Variety in Distribution Networks: A Transvection Analysis

Kajsa Hulthén
Department of Industrial Marketing
Chalmers University of Technology

Abstract

In recent years, the debate concerning changes taking place in distribution structures has been intense in both academia and in practice. One main standpoint is that distribution is subject to considerable reorganisation. Furthermore, some observers point to an increasing degree of variety in the distribution 'reality', both in how production and distribution structures are organised and in end-user needs.

In this thesis, the overarching phenomenon dealt with is *variety in distribution*. The theoretical framework is based on two main sources of inspiration. First, the Industrial Network Approach (e.g. Håkansson, 1987), highlighting the interdependencies between actors, activities, and resources in industrial systems, is applied. Second, as a means to deal with interdependence in distribution networks, the transvection concept (Alderson, 1965), based on two main types of activities, transformations and sortings, is used to describe and analyse the 'entire process' from raw material to the delivery of the end-product to a specific end-user. Combined, they provide a framework for analysing variety in distribution, where distribution networks are conceptualised as 'sets of crossing transvections'.

To explore variety in distribution networks, the framework is applied on distribution of PCs. Variety is analysed by identifying and analysing a number of transvections, and how they are interconnected. The analysis focuses on how objects, starting as raw material and ending up as an end-product, are changing in different dimensions as they are sorted and transformed.

The thesis concludes that the key to understanding variety in distribution networks is sorting. Sorting directs objects to different resources and actors and is therefore essential for how variety in the objects' features is created. Sorting by a mix of postponement and speculation strategies allows efficient resource utilisation to be obtained at the same time as end-user needs can be taken into consideration.

The study indicates that the focus in mainstream distribution literature on 'channels' only captures a limited part of the inherent complexity, owing to interdependence, in distribution structures. The transvection is brought forward as an analytical concept, taking into consideration both the producer and the user side in distribution networks, and their different kinds of logic. Furthermore, the thesis suggests that a network perspective brings about a more profound understanding of variety in distribution compared to a 'channel' perspective.

Keywords: distribution, marketing channels, network, sorting, transformation, transvection, variety

Preface

Just like the transvection being fulfilled, ending with the end-product in the hands of the end-user, my very own transvection is now fulfilled, resulting in this dissertation, in the hands of the reader. The fulfillment of a transvection requires resources. In this transvection an immense amount of resources has been used, of which only a very limited part have been my own.

The two unquestionably most important resources for the fulfillment of this transvection are Lars-Erik Gadde and Anna Dubois. Together they provided the foremost important intellectual resources by letting me share their comprehensive knowledge in different, but complementing, areas. Sorting has perhaps been the main activity from their part, helping me to direct and re-direct the study, by patiently reading and commenting on an uncountable amount of drafts, always with an unbelievable enthusiasm. Not only have they been the major sources of 'intellectual inspiration', they have also been the source of laughter, even at times when I have been so confused that crying would probably have been the first choice in any other research environment. Anna and Lars-Erik: thank you for taking me on, thank you for being my colleagues, thank you for supporting me through this process, and thank you for making me not wanting to leave the department. Thanks!

Lars-Gunnar Mattsson, at the Stockholm School of Economics, has also been incredibly valuable, letting me share his extensive knowledge about distribution. The interest and support you have shown by reading and discussing my drafts really challenged my thinking during the last year. The 'salt-transvections' will not be forgotten. Lars-Gunnar is also the only one I know that actually met Wroe Alderson, the man that provided the main theoretical inspiration by coining the transvection concept in 1958, and to whom I naturally also am very grateful.

The colleagues at the department have played a crucial role in this process, always eager to discuss research: at seminars, at lunch, at conferences, in the corridor, you name it! Lennart Bångens: thank you for introducing me to the department and for being a good friend, not to mention giving me tennis lessons. Jens Laage-Hellman: what happened to that tailor-made-insulation-project? It is now time to take it up again. Daniel Hjelmgren: thank you for creating even more 'strange and complex' figures and for many good comments on seminars. Frida Wennerström: thank you for being interested and cheerful. Fredrik: it is not many people that share our odd interest in transvections so – let's keep together. Viktoria Sundquist and Stefan Karlsson: I am really looking forward to working more with both of you. Last but not

least, thank you Yvonne for always being very helpful, even when I come rushing in the last minute.

