors as suppliers, processors and buyers. This may be interpreted as a process innovation (efficiency improvement) that as such leads to a better, faster and more reliable product. These innovation processes can only be realised through cooperation and, consequently, through an increasing integration in the enterprise, sector or industry. Although cooperation leads to more dependency and possibly reduces flexibility, it is indispensable for the innovation process in the sector. Information technology can play an important integrative role in this. However, increase in productivity and economic growth as a result of innovation through information technology cannot be detected with the current measuring instruments. This has particularly to do with the increasing importance of services in the growing knowledge economy and the fact that a large part of the gains from information technology were not expressed in cost reduction, but much more in quality improvement. The application of new technologies and information technology in particular leads to shifts in the tasks and jobs of people: on balance,

routine jobs and low-quality labour will disappear and on average more broad-based jobs with more responsibilities will be created. This seems to reduce the possibilities of substitutability: labour and capital are becoming more and more complementary. Each new investment in technology will thus require the automatic appointment of the most highly qualified people to ensure adequate execution. Innovation is particularly based on such notions as 'learning by doing' and 'learning by using'. The result of all this is that a new technology cannot be reversed once it has been established. This holds particularly true for the adoption of information technology in small and medium-sized enterprises.

Small and medium-sized enterprises and information technology

The second subquestion concerns the relation between small and medium-sized enterprises and information technology. Information technology is a technological development that eventually led to the creation of the IT paradigm. It is a technology with which the primary and secondary business processes in organisations and enterprises can be supported and improved. This involves a number of steps such as the improvement of efficiency, effectiveness and the competitive advantage, and the integration of information flows in the industrial column and phenomena of supply chain reversal.

Small and medium-sized enterprises form a very heterogeneous group that represents the largest number of enterprises in the Dutch economy. There is a great difference between the large firms and small and medium-sized enterprises as far as material and behavioural advantages are concerned. This explains the relatively low adoption rate of information technology in small and medium-sized enterprises. In connection with this, the development and pursuit of innovation policy in the past ten to twenty years has been specifically aimed at the stimulation of the adoption of information technology in small and medium-sized enterprises. Raising the awareness of information technology and stimulating learning processes deserve special attention in this process. It is also desirable to directly accommodate the largest possible group of enterprises as specifically as possible. In the case of the heterogeneous group of small and medium-sized enterprises, this is rather difficult.

Diffusion and adoption of information technology

Subquestion three relates to diffusion and adoption. Diffusion and adoption mechanisms cannot be separated, because the degree of diffusion of an innovation in a social system actually depends on the individual adoption behaviour of the potential adopters who are part of that social system. It is only for the sake of clarity that the aspects of diffusion and adoption were unlinked.

The diffusion of information technology in the Dutch small and medium-sized enterprises plays a valuable role in improving the general competitive position of the Netherlands in the global economy. Diffusion research is generally aimed at the analysis of the diffusion of innovations in a social system, in this case a part of the Dutch SME sector. Communication with the potential adopters is central to the diffusion process as it helps to reduce the entrepreneurs' uncertainty about information technology. Homogenisation of the group of potential adopters is prerequisite for optimising the effectiveness of communication. The environment of the group of potential adopters have thus considerable influence on the adoption rate of an innovation in that social system.

The adoption of information technology takes place at the microeconomic level. Particularly the phases of knowledge and persuasion in the adoption process are of primary importance in this study as it is precisely these phases that relate to the awareness of the innovation of information technology that is so essential for diffusion and adoption. Generally speaking, it may be said that the awareness of the entrepreneurs in small and medium-sized enterprises concerning the role and possible applications of information technology is relatively low, while this is actually a crucial element in the adoption process of an innovation. One thing and another has to do with the constantly changing dynamics of the adoption context, which makes it rather difficult, particularly for small businesses, to develop and maintain a conception of this context. Knowledge largely depends on the presence of bounded reality, is primarily tacit and is acquired through learning by doing. With respect to the adoption of a complex technological innovation such as information technology, it is therefore difficult to exchange explicit knowledge via non-interpersonal communication channels. In addition to communication, learning is a major element in the process of awareness raising. Learning comprises various stages that together form the mental model of an individual or organisation. It is on this basis that a mental model contains the necessary insights and

