



NORTH-HOLLAND

Information Technology and Innovation in Small and Medium-Sized Enterprises

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ABSTRACT

This article is based on a recent report from the Dutch Council for Small and Medium-Sized Enterprises (SMEs), in which the possible application of information technology in small enterprises is studied. We start with a study of the relationship between information technology and innovation in SMEs. Next, an innovation model is developed and applied to a typical branch of industry in this respect (i.e., the car disassembly sector). Two analytic methods are used: the techno-economic scenario analysis and the actor-oriented social construction of technology (SCOT) method. Finally, a number of general conclusions are drawn, of which the need for cooperation and networking is foremost. We close with some policy recommendations. © 1998 Elsevier Science Inc.

1. Introduction

The application of information technology (IT) is an important driving force behind many socioeconomic changes. In trade and industry, the application of IT stimulates innovation in all possible fields. Companies can thus offer their customers a faster, more individual and reliable product or service on a more regular basis. Often the entire internal labor and organizational structure of a company has to be transformed into a flatter and more flexible organization in order to realize such innovations. This leads to new forms of labor such as teleworking and freelance work, and new forms of independent work. The changes in the external organization of a company are also very significant in many cases. The structure of entire chains of activities are changed in such a way that all attention is focused on the customer. In some extreme cases there may even be a total reversal of chains. Parties in the chain may get other functions (e.g., wholesalers) and develop other closer relationships, often in the form of cooperative networks. Particularly because of these changes in the chains, many small and medium-sized enterprises (SMEs) cannot evade the innovative developments resulting from the

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application of IT. The different speeds with which various chains actually implement IT are not so much the result of potential differences in the application of IT, but have far more to do with the different forms of pressure in terms of international competition and environmental regulations. This is one of the findings of the research we conducted by order of the Dutch Council for Small and Medium-Sized Enterprises [1]. These findings are in line with the results of two earlier studies conducted on behalf of this Council concerning the application of IT [2,3], which are described in Stroeken and Coumans [4]. We also found that the average entrepreneur has insufficient strategic insight into the possibilities of IT in product and process innovation and the way in which certain aspects need to be implemented. This article is based on the most recent RMK report and aims to incorporate the opportunities offered by and problems involved with the application of IT in SMEs in an innovation model. This model is discussed in Section 3 and its application in the car disassembly industry in Section 4. Finally, a number of general conclusions drawn. We begin, however, with a further analysis of the relationship between IT and innovation.

2. IT and Innovation

STANDARDIZATION, SPECIALIZATION, AND DIFFERENTIATION

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 standardization of products and processes. This may lead to an increase in scale and mechanization. Moreover, standardization 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 specialization. Differentiation allows a producer to get a higher added value than his competitor by offering a specific, high quality product, which the consumer is willing to pay for. Specialization is an important part of this strategy. By increased standardization, followed by differentiation and specialization, companies can enhance their profiles in an ongoing phase of technological development.

A fine example of such a technological innovation process can be found in the banking business in the Netherlands, particularly with respect to the flow of payments [5]. Banks have standardized their internal organization with the use of direct debit, giro collection forms, standing orders, and collective lists of giro transfers. To facilitate the transfers between banks, the National Payment System is being introduced. Once this system is fully operational, each bank will process every transfer, collection, etc., in the same way and with the same speed. Furthermore, all cash dispensers will in principle be available for general use. This ongoing standardization in the flow of payments enables the banks to focus their attention elsewhere and to specialize in other fields. The cost saving as a result of standardization provides an extra stimulus. The banks have now completed several phases of standardization. In specialization and differentiation, banks are focusing on the integration of modes of payment and shopping, and of the logistics of finance, goods, and services in and between companies and branches of industry. Thanks to point-of-sale terminals and the chip card, the integration of modes of payment and shopping is well underway in the retail trade. This process still has to be implemented in a number of other sectors in the consumer market, for example, in health care and parts of the hotel and catering industry. In transport and social security, the first steps toward financial and logistic integration have already been taken. Banks, however, do not yet feel the need to standardize this integrated form of

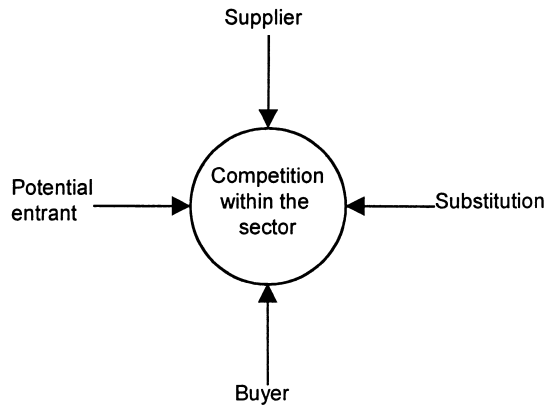


Fig. 1. Competition-determining factors at the meso-level.

service. Customers should not be able to move over to the competitor too easily. In other words, differentiation and specialization in banking is mainly focused on this aspect.

INTEGRATION

The standardization and differentiation/specialization necessary for innovation can only be established through an increasing integration within companies or branches of industry. IT can play an important role in this. With this in mind, Porter [6] highlights the question of how enterprises can gain a competitive advantage. Enterprises need to have a thorough understanding of the sector in which they operate and the ability to analyze the five factors that determine competition in and around the sector:

1. Potential entrants to the sector.
2. Substitution possibilities in allied industries.
3. Suppliers.
4. Buyers
5. Competition within the sector.

Figure 1 reveals the influence of these five factors.

VERTICAL RELATIONSHIPS

Suppliers and buyers are characterized by a vertical relationship. 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.