Peter Fredriksson and Fredrik von Corswant at our 'neighbor department' have been invaluable during the last six months, sharing the anxiety related to finishing a dissertation. The collegial relationship with you has been…genialisk i sin enkelhet.

Some other resources, embodied as former colleagues at the department, have also been crucial for this research process. Daniel Olsson: I miss you terribly as a colleague! The fun we have together is really something special. Oskar Jellbo: where are you when I need you the most? The decisions concerning 'fonts', 'marginals' and 'paragraphs' have not been nearly as entertaining this time. Finally, Jonna Sandell and Ragnar Hörndahl were truly supporting during my first time at the department, which meant a lot for the following process.

Beyond these internal resources provided at the department, many external resources have been accessed and used. Trondheim has provided some of them. Tim Torvatn and Ann-Charlott Pedersen: you have been fantastic, always eager to read drafts, commenting and discussing research, and most importantly, you have been very encouraging! Elsebeth Holmen: thank you for interesting discussions, ranging from gastronomy to resource theory, and for being a PhD student's role model. Espen Gressetvold: you are a great friend and fellow PhD student that always bring 'liveliness' to the department when visiting!

At BI, Oslo, two main resources can be found. Håkan Håkansson has been a major source of inspiration, not only with regard to this study, but to the research process as a whole. It is people like you that really make one want to be a part of academia! The relationship with Debbie Harrison has been 'jolly good'. I hope we can have 'springy legs' together in future research projects!

The 'White House' in Uppsala has provided several resources. Alexandra Waluszewski: thank you for bringing the 'Kleenex', for always being enthusiastic and supportive when I need it most, and for an unforgettably hilarious moment in Trondheim. Anna Bengtsson, Torkel Wedin, and Susanne Åberg: you have been great fellow PhD students and friends, with whom I have shared both challenging research discussions and crazy conference experiences. Furthermore, I would also like to mention Enrico Baraldi, Virpi Havila, Anna Löfmarck-Vaghult, and Bertil Markgren, all being good speaking partners at seminars. At Stockholm School of Economics, the 'D-sektionen' has been an important node in the network. Ivan Snehota: thank you for deep-loading

thoughts, espresso, and for being *the* gentleman in the network. Michael Kaplan, Hans Kjellberg, Anders Liljenberg, Anders Lundgren, and Anna Nyberg have all provided intellectual challenges at several courses and seminars. Furthermore, Luis Arajou and Geoff Easton from Lancaster University have always been inspiring and supportive.

Without the people at the firms that were involved in the study, this thesis could not have been completed. Thank you all for taking the time! Linda Schenck did a wonderful job correcting the language with respect to use and grammar. The remaining errors are totally my own mistakes, when trying to make changes or when adding pieces in the very last moment. I also want to thank the group members in the ERFA group, which I have had the privilege to be part of. The group-members have continuously challenged me by their perspectives on distribution, letting me share their own problems in 'distribution reality'. This has indeed been very valuable.

Last, but not least, my family and friends have been the major source of inspiration and energy when I have needed it the most. I am also very pleased to be able to answer 'Just did!' to the never-ever-ending, and very annoying, question: When are you finishing? A special thanks to Per for taking care of me, our friends and families, and our home during the last months. And finally, a special thanks to my mother, for believing in me to an extent that is incredible!

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Kajsa Hulthén

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1 Introduction

This thesis deals with distribution. The underlying interest of the study concerns the diversity of ways in which firms approach different end-users. This introductory chapter presents the empirical area in focus, the PC industry, in section 1.1. This is followed by an introduction of the problem area in section 1.2. The aim of the thesis is presented in section 1.3, and finally, the structure of the thesis is outlined in section 1.4.

1.1 Introducing the empirical area

Since IBM launched the 'original' PC[1] in 1981, PCs have become increasingly similar, being mad up of components with highly standardised technological interfaces. This, and the fact that many companies use the same components, has led to the commonly-held view that 'a PC is a PC'. However, although these 'products' may be regarded at a first glance as quite standardised, the ways in which PCs are bought and used as well as produced and sold display great variety.