knowledge for dealing with new situations that need to be anticipated or require a better proactive response. Learning takes place through a cyclic interaction between exploitation and exploration, which leads to the necessary experiences and insights. Thus, the entrepreneur as a potential adopter will experience that innovation may provide the desired opening for establishing a certain strategic policy. At the strategic level, three shortcomings can be distinguished with regard to the learning processes: cognitive inertia, problems with linking the learning stages due to the length of the time span of the learning cycle, and vision-related problems due to the presence of variations in the mental models of the parties involved. The adoption of information technology involves the awareness of, and learning about, the dynamic environment in relation to the role of information technology.

The IT scenario model

Subquestion four relates to the development of the IT scenario model. The desired stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises requires that the communication with small and medium-sized enterprises concerning the innovation is given shape. The IT scenario model is an instrument that may help to realise this. The IT scenario model can be described as *'a structure that integrates economic and business aspects of developments in industry, supply chains and information technology into an industry-specific scenario for entrepreneurs in the small and medium-sized industry sector'*. The concepts of the scenario methods and IT growth phases offer clear starting points for transforming the theoretical approaches to homogenisation, environmental dynamics, uncertainty, awareness, communication and learning, and for applying them in the model. These are theories at the meso- and micro-levels. Scenarios reduce the learning deficiencies and therefore form an instrument fort supporting and influencing the strategic management processes. Through the tripartition of strategy, technology and organisation, among other things, the IT growth-phase models provide insight into the layout and enabling role of information technology in an enterprise, and also include aspects of the developments in supply chains and industries. Elements of recent IT growth-phase models also form an alternative measuring instrument for the further examination of the productivity relation between information technology and economy. The concept of the IT scenario model consists of three main components: an environmental aspect, six phases and three aspect areas.

The industry-specific operationalisation of the IT scenario model

Subquestion five relates to the industry-specific operationalisation of the IT scenario model for the two branches of industry. The hairdressing and furnishing industries were selected for the operationalisation on the basis of various criteria. The model was operationalised in the form of IT scenarios on the basis of interviews with trade associations, buying organisations, knowledge institutions and entrepreneurs. The industry-specific operationalisation of the three main components took place in four steps. The environment component relates to the description of the general techno-economic developments in and around a specific branch of industry. This component is concretised for a branch by means of a scenario method (step one). The phases go deeper into the specific meso-developments in the industry and are further defined and worked out in step two. Per phase, three aspect areas can be distinguished: strategy, technology and organisation. The operationalisation of these aspect areas is part of step three. Within the context of this study, the IT scenario model has so far been operationalised for two branches of industry. In the next step, the whole of operationalised components is transformed into a concrete communication concept, for example, in the shape of a website application. With the use of this concept, well-founded and specific information on the strategic, technological and organisational aspects of information technology can be communicated to the entrepreneurs. Thus, this instrument contributes to the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises.

Testing the IT scenario model

Subquestion six relates to the testing of the IT scenario model. To test the model, the industry-specific IT scenarios were used as a frame of reference in the incentive project called 'Get more out of your computer'. This pilot project aimed to stimulate automation in a dozen enterprises in the hairdressing, furnishing and clothing industries in the Rotterdam region through workshops, teachers form the Regional Training Centres as business

consultants and an informative, industry-specific CD-ROM with a diagnostic component that automatically generated a business-specific IT plan. The IT scenario was used as a frame of reference for classifying the enterprises involved into phases, which made it subsequently possible to communicate specifically on the phases that they still had to go through and the corresponding aspect areas of strategy, technology and organisation. The company visits show that the IT scenario model is a useful frame of reference for structuring the knowledge exchange process concerning the strategic application of information technology. The combination of communication channels (such as an ROC teacher and a multimedia application) can be very effective in this respect.