Supply and Outsourcing Networks

Cooperation with larger companies within supply and outsourcing networks is becoming increasingly important for the innovation process in SMEs. Thus, the larger companies make fixed and reliable agreements about supplies with smaller companies, usually, 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 do processing

on the basis of detailed instructions provided by the contracting firm. This involves contracting out work that has to be carried out (contracting out of capacity).

Strong vertical relationships exist when there are close cooperative relationships between contracting firms and so-called “co-makers.” This depends on the establishment of long-term relationships with a limited number of suppliers on the basis of mutual trust.

The Relationship with 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 services to the buyer and provides the company in question with information about the behavior, needs, and characteristics of the buyer. This facilitates direct marketing and new ways of distributing and selling. More time has to be spent on drawing and retaining the attention of the public. For example, product differentiation can be increased if a company can improve the way in which it caters to the needs of individual customers. The implementation of IT strengthens the position of the consumer considerably. New services are offered such as those on the Internet, which, for example, can search for outlets that sell a certain CD at the lowest price for the customer. 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.

EDI and PDI

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.

HORIZONTAL RELATIONSHIPS

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 largely determines the competition within a sector. Entrepreneurs can raise the access thresholds by using technology and product development to create a situation in which consumers will set higher standards with respect to the quality of a product. 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 favorable market situations and force up the prices. IT 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.

The banks in the Netherlands have mainly opted for horizontal integration. In the 1960s, 1970s, and first half of the 1980s, this integration led to many small banks being consolidated into five large banking institutions: the NMB, RABO, ABN, AMRO, and Postbank. This first wave of mergers was particularly characterized by a national orientation. “Standardization” and “scaling up” were the main mottos. At the end of the 1980s there was a second wave of mergers, which apparently lost most of its momentum by the beginning of the 1990s. This second wave of mergers was mainly internation-

ally oriented and in the current three large banking groups: ABN/AMRO, RABO, and ING/Postbank. The abolition of the European borders has also led to a scaling-up process in the banking business, if only to cater to the internationalizing business community. In this phase the insurance companies also became involved in the cooperation, as there was increasing communality in the processing of information as a core activity.

Vertical differentiation in the form of a relationship between suppliers and producers has never actually been realized in the banking sector. Perhaps because of the nature of the product “money,” the entire production process always took place within one and the same group, from local collection, through processing in regional processor centers, to central processing. Supply relationships in the sense of co-makerships do not really exist as such in the banking world. Eventually, vertical integration in the banking sector particularly affected the regional level, which disappeared as a result of improved automation. Furthermore, the efficiency at the local level was greatly improved, not in the least because of the introduction of cash dispensers and point-of-sale terminals.

Collectivity versus Individuality

Another important aspect of the implementation of IT in various branches of industry is the collective element. In the previous section we have shown that the most important change for the SMEs within the context of innovation is best described as a greater need for cooperation and integration. Cooperation plays an important role in the innovation process. This role may, for example, concern the improvement of information exchange, agreement on standards, or cooperation in R&D. Cooperation is of course possible in many ways. It may involve formal cooperation, but also more informal types of cooperation (informal networks). The policy on technology of the Dutch Ministry of Economic Affairs therefore also focuses on cooperative networks, and rightly so. Important actors in said cooperative networks—apart from the companies themselves—are organizations that are part of the intermediary knowledge infrastructure. By these we mean suppliers of knowledge, on the one hand, such as universities, colleges of higher professional education, and large technical institutes, and, on the other hand, intermediaries such as trade organizations, innovation centers, industrial technology centers, institutes for small and medium-sized enterprises, and private consultants.

Cooperation is also important in realizing certain scale effects in IT. The effectiveness of a particular IT application in a branch of industry often depends on the internal IT applications of various actors in that branch (infrastructure). For example, an electronic market will only function properly if there is a large number of suppliers and potential buyers who all use a compatible system. Whether an actor will decide to invest in a certain IT application largely depends on his subjective value judgment in this matter. Certain actors may, for example, regard the creation of an electronic market as a means to achieve cost saving, whereas others may look upon it as something that will erode certain functions in the future. Each actor will analyze an IT application from his or her own position. Actors can value an IT application using different factors. Here are some examples:

- Changes in the economic position,
- Changes in the position of power,

- Changes in sales and purchasing channels, and
- Changes in job descriptions,

Whether an IT application is actually implemented, and in what form and at what speed, is largely determined by the social sphere of influence affecting the innovation in question. This social sphere of influence is in turn determined by the positions of power of the various actors at that time as well as the actors' subjective valuation of a new IT application. As each actor regards and tries to influence an IT application from his or her own position, it is important to have an overview of the possible forms in which the IT application may be most effective for a branch of industry. Policy makers (trade organizations, government, innovation centers, etc.) therefore have an important task in steering the IT application in the direction that is the most desirable socially. The basis for this is provided by mapping out the social sphere of influence affecting an IT application. This reveals in what direction the IT application will develop and how policy makers will have to adjust their intervention instruments. The sequence that has been implicitly discussed here (description of the IT application, description of the social sphere of influence, the roles of actors, and the role of the government) is also discussed in Section 3 in connection with the industrial innovation model. In Section 4, this model is applied to the car disassembly industry to analyze what the possibilities are for introducing an order system for used parts and what role the government eventually has to play to stimulate an innovation that is socially desirable.