In order to approach different end-users, firms try to segment customers into customer groups. Kaplan (2002) outlines an example of one such categorisation used by firms in the PC industry.

- *Private/home* - Private consumers buying and using PCs at home.
- *Small Businesses* - Firms consisting of one or just a few people buying and using PCs at the workplace.
- *Medium-sized Businesses* - Firms with 200-1000 employees.
- *Large Businesses* - Multinational and national firms with more than 1000 employees.
- *Public Customers* - Health and educational institutions and local, regional, and national government.

This kind of categorisation is obviously only a simplified picture regarding the diversity of end-user contexts. Consider a person who is going to buy a PC for his or her home in order to use it for Internet services, writing and reading documents, or playing PC-games. These various types of activities will require different software and hardware. For example, playing PC-games requires

[1] It was called a PC (personal computer) since it was meant to be used in homes and by individuals.

greater performance[2] in hardware than word processing. Buyers are also more or less familiar with PCs and their characteristics. Some buyers need a lot of help in choosing the right solution in terms of hardware and software in relation to their needs. Others know exactly what they need and wish to be involved in specifying the PC in terms of components in order to get a specific configuration[3]. Some buyers might even want to assemble the PC themselves. There is also a difference in the requirements for delivery time. While some people want to be able to take the PC home directly from a store, others might be willing to wait for a couple of days, or even weeks.

A customer[4] can also be an organisation, which often means different requirements for a PC. The way a PC is used also varies both within and among organisations. Some users only need a word processor while others do advanced calculations or programming. Some users might be in need of security solutions that prevent data from being transferred from the PC. Company PCs are often connected into larger networks, connecting thousands of PCs across geographical boundaries. The network setting requires knowledge about this system and how the PC fits into it, both in terms of hardware and software. In line with this, some organisations have purchasing policies that limit the freedom of action of the individual buyers with regard to choice of suppliers or even to certain configurations. The variety in end-user contexts also requires different levels of support and installation services.

The variety of end-users is thus greater than that outlined in the categorisation above, both with regard to the end-users individual contexts and to their different situations. With this variety in mind, it must be difficult for one supplier to fulfil the entire range of end-user needs. Different suppliers meet needs in various ways. Some suppliers focus on local stores for private consumers. This enables customers to discuss their needs with a salesman who can help them choose a solution suited to their needs. These suppliers often provide a range of different brands, each with a number of models with different levels of performance. In that case the customers can choose from the PCs in stock and take the PC home directly. Other suppliers sell PCs and

[2] Performance levels indicate the power of a PC in terms of for example processor capacity, memory capacity, and hard disc ‘space’.

[3] The configuration of a PC refers to the unique combination of hardware and software of a particular PC.

[4] Customer is defined as the buying organisation. The actual user of the PC is most often not the same person as the one that has the contact with the supplier.

components[5] on the Internet or by phone, focusing on customers who are capable of choosing products themselves. The selection of products can be made from a specified assortment in a catalogue or on a website. In yet other cases, suppliers let the customers be involved in the design of the PC by letting them combine components from a predefined assortment. Other suppliers focus on delivering system solutions to large firms where the individual PC is only one part of a large integrated computer system. In this case it might be more of an IT-system than a computer that is being bought, and the suppliers might take full responsibility for the analysis and solution of needs, design, installation, support, and operations.

As is clear above, there is great variety in the ways PCs are bought and sold. The fact that a PC is composed of a limited number of standard components with standardised interfaces implies that '*there are many possible ways to organize the value chain*' (Curry & Kenney, 1999, p. 16) and that '*a manufacturer has many different choices of how and where to build PCs*' (Feitzinger & Lee, 1997, p. 120). Furthermore, according to Tunisini (1997), the ways PC manufacturers choose to approach end-users are related to the nature of end-user demands and technological development, which means that when these change, new ways of approaching end-users of PCs are developed. For example, after relying on their own sales forces until the mid-1980s, large computer manufacturers then began to work with other firms in order to be able to reach out to end-users with differentiated offers (ibid.).