The innovation process is a learning process for which the IT scenario model provides opportunities to raise the awareness of the strategic use of information technology through the provision of information and advice to individual enterprises in a certain industry. Thus, the model plays a significant role in the diffusion and adoption policy concerning information technology in small and medium-sized enterprises. At a higher abstraction level, the model also influences learning processes concerning the innovation policy of such bodies as the national government, umbrella organisations for small and medium-sized enterprises and individual trade associations.

9.2 Recommendations

The recommendations concern the theoretical framework, the communication concept to be developed and the deepening and broadening of the IT scenario model. The recommendations are meant to give a clear indication as to how the results of this study can be given a place in such a way that they fit in the framework with regard to the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises from a theoretical and practical point of view.

It is first of all recommended to compare the IT scenario model with the presented theoretical framework in order to determine to what extent the relevant theoretical approaches and concepts have been incorporated in the model. It is in this respect of primary importance to further examine the relevant theoretical developments so that the theoretical framework may be further refined. The starting point remains, of course, the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises.

In the second place, future follow-up studies should focus on the transformation of the IT scenario model into an industry-specific, interactive communication concept in the shape of a CD-ROM or website application with which entrepreneurs in the SME sector can be informed about the strategic, technological and organisational implications of information technology. With the use of this communication concept, more thorough tests and evaluations can subsequently be performed with regard to the implications of the application of the industry-specific operationalised model for the strategic innovation behaviour of small and medium-sized enterprises.

Finally, it is important to deepen and broaden the IT scenario model. By deepening we mean that certain relevant theoretical approaches and concepts will be incorporated more emphatically in the model in order to obtain the best possible instrument for stimulating the diffusion and adoption of information technology in small and medium-sized enterprises. The same goes for the multimedia communication concept derived from the model. The broadening of the model relates to the operationalisation and application of the model in multiple branches of industry to gain more and different insights into the role industry-specific IT scenarios in the diffusion and adoption process of information technology in small and medium-sized enterprises. The deepening and broadening also makes it necessary to identify the position and future of the IT scenario model from a policy perspective to realise the stimulation of the diffusion and adoption of information technology in small and medium-sized enterprises in terms of an integrated theoretical and practical long-term approach.

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Appendices

Appendix 1: The CD-ROM concept of the 'Get more out of your computer' project

The 'Get more out of your computer' project was initiated by MKB-Nederland (the Dutch Federation of Small and Medium-sized Enterprises) to inform and advise small and medium-sized enterprises about the possibilities of information technology through a sector consultant and an industry-specific CD-ROM. In this appendix, we give an outline of the CD-ROM concept by discussing the structure of the CD-ROM and its components and looking at a number of texts and illustrations. The CD-ROM concept consists of an informative part and a diagnostic part. The informative part is meant to provide the entrepreneur with information about the role of information technology in and around the enterprise from a broad perspective. Various subjects are discussed in this part. Knol (1998) gives a more extensive description of the project and the CD-ROM concept (methodology, structure and content). Table a1 represents the structure of the informative part of the CD-ROM concept.

Part 1: The enterprise in the branch of industry 1. *The branch*: Various aspects of the branch are highlighted here, including the total turnover in the branch, employment in the branch and the total number of enterprises in the branch. 2. *The various types of enterprises in the branch:* Each branch of industry consists of different types of enterprises. A number of characteristics are described per type of enterprise, such as the breakdown of turnover, employment, average turnover per employee, etc. *3.* *The developments in the branch:* There are many developments in and around the branch. A number of them are briefly described from various points of view (government, buyer, supplier, automation, etc.). *4.* *The major types of automation in the branch:* The major types of automation are discussed here. No technical details, only general information. *5.* *Automation and the future of enterprises:* A number of automation options are discussed per size category of the enterprises in the branch.
Part 2: Automation in the enterprise *1.* *Business strategy as a starting point for automation:* Business strategy is considered to be the starting point for automation. Other important angles with regard to automation are those of strategy, organisation and technology. *2.* *Business processes and automation:* The entrepreneur usually has some vision on business processes. Automation options are discussed on the basis of these business processes. *3.* *Overview of automation options:* Under the previous item, various automation options were described per business process. To create a clear and brief overview, the major types of automation are reiterated.
Part 3: Automation: approach and management *1.* *The approach to automation:* A rough sketch of the approach to automation. Four steps are essential: 1. the strategy, 2. the IT policy, 3. the IT plan and 4. the approach and management. *2.* *Focal points in the management of automation* A brief description of a number of focal points in the management of automation.