3. Industrial Innovation Model

INTRODUCTION

The purpose of the industrial innovation model (Figure 2) is to give an indication of how the government should use its instruments to stimulate socially desirable innovation in a branch of industry (step 5). A scenario describing how an IT application will improve the functions in a branch of industry will form the basis for this (step 2). The added value of an IT application differs per branch of industry. This depends on the information exchange within the branch of industry, the opportunities for automation in a company, as well as on the extent to which a social basis is present for a potential IT application. Step 1 therefore is to give a description of the branch of industry. As IT applications in a branch of industry practically always lead to shifts in power and functions, the expected responses to the potential IT application of the various relevant actors are very important in this respect. These responses are described in step 3. To be able to describe these responses adequately, it is necessary to put oneself in the position of the actors and discuss the social sphere of influence affecting the innovation. For this purpose, the social construction of technology (SCOT)-approach is used. What role the various actors should play to implement an IT application successfully in a branch of industry is described in step 4. The difference between the actors' responses to the new IT application in their branch of industry, and the role desired of the actors will eventually form the basis for the role desired of the government.

Why the scenario method is used as a forecasting method to describe how a potential IT application will change the functions in a branch of industry is explained in Section. The SCOT approach as well as its main variant, (i.e., the SST approach) is described in this section (see SOCIAL SHAPING OF TECHNOLOGY and SOCIAL CONSTRUCTION OF TECHNOLOGY [SCOT]).

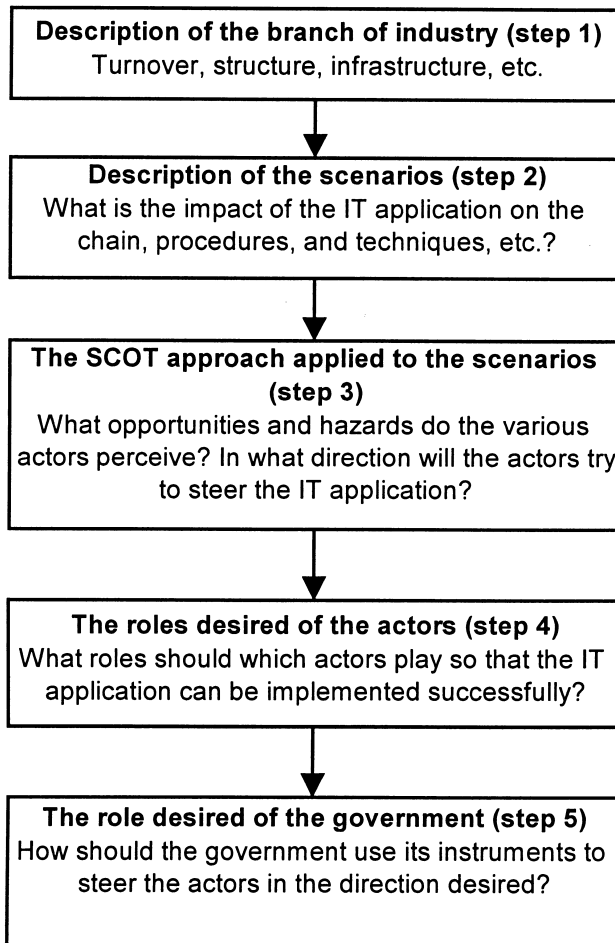


Fig. 2. Industrial innovation model.

SCENARIO ANALYSIS

There are a lot of forecasting methods to predict the future consequences of the implementation of new technology (e.g., see [7]) Most of the methods involve extrapolation of state-of-the-art developments. Here, we have reason to believe a scenario method based on substantial changes is the most suitable. The acceleration of numerous social, economic, technological, and cultural developments implies that knowledge about the way in which our society functions is becoming outdated at an increasing rate: the “half-life” of knowledge is decreasing [8]. It seems as if past developments are losing value in the forecasting of future events. However, this is only true as far as knowledge about past situations is concerned. Apparently, it is becoming more and more risky to extrapolate future trends from past developments. The average unemployment level from the past 5 years no longer says much about the unemployment percentage expected for next year. This means that the classic time-series analyses aimed at identifying trends are becoming less significant in the social and economic sciences. The developments in IT in particular take place very rapidly. It therefore is useless to

extrapolate the future development of IT in a branch of industry from past trends. That is why the scenario method is more suitable in this respect.

The scenario method does not involve extrapolation from past trends, but takes the more fundamental changes into account [9–11]. It provides the outlines of “different worlds” on which policy makers can exert very little influence. Using various scenarios instead of just one prognosis prevents policy makers from getting a false sense of security about future developments. These scenarios provide insight into possible developments, potential bottlenecks, and the corresponding insecurity margins. In this way policy makers are encouraged to contemplate various strategic policy options that may lead to different results in different worlds.

In our context, there are two types of scenario methods: the projective method and the prospective method. Unlike the projective scenarios, the prospective ones focus on an open future, involving an almost constant assessment of how the trends will change and what new trends will emerge. They are based on an active approach to the future, using creative imagination, inventiveness, and an orientation toward the “coming” changes. The projective scenarios, on the other hand, are based on hypothetical sequences of events. They describe how the current situation may develop into a future situation step by step. In the prospective scenarios, the starting point is the final situation; in the projective ones, it is the initial situation.

Projective scenarios aim at extending a sequence of possible events into the future. This shows that the entrepreneurial environment is relevant within a broad context. Not only certain technological developments, but also possible strategic courses that enterprises might follow are taken into account. In addition, it is necessary to examine to what extent the objectives of the enterprises are valid in the new environmental situation and how they can be adjusted. The actors’ responses to the new situation in a branch of industry therefore largely determine the probability of the scenario in question. In this article, the SCOT approach is used to map out these responses as well as the social sphere of influence. As the current and future spheres of influence receive more attention in the projective scenarios than in the prospective ones, we have opted to use the former.