Curry & Kenney (1999, p. 9) state that new '*business models are constantly being introduced*.' The term business model has become an established expression in the computer industry, for describing how a firm operates (Kaplan, 2002). Within the PC industry, producing firms have identified a number of different business models, for example, the 'direct sales model', and the 'indirect sales model'. This has also led to the co-existence of a number of business models in the PC industry, relying on very different kinds of logic. This is illustrated in Figure 1.1 below, where the production and distribution network in the PC industry is outlined as perceived by Curry & Kenney (1999). The figure shows their view of how the 'flow' of components, illustrated by dotted lines, and the 'flow' of PCs, illustrated by solid lines, are transferred in a production and distribution network of the PC industry.

[5] Examples of components are processors, memory, and disc drives.

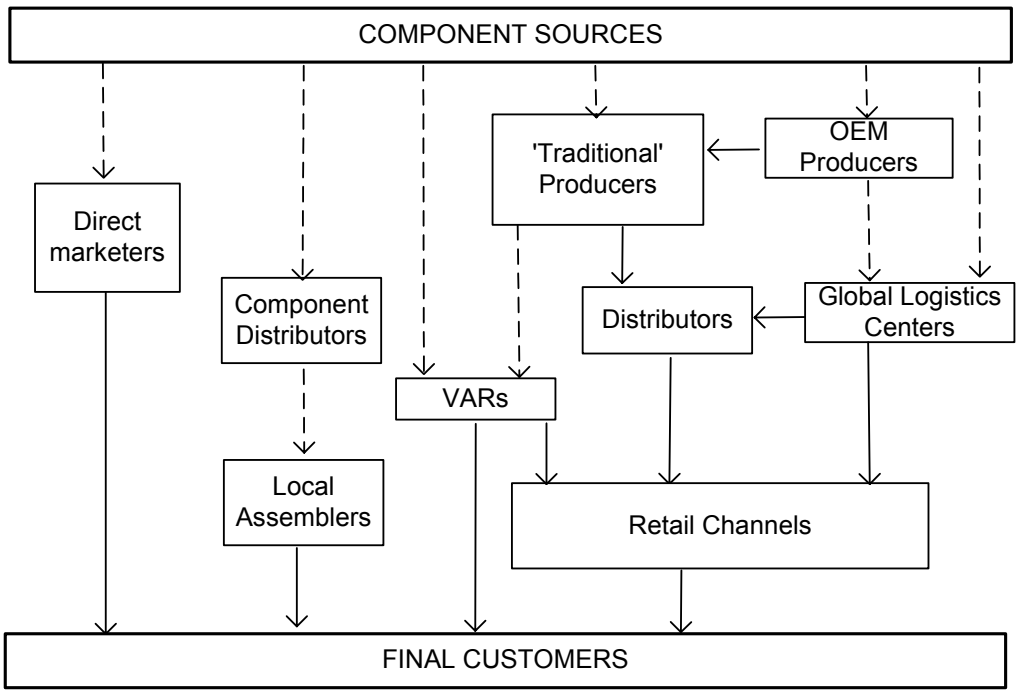

Figure 1.1 The production and distribution network in the PC industry[6]

Obviously, how components end up at the end-user is in no way 'given', but there are many possible routes from the sources of components to the final customers, thanks to the modular structure of a PC, which means that it can be '*assembled from a combination of separately produced components with a few simple tools'* (ibid., p. 10). Furthermore, most often there are many firms involved in the different activities, such as the production of components, the assembly of PCs, stockkeeping, sales, transportation, and coordination of information. All in all, the diverse needs of end-users generate a challenge for every firm involved or hoping to be involved in the production and distribution of PCs.

1.2 Variety in Distribution - the phenomenon in focus

With these conditions in mind, the overarching phenomenon studied in this thesis is, 'variety in distribution'. It is interesting to explore both from a practical and academic point of view.