Table a1: The structure of the informative part

The diagnostic part of the CD-ROM concept generates an industry-specific IT plan on the basis of a questions-and-answers session. Most of these questions are multiple-choice questions which help to inventory the application of information technology in the enterprise. The diagnostic part therefore emphasises the aspect area of technology. The aspect areas of strategy and organisation receive less attention in the present version of the CD-ROM. The generated IT plan is meant to make the entrepreneur aware of the possibilities of information technology in his enterprise so that he may develop strategic initiatives for the adoption of types of information technology that are relevant to his enterprise. Table a2 represents the structure of the IT plan.

Part 1: The analysis of the enterprise

1. *Introduction*:
   The aim and contents of the IT plan are outlined in the introduction. It is also stated repeatedly that it is a unique plan especially for company x. This is done to convince the entrepreneur that the plan can be of use to him.
2. *The indirect environment:*
   A brief description of what is meant by 'indirect environment'. In addition, a number of standard texts on the indirect environment are presented,. These relate to the characteristics of the actors in this environment, the developments concerning the indirect environment, etc.
3. *The direct environment:*
   A brief description of what is meant by 'direct environment'. The actors in the direct environment of the enterprise are also looked at. This is linked to a number of facts that have been obtained through the questions-answers session. However, this does not go very deep due to the fact that qualitative matters are difficult to measure and also because the focus of the diagnostic part is mainly on automation in this project.

Part 2: The IT analysis

1. *Introduction:*
   A description of the contents of the IT analysis.
2. *The organisation of the enterprise:*
   A number of characteristics of the organisation are represented, including the size of the enterprise, the people in charge, etc.
3. *The present automation in the enterprise:*
   A brief description of the present automation.
4. *The automation options per business process:*
   Business processes form the basis for information and advice on automation. The automation options are listed per business process.

Part 3: Recommendations

1. *Introduction:*
   A description of the recommendations.
2. *Strategy:*
   A number of standard texts are provided. The subject-matter relates to the fact that business strategy should be the starting point for automation.
3. *Organisation:*
   A number of standard texts are provided. These concern the fact that the use of automation leads to organisational changes.
4. *Automation:*
   The types of automation from part 2 are represented in an overview of software and hardware. Furthermore, a number of statements are made concerning knowledge, et cetera.

Table a2: The structure of the IT plan

The CD-ROM concept has been operationalised for the hairdressing, furnishing and clothing industries. To give you a better insight into the contents of the informative part of the CD-ROM, we have represented a number of texts and illustrations of this informative part below. Table a3 contains a number of texts on the accounting program, the hairstyle-simulation program and electronic communication. Figures a1 to a6 (in Dutch) illustrate the relations concerning business strategy, automation and business processes, the accounting program, the order-processing program, the hairstyle-simulation program, EDI applications (Electronic Data Interchange) and telebanking.

The accounting program You can keep the books with the use of an accounting program. When choosing an accounting program, it is important that you first consult your accountant on this matter.
The hairstyle-simulation program The hairstyle-simulation program enables you to project different hairstyles over the computer image of your customers. This computer image is obtained by scanning a photograph of the customer.
Electronic communication Electronic communication means that you communicate with the outside world using your computer. This may be done through the *Internet* or *e-mail*. *- The Internet* The Internet is a link between many computers all over the world. It can be compared to a life-size electronic notice board. A piece of that notice board is represented by an address: www.TUE.nl. You can look at this electronic notice board with your computer. *- E-mail* E-mail is electronic mail via the Internet. An e-mail address is an electronic post-box. An e-mail message is an electronic parcel that is delivered to the e-mail address of the addressee via the Internet. Many private individuals and companies have an e-mail address nowadays.