SOCIAL SHAPING OF TECHNOLOGY

In the 1980s, criticism of the technological deterministic view [12] led to a number of studies on the social shaping of technology (SST). Technology was no longer seen as a predestined logical and technological path. It was seen as something that can be steered and monitored. Innovation can be understood as an evolution of options. In each period in the development and implementation of technology one is confronted with various technical options. The options selected depend on “social” and “technical” factors. These choices form the content of an “artefact” and determine the direction or path of an innovation. Innovation leads to many new possibilities in terms of technology, each having different implications for society and/or certain groups. Technological development is therefore the outcome of the interaction between social and technical elements. The development of industrial technologies is characterized by dual dynamics. On the one hand, there are processes that lead to stabilisation and standardization of technical artefacts. On the other, there is a dynamic process with constantly changing customer demands and technological options, leading to new possibilities in application and undermining existing solutions. A term that gets much attention in this theory is “innofusion” (i.e., the extent to which IT is focused on company-specific needs and systems, and the way in which IT is embedded in existing organizations and infrastruc-

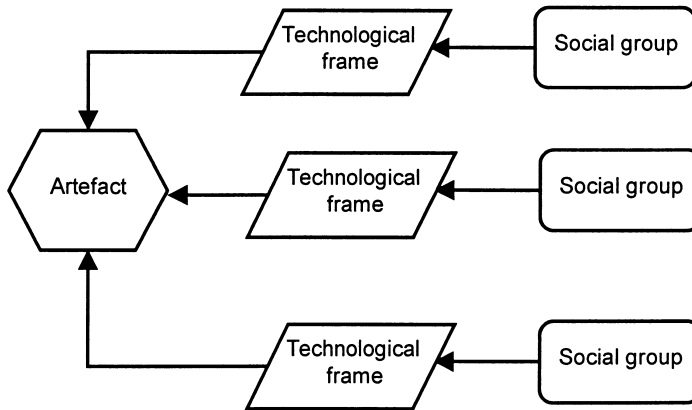


Fig. 3. Subjective assessment of an artefact.

tures). Giving feedback about users' wishes (IT demand) to the supply side (IT suppliers) is an important aspect of the innovation process.

The SST perspective offers policy makers a broad view on possible technological options and the possible social consequences, opportunities, and hazards involved. Constructive technological assessment is a fine example of SST, in which various technological routes are highlighted beforehand and possible social consequences can be indicated.

SOCIAL CONSTRUCTION OF TECHNOLOGY (SCOT)

In the SCOT approach, technical equipment or processes, (i.e., technical artefacts) are considered to be social constructions [13]. Social constructions consist of nothing more than the meaning attributed to them by relevant social groups. The technological frame that colors the views of a social group determines this meaning (see Figure 3). This frame consists of the prevailing standards and values in a social group, such as solution strategies, skills, utilization practices, and goals. The meanings that a "social group" attributes to an artefact constitute that same artefact: they determine what is and what is not problematic and whether there is a solution to a problem, and if so, to what extent. The artefact does not exist outside the interactions of relevant social groups attributing meanings to it. This is where the term "flexibility of meaning" comes in [14]. Attributions of meaning encompass much more than just the difference in interpretations.

Factors in the development of an artefact, such as scientific facts, technical knowledge, theories, social interests or economic power, are constructed and analyzed socially by the social group. Thus, the distinctions between, for example, technical, cognitive, and social factors disappear. This does not mean that technical development in the SCOT approach is described by emphasising "social factors" at the cost of other factors. It does mean that the the technical content is described looking through the eyes of the actors. In other words, social groups determine whether or not they see a piece of technology as a problem or solution.

Stabilization of a technical artefact will in general be accompanied by a gradual reduction of the number of problems that various social groups associate with that artefact. It is not necessary to solve a problem in the usual sense of the word to make it disappear. What counts is whether or not the relevant social group attributes meaning

to a problem. A stabilization mechanism includes a certain recognizable pattern of events with which an apparent problem is solved (or not), usually resulting in an increasing stabilization of the artefact in question within a certain social group. Advertising and public information campaigns can play an important role in the stabilization of a technical artefact.

ANOTHER CLOSE LOOK AT SCOT AND SST

In the SCOT approach, technology is seen to be nothing more than the various attributions of meaning by various social groups. In contrast to the SST theory, the SCOT approach does not explicitly take technological possibilities into account. Technological possibilities do, however, influence the opinion that social groups have concerning artefacts. If there are, for example, technological possibilities to recycle a certain material, this will influence the prevailing view on recycling.

The SST theory on the other hand is based on the assumption that, depending on “social” and “technical” factors, choices will be made, be it consciously or not. According to the SCOT approach, however, these choices cannot be made objectively, as “technical” factors have different meanings for various “social” groups.

As we want to know the probability of the scenarios, we have opted for the SCOT approach. We want to know how various actors look upon the two scenarios. The SST approach is based on the assumption that choices can be made. We have selected two scenarios for the car disassembly industry as examples (i.e., for two possible configurations of an order system).

4. The Industrial Innovation Model Applied to the Car Disassembly Industry

DESCRIPTION OF THE BRANCH OF INDUSTRY (STEP 1)

Turnover of the Branch of Industry

Each year, approximately 400,000 scrap cars are processed by the Dutch car disassembly industry, in which about 400 companies are active. This branch of industry employs at least 1500 people and has a total turnover of about NLG 250 million.

Current Structure of the Branch of Industry

Figure 4 illustrates the current order situation in the car disassembly industry.

Car disassembly firms are becoming more and more professional in terms of business management. This mainly is the result of tighter environmental measures and licensing regulations and the related increase in scale. It is becoming increasingly important for car disassembly firms to be able to offer a good product. This requires an adequate stock system for stock control. Investing in a stock system is also becoming more interesting as software and hardware have become cheaper and easier to use. The next step toward increasing the sales of used parts consists of setting up an electronic order system, which will provide potential buyers with the necessary information about the used parts offered. In this way dealers, private individuals, and garage owners can directly check the stock of the car disassembly firms and order what they need. This electronic order system is based on the various stock systems of the car disassembly firms.

A future order system should be able to compete with the current purchase channels for used parts. Dealers and garage owners can order used parts through the following purchase channels. (Dealers use relatively more new original parts.)

- The dealer. All available parts can be ordered from the official dealer. Orders can also be placed electronically via the so-called RDC network. This is the EDI system of the car importers where dealers can order new parts and cars.

Current structure of the branch of industry

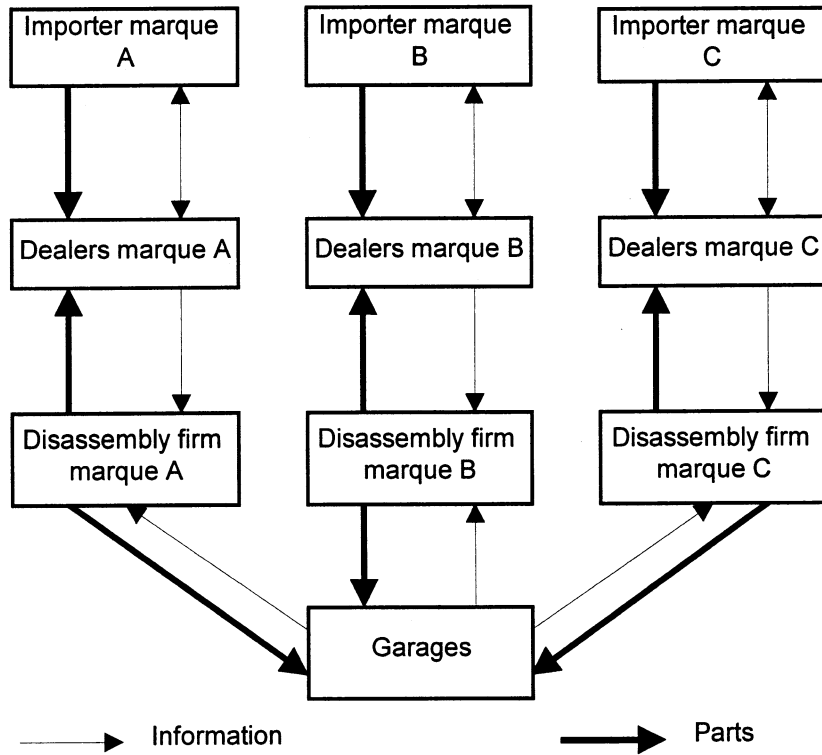


Fig. 4. Current order situation in the car disassembly industry (for the sake of simplicity, we have assumed that the dealers and disassembly firms sell or process only one marque of car).

- The wholesale trade. Most of the original parts can be ordered from one wholesale dealer. Orders can be placed in person or by fax, telephone, or EDI.
- The wholesale trade in imitation parts. These parts are of lesser quality and cheaper. These wholesale dealers have imitation parts of various marques.
- Car disassembly/demolition firms. Parts can also be ordered via the Stiba Parts Service (SOS). SOS is a computer system that enables one to search for used parts throughout the Netherlands. Via a terminal that links the car companies with the RDC, orders for parts can be placed with the associated car disassembly firms. The car disassembly firm will check whether the requested parts are available from stock and will contact the garage in question by telephone.

Current IT Systems in the Car Disassembly Industry

ARISCO. Arisco is an information system enabling insurance companies to estimate damages. Arisco keeps a record of its own item numbers, which are linked to the manufacturer's item numbers. The parts are selected with the use of a hand-held reader and the damage is subsequently calculated on the basis of new parts. The specifications of the car in question such as its year of construction, speedometer reading, and version, etc., are taken into account to calculate its current value. If the estimated damage is

higher than the car's current value, the car is declared a total loss and will have to be disassembled.

RDC. Dealers, disassembly firms, and garage owners can cancel the obligatory periodic motor vehicle test for old vehicles via the RDC, which is connected with the RDW, the government body for vehicle registration in the Netherlands. Dealers can order parts and cars from the importer via this same system. The RDW keeps records of license numbers, car types, versions, colors, speedometer readings, etc. If a customer suspects that a dealer has tampered with the speedometer of a car, this can be checked with the RDW.

SCENARIOS (STEP 2)

Scenario I: Car Disassembly Firms and Importer Jointly Develop A Marque-Dependent Order System for Used Parts

Together with the importer, the car disassembly firms set up an order system, based on the existing RDC network by means of which dealers already order new parts and cars. In the future, dealers will also be able to order used parts via the existing order system. Stock and order systems will be developed per marque, which may cause some difficulties when linking them with each other. Car disassembly firms processing multiple marques will have to establish multiple links with the importers' order systems for used parts. Garage owners will then be able to order parts in various ways. If, due to various conversion programs, the electronic order system for used parts should become rather expensive, the garage owners may of course become less enthusiastic about the whole idea. Figure 5 illustrates a marque-dependent order system.

The importer may choose to hive off part of his stocking tasks and after-sales service to one or more car disassembly firms. Mercedes has already taken the first step in this direction. The car disassembly firm of Mark van de Brand will take over the control of Mercedes' overstock (new parts of a few years old). The overstock will be transferred to Mark van de Brand's firm and will be fed into his stock system. For dealers, such a stock transfer may be quite transparent. It will give a dealer the possibility to order used parts, overstock or new parts via one single order system.