Table a3: Some texts from the informative part

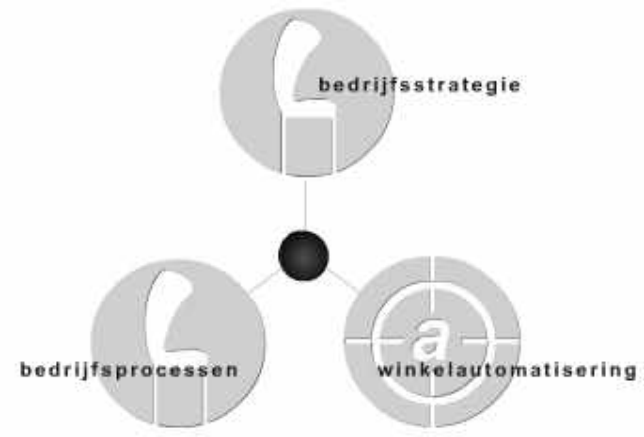


Figure a1: Schematic representation of the relation between business strategy (bedrijfsstrategie), shop automation (winkelautomatisering), and business processes (bedrijfsprocessen)

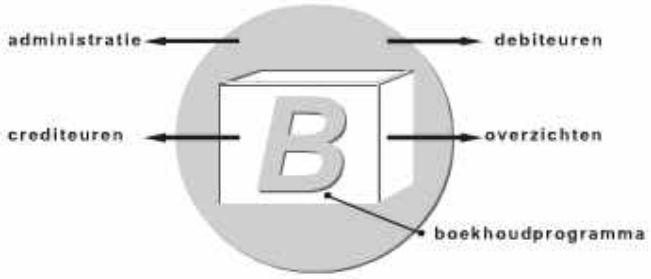


Figure a2: Schematic representation of an accounting program
(administratie = administration, crediteuren = creditors, debiteuren = debtors. overzichten = statements, and boekhoudprogramma = accounting program)

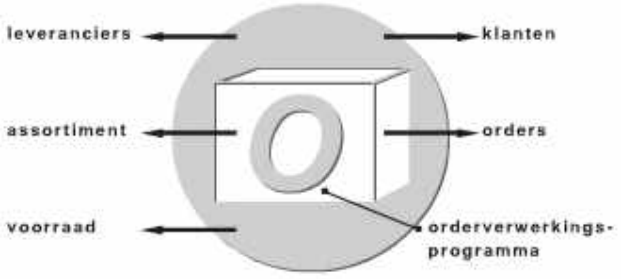


Figure a3: Schematic representation of an order-processing program
(leveranciers = suppliers, assortiment = product range, voorraad = stock, klanten = customers, orders = orders, and orderverwerkingsprogramma = order-processing program)

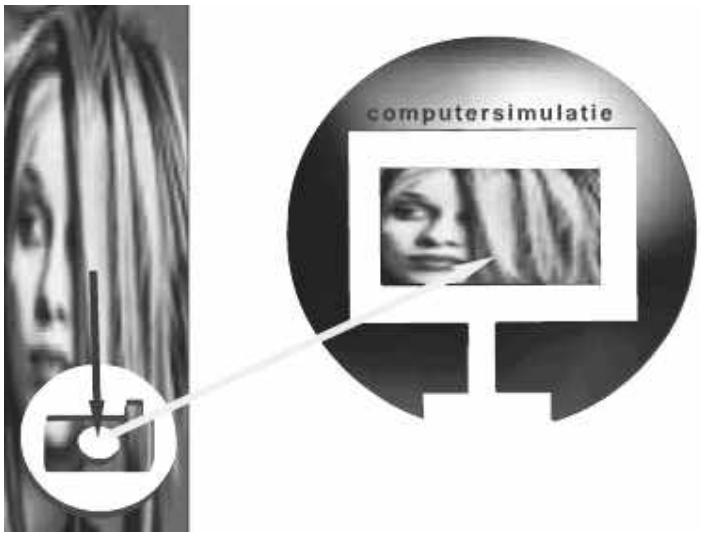


Figure a4: The hairstyle-simulation program
(computersimulatie = computer simulation)

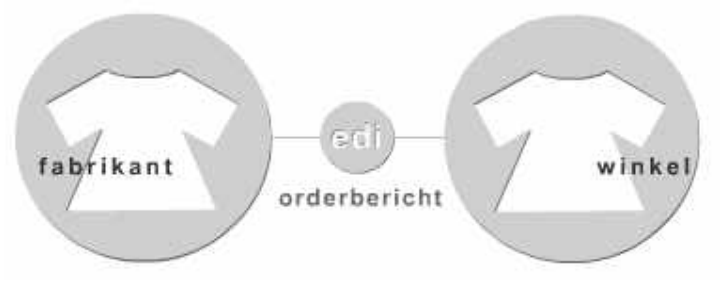


Figure a5: Electronic communication by means of EDI
(fabrikant = manufacturer, orderbericht = order message, and winkel = shop)

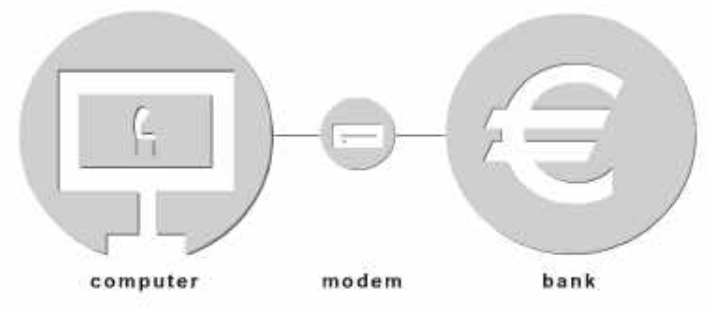


Figure a6: Telebanking

Appendix 2: The pros and cons of small and large enterprises

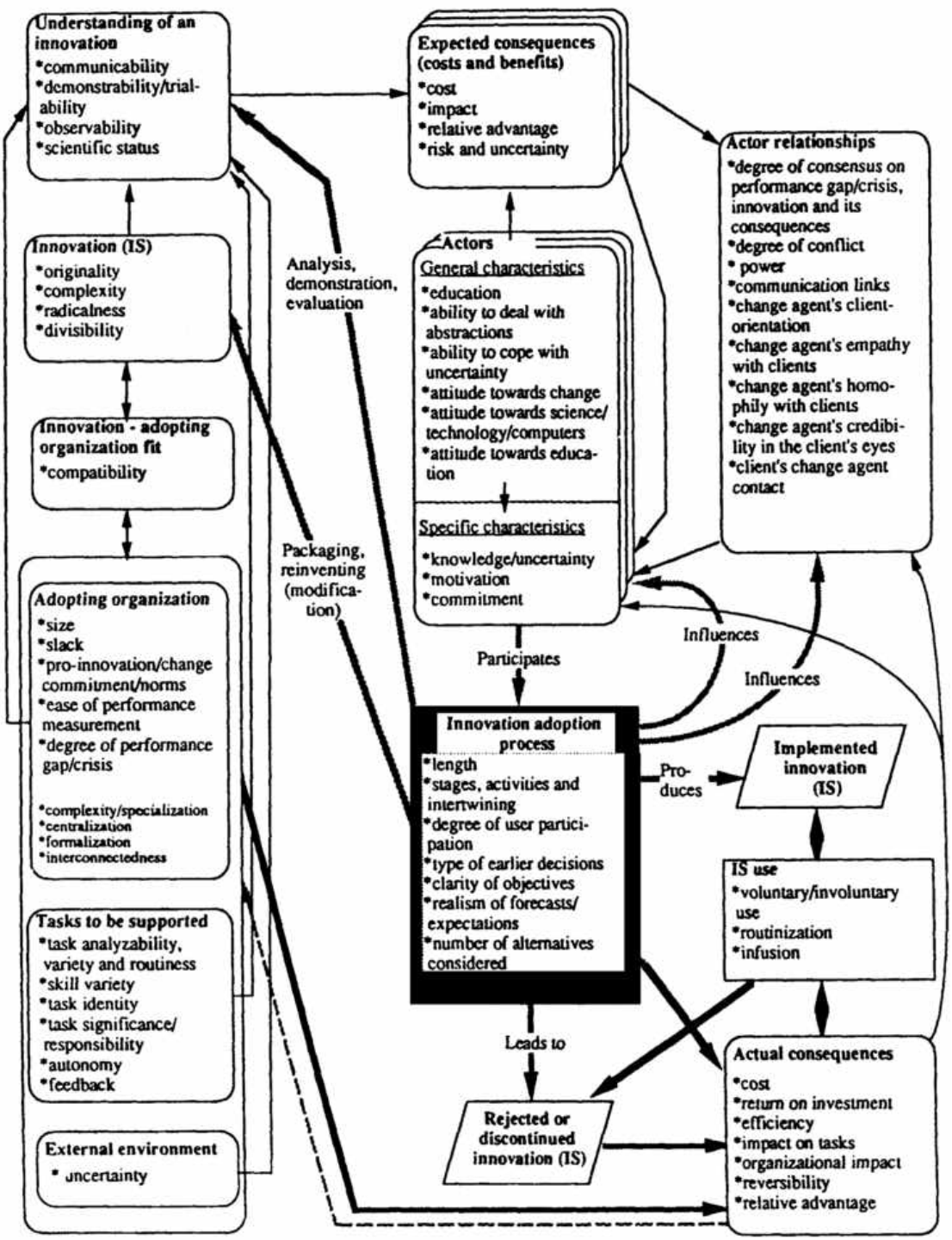
Table a4 gives an overview of the pros and cons of small and large enterprises (Rothwell and Zegveld, 1982).