Scenario II: One Marque-Independent Order System for Used Parts

The various stock systems of the car disassembly firms are integrated into one marque-independent order system for used parts. The order system and the RDC system remains separate, except if each importer decides to develop a conversion program to link them. Thus, a dealer, garage owner, or private individual can search for and order specific parts in a fast and reliable way. Figure 6 illustrates a marque-independent order system.

SCOT APPROACH APPLIED TO SCENARIOS (STEP 3)

The SCOT approach is now used to assign a certain probability to the scenarios or to indicate which actors adopt a positive or negative attitude toward the initial situation described. This means that we will outline the social spheres of influence affecting the scenarios (see Figure 7). The opinion of each relevant actor will also be indicated.

Innovation Centers

Innovation centers were established to stimulate innovations in SMEs. They will also stimulate the IT application involved.

Chain structure of scenario I

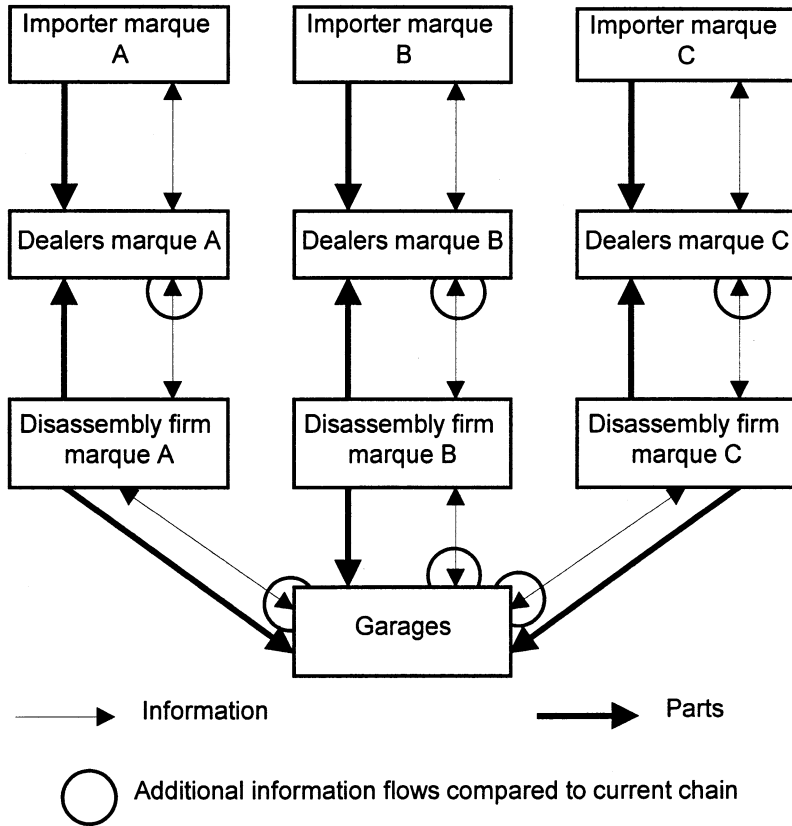


Fig. 5. A marque-dependent order system for the car disassembly industry.

Government

The government encourages the manufacture of durable products. The initiative to stimulate the use of used parts will certainly be supported.

Car Manufacturer Mercedes

The importer of Mercedes will hive off part of his stocking tasks and after-sales service to a car disassembly firm that will take over the control of Mercedes' overstock. Mercedes will make its item codes available for this purpose.

Other Manufacturers/Importers

Through advertising and other activities, manufacturers/importers like to project an environmentally friendly image. However, they usually do not go any further than that, as it is not really in their interest to stimulate the trade in used parts. Such would after all have a negative effect on the sales of new parts. Importers/manufacturers will only promote IT applications beneficial to them. They have a great influence on the way dealers operate and, consequently, on the car industry as a whole. The innovative power of the industry is largely determined by the manufacturers/importers. Stock systems are based on item codes, but these are unfortunately not made available by the manufacturers/importers.

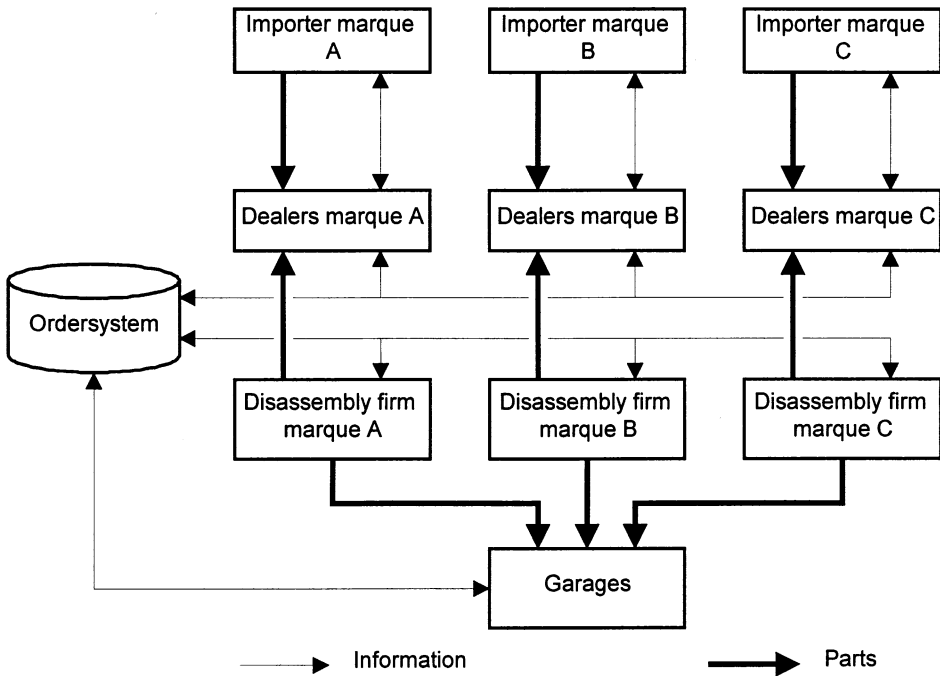
Chain structure of scenario II

Fig. 6. A marque-independent order system for the car disassembly industry.

STIBA

STIBA is an organization that represents car disassembly firms. The introduction of new stock and order systems will lead to an increase in the sales of used parts. STIBA will therefore promote this IT application among its members.

BOVAG

BOVAG is an organization that represents the independent garages. If the new order system should be introduced on the market, BOVAG will promote it among its members. As long as this order system is not yet available, BOVAG will only play a passive role.

Suppliers of Software and Hardware

These will only profit from a new order system.

Insurance Companies

A new order system will only lead to an increase in the use of used parts. Insurance companies can take advantage of this new development by introducing a "second-hand" insurance policy. The prices involved may lie somewhere between those of bodywork insurance and third-party insurance. If a car should then become too old for bodywork insurance, in which case one normally would switch over to the cheaper third-party insurance, it will nevertheless remain fully insured at a cheap price, because it has been repaired with used parts.

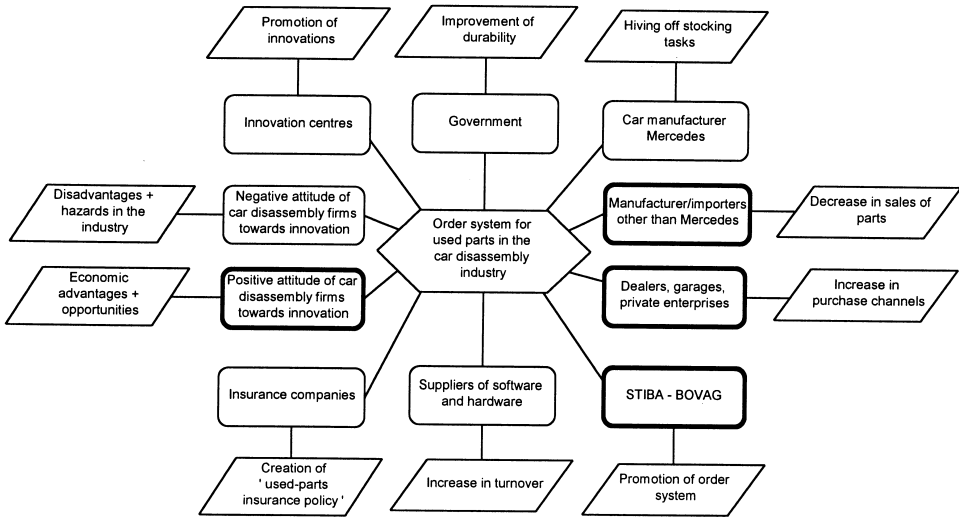


Fig. 7. Subjective assessment of an order system for the car disassembly industry (actors in bold-faced boxes are important).

Car Disassembly Firms

Stock systems are based on item codes, but these are unfortunately not made available by the manufacturers/importers. In addition, some marques change their item codes regularly. The same part may therefore have different item numbers. Also, certain parts may have been fitted into multiple types of car and products (e.g., a dashboard) may consist of several parts. This makes automation of stock control more troublesome. The car disassembly firms are merely interested in the short-term profits they can make through automation. The fact that, in the long term, the various stock systems may be linked to form one single-order system is something they do not really take into account in their investment policies. Standardization and a compatible database structure, both essential for integrating the stock systems into one order system, thus are pushed into the background.

A central order system requires that the car disassembly firms have their stock available on-line. Unfortunately, only very few car disassembly firms have a stock system. Furthermore, they are not familiar with the corresponding organizational, technical, and social changes related to stock control. For example, using a stock system also means that all activities have to be registered. Additional staff will probably have to be employed to set up the system.

The large car disassembly firms, employing several people in the accounts department, will look more favorably on the automation of stock control and a new order system than the small ones. An electronic order system makes the supply of used parts more transparent. Some car disassembly firms see this as a threat, particularly if customers have direct access to information about the prices involved. Car disassembly firms that generally ask a lower price for parts (usually the larger firms), will therefore look more favorably on the new order system.

EVALUATION OF SCENARIOS I AND II USING THE SCOT METHOD

It remains to be seen whether the scenario that is socially most desirable (scenario II: a marque-independent order system) will actually be realized in the car disassembly

industry. If the manufacturers/importers experience a central order system for used parts too much as a threat, because it will lead to a decrease in sales of new parts, they may, together with the car disassembly firms, set up such a system for their dealers themselves (scenario I). This may seem paradoxical, but by developing and managing their own order system the manufacturers can steer it in the direction that is most desirable to them. The more manufacturers set up their own order system in close cooperation with a car disassembly firm, the less interesting it becomes for the remaining car disassembly firms to integrate their stock systems into one central order system. If separate order systems are created for each marque, which can hardly, if at all, be integrated into one central order system, it will not be interesting for the other sales outlets (e.g., marque-independent garages, private enterprises) to invest in an electronic order system. After all, this means that they would have to invest per marque in a marque-dependent order system. From a social perspective, this is a less desirable development. Mercedes has already begun to create a marque-dependent order system (scenario I) and will hive off part of its stocking tasks and after-sales service to a car disassembly firm that will take over the control of its overstock.