Aspect	Small firms	Large firms
Marketing	+ Ability to react quickly to keep abreast of fast-changing market requirements - Market start-up abroad can be prohibitively costly.	+ Comprehensive distribution and servicing facilities. High degree of market power with existing product.
Management	+ Lack of bureaucracy. Dynamic, entrepreneurial managers react quickly to take advantage of new opportunities and are willing to accept risk.	+ Professional managers able to control complex organisations and establish corporate strategies. - Can suffer an excess of bureaucracy. Often controlled by accountants who can be risk-averse. Managers can become mere 'administrators' who lack dynamism with respect to new long-term opportunities.
Internal communication	+ Efficient and informal internal communication networks. Affords a fast response to internal problem solving: provides ability to reorganise rapidly to adapt to change in the external environment.	- Internal communications often cumbersome: this can lead to slow reaction to external threats and opportunities.
Qualified technical manpower	- Often lack suitably qualified technical specialists. Often unable to support a formal R&D effort on an appreciable scale.	+ Ability to attract highly skilled technical specialists. Can support the establishment of a large R&D laboratory.
External communication	- Often lack the time or resources to identify and use important external sources of scientific and technological expertise.	+ Able to 'plug-in' to external sources of scientific and technological expertise. Can afford library and information services. Can subcontract R&D to specialist centres of expertise. Can buy crucial technical information and technology.
Finance	- Can experience great difficulty in attracting capital, especially risk capital. Innovation can represent a disproportionately large financial risk. Inability to spread risk over a portfolio of projects.	+ Ability to borrow on capital market. Ability to spread risk over a portfolio of projects. Better able to fund diversification into new technologies and new markets.
Economies of scale and the systems approach	- In some areas scale economies form substantial entry barriers to small firms. Inability to offer integrated product lines or systems.	+ Ability to gain scale economies in R&D, production and marketing. Ability to offer a range of complementary products. Ability to bid for large turnkey projects.
Growth	- Can experience difficulty in acquiring external capital necessary for rapid growth. Entrepreneurial managers sometimes unable to cope with increasingly complex organisations.	+ Ability to finance expansion of production base. Ability to fund growth via diversification and acquisition.
Patents	- Can experience problems in coping with the patent system. Cannot afford time or costs involved in patent litigation.	+ Ability to employ patent specialists. Can afford to litigate to defend patents against infringement.
Government regulations	- Often cannot cope with complex regulations. Unit costs of compliance for small firms often high.	+ Ability to fund legal services to cope with complex regulatory requirements. Can spread regulatory costs. Able to fund R&D necessary for compliances.