Which scenario will be realized depends on which party will be the most powerful in this industry, but also on which order system is developed first and eventually sets a standard. The manufacturers are powerful actors and they can be expected to develop the most important initiatives. These initiatives will probably lead to the introduction of a marque-dependent order system. The industrial associations and the government are not yet powerful enough to steer all actors in a direction that society as a whole will eventually find most desirable.

The actors' opinions about an order system for used parts are in both scenarios more or less the same. In both scenarios the manufacturers fear a decrease in the sales of new parts. In scenario I, this fear leads to the creation of their "own" marque-dependent order system. In both scenarios, garage owners and private individuals will see an increase in the number of purchase channels, but they will of course look more favorably on one single marque-independent order system (scenario II).

THE ROLE DESIRED OF THE ACTORS (STEP 4)

STIBA

STIBA should supply its members with the necessary information. This should include the following points:

- What are the organizational consequences of stock and order systems (e.g., necessary training courses, additional personnel, and new mode of operation)?
- What size should a company have for a stock and order system to be profitable?
- Selection of suppliers. Which supplier offers which system and for what price? What are the pros and cons of each system?
- Should the order system be linked to a website on the Internet so that private individuals and/or companies can order parts there and check what is available from stock?
- What modules and/or functions should be incorporated into a stock program? Should it be possible to extend the system with a link to the accounts department or with a scanner, enabling a fast selection of parts?

Standardization of the item codes is the first essential step toward automation. By using a similar database structure, it will be much easier to integrate the stock systems into one order system in the future. Some marques change their item numbers regularly.

The same part may therefore have different item numbers. Also, certain parts may have been fitted into multiple types of car and a product (e.g., a dashboard) may consist of several parts.

Knowledge about the consequences that a stock system may have for an organization may be found in the intermediary knowledge infrastructure. STIBA should also play an intermediary role between the different actors in the industry to realize a marque-independent order system.

Insurance Companies

Insurance companies influence the use of second-hand parts to a considerable extent. The demand for used parts will strongly increase if the insurance companies introduce a so-called "second-hand" insurance policy for cars repaired with used parts. The prices involved would lie somewhere between those of bodywork insurance and third-party insurance. If a car then becomes too old for bodywork insurance, and one normally would switch to the cheaper third-party insurance, it nevertheless remains fully insured at a cheap price.

Arisco is an information system enabling insurance companies to estimate damages. Arisco keeps a record of its own item numbers, which are linked to the manufacturer's item numbers. Parts are selected with the use of a hand-held reader and the damage is subsequently calculated on the basis of new parts. If this system is linked to the order system for used parts, calculations may be made on the basis of used parts. A "second-hand" insurance policy would require such a system. Conversely, an order system for used parts requires a stimulus in the form of such a "second-hand" insurance policy. Apparently, this is a chicken-and-egg problem.

Manufacturers/Importers

Manufacturers/importers play an important role in the implementation of IT in the car disassembly industry. They largely determine the policies that the dealers pursue. They often demand that showrooms and garages meet certain standards and provide most of the software that the dealers are using. They also play an important role in establishing procedures for the best preservation and testing of parts, and in the provision of testing equipment.

Stock systems are based on item codes, but the latter are not made available by the manufacturers/importers (Mercedes excluded). They will have to make these item codes available on a broad scale and will have to cooperate to promote automation and, ultimately, the sales of used parts.

THE ROLE DESIRED OF THE GOVERNMENT (STEP 5)

The government of the Netherlands is already very active in promoting the reuse of products. It has, for example, introduced a "removal contribution" of NLG 250, which is paid when a car is disassembled in an environmentally friendly way. This contribution is imposed on consumers who buy a new car. To stimulate the reuse of products even further, the car disassembly firms might be encouraged to set up a stock system. The government might also exert some pressure on manufacturers/importers to stimulate the reuse of products or on the insurance companies to make them adapt their policies so that eventually a larger reuse of products will be realized. For example, it might demand of manufacturers/importers that they participate in the recycling of used products and realize a certain percentage. Consequently, this may automatically lead to a situation in which they have to collaborate intensively with car disassembly

firms. Furthermore, it might be examined whether STIBA has sufficient capacity to execute its tasks (promotion, providing information, setting up database structures, etc.).

5. Conclusion

We have studied the relationship between information technology and innovation in SMEs. An innovation model was developed and applied to a typical branch of industry in this respect, (i.e., the car disassembly sector). Two analytic methods were used: the techno-economic scenario analysis and the actor-oriented SCOT method. The innovation expected to take place in the car disassembly sector in the future as a result of the application of IT can be described with the use of the concepts mentioned at the beginning of this article, (i.e., standardization, specialization, differentiation, and vertical and horizontal integration). In car disassembly, standardization is mainly based on item coding in combination with the implementation of stock and order systems. In this respect, scenario II (marque-independent) obviously goes much further than scenario I (marque-dependent). Specialization via disassemblers may subsequently involve the processing of specific parts or parts that currently cannot be processed profitably. In this, differentiation will depend on the specific wishes of the customers. All this can only be realized by harmonizing all activities in the chain from manufacturer to dealer, (i.e., via vertical integration). The car disassembly firms themselves may increase their capacity by referring to each other's stocks or by developing and utilizing IT systems in large companies or networks (i.e., via horizontal integration). In this respect, scenario II also offers the most advantages in terms of scale. However, it remains to be seen whether such a scenario will actually be realized. This will mainly depend on the power that the government and trade associations will be able to bring into play.

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Received 10 February 1998; accepted 17 June 1998