Table a4: Pros and cons of small and large enterprises (Rothwell and Zegveld, 1982)

Appendix 3: Iivari's adoption framework for information systems

The adoption framework for information systems of Iivari (1993) has been schematically represented in Figure a7. The framework consists of four parts: 1. the innovation and context, 2. the actors, 3. the adoption process and 4. the connections. The four parts are explained below.



Figuur a7: Adoption framework for information systems of Iivari (1993)

1. The innovation and context

The characteristics of the innovation and context relate to the elements on the left side of the framework. The characteristics concerning the innovation are twofold. First, the innovation itself has a number of characteristics such as the extent to which the innovation is experienced as a complex and the extent to which the innovation can de adapted to the environment. Secondly, the innovation can be said to have a number of characteristics that determine the way in which the innovation is perceived by the people involved. The characteristics of the context can be divided into three components: the organisation adopting the innovation, the tasks that the innovation has to support and the environment outside the organisation.

2. The actors

Various actors play a significant role in the introduction of an innovation. There is mutual contact between these actors and therefore they influence each other. This group of actors includes the potential user(s), the management of the organisation, the provider/seller of the innovation and possibly an external organisation stimulating the innovation.

Many actors are uncertain about the innovation, depending on the knowledge they have. The actors will try to reduce this uncertainty as much as possible before taking a decision. The only way to reduce this uncertainty is by acquiring knowledge. In addition to uncertainty, motivation and conviction play an important role in the decision-making process concerning the adoption of an innovation. Each individual determines his own expectations with regard to the innovation on the basis of their knowledge, motivation and conviction. The characteristics of the actors, the mutual relations and their expectations are expressed in the three rectangles at the top right of the framework.

3. The adoption process

The adoption process can be regarded as a social process in which various actors are involved. There is some interaction: the actors influence the adoption process, but they themselves and their mutual relations are influenced too during the process. During the adoption process, the individual's perception of the innovation is subject to change. It is also often possible to alter the innovation in such a way that it fits better into the organisation. If it is not possible, or not desirable, to alter the innovation, it is often essential to make organisational adaptations for the innovation to become a success. The characteristics of the adoption process have been represented at the bottom right of the framework.

4. The connections

The framework distinguishes four different types of connections. The first type of connection (thin arrows) describes mainly the cognitive relations. The second type (bold arrows at the bottom of the framework) describes the material relations. The third type (dotted arrow) represents the impact relation. The fourth type (bold arrows that run up from the adoption process) describe the process relations.

Appendix 4: An illustrative outline of possible scenario drivers

Scenarios provide a method to give the management some insight into possible global and sectoral developments by presenting them with various fundamental perspectives on the future in a qualitative way. To construct these different perspectives, it is necessary to analyse those drivers that relate to the developments that are most crucial and most relevant to the scenario. Porter (1985) classified the relevant drivers into three groups: constant, predetermined and uncertain elements. *Constant elements* are those elements that are not likely to change. *Predetermined structural elements* are the areas in which the structure does change, but in a way that is highly predictable. Examples of these are the introduction of the Euro and the developments with regard to the implementation of a uniform tax system at the European level. *Uncertain structural elements* are those aspects of a future structure that depend on unsolvable uncertainties (customers' wishes, joint ventures and market developments). The table below gives an overview of possible scenario drivers that may be relevant to the various perspectives on the future.

	constant variable	**predetermined elements**	**uncertain structural elements**	
			independent	**dependent**
demographic 1. composition of the population 2. degree of individualisation 3. schooling				
socio-economic 1. economic growth 2. international competition 3. consumers' expenditure 4. wage trends 5. political system 6. general government policy 7. EU integration				
technological 1. IT paradigm 2. technological development 3. internal IT use of businesses 4. external IT use of businesses 5. IT use of consumer 6. technology and IT policy government 7. branch policy on IT				
legislation and public affairs 1. legislation in general 2. shop hours and establishment acts 3. legislation on working conditions and environment management 4. tax system 5. payment system				
Industry-specific 1. degree of branch overlapping 2. market structure en innovation 3. size of companies in an industry 4. increase in number of enterprises 5. products and services 6. process innovation				

Table a9: Overview of possible relevant scenario drivers

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