Variety in distribution practice

The variety exemplified in the previous section is not specific to the users of PCs. '*Consumers demand - and get - more variety and options in all kinds of products*' (McKenna, 1988, p. 88). This indicates an increasing variety on the

[6] Slightly modified from the original source: Curry & Kenney (1999, p. 21).

end-user 'side' and that firms involved in offering this variety need, somehow, to cope with this diversity. Furthermore, many customers demand that their orders to be filled quickly (Feitzinger & Lee, 1997). Others require deliveries to certain places. End-user demands vary in a number of different dimensions, including the design of the product, place of delivery, and delivery times. Another aspect is that the end-users do not always want predefined end-products to choose from. Instead, many customers '*are demanding highly customized products and services*' (ibid., p. 116).

How to approach this end-user variety is a balance between deciding what degree of differentiation to offer in order to satisfy end-users and the costs of doing so. Lampel & Mintzberg (1996) discuss this in terms of balancing between two kinds of logic, the logic of aggregation and the logic of individualisation. These are the underlying kinds of logic of standardisation and customisation, respectively. The authors argue that these two strategies, standardisation and customisation, only represent the '*poles of a continuum of real-world strategies*' (ibid., p. 21). For example, firms may allow customised deliveries but do not offer changes in the physical appearance of the product, or be willing to assemble on demand but do not make changes in the design of the product. The authors identify five different strategies based on customisation and standardisation, illustrated in Figure 1.2.

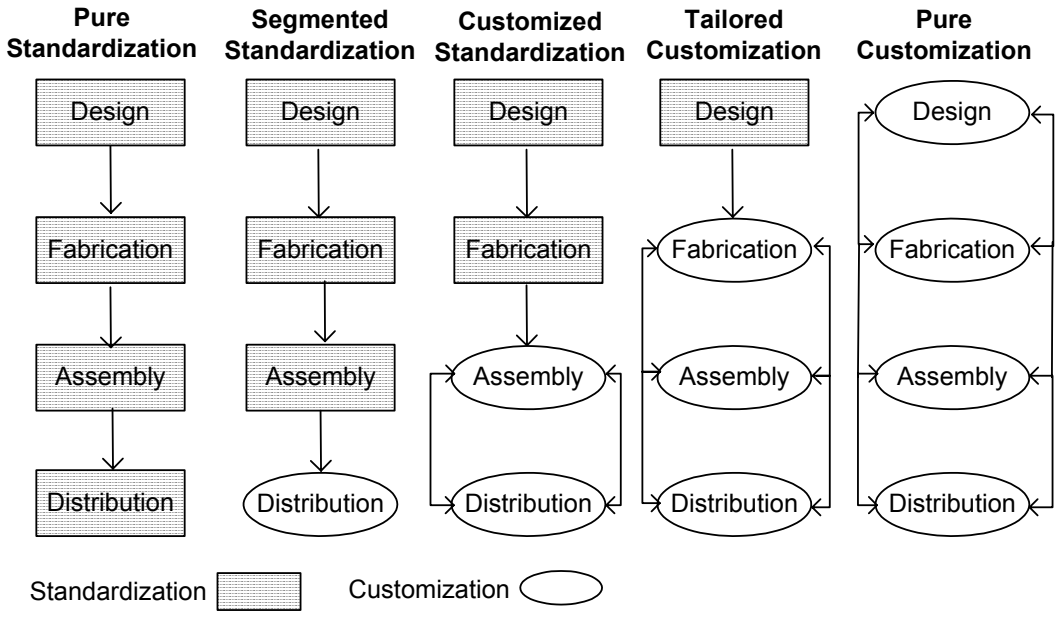

Figure 1.2 Five production and distribution strategies[7]

[7] Source: Lampel & Mintzberg (1996, p. 24)

In *pure standardisation*, there is no difference in how various end-users are treated. The end-user has to adapt or to choose another product. The model T-Ford is an example of a product made and distributed with this strategy. The end-user could get any colour - as long as it was black. *Segmented standardisation* implies that products are slightly modified with regard to different segments, but not to individual end-users. In some cases, distribution can be somewhat customised, for example, with regard to delivery schedules. Car manufacturers that let end-users select certain accessories with regard to predefined options are involved in *customised standardisation.* Products are then made from standard components and assembly is initiated by a customer order. This implies that manufacture of components is standardised but assembly is customised. Each end-user is able to have a made-to-order configuration, but limited by the range of components available. *Tailored customisation* refers to the situation when the supplier proposes a prototype and then adapts it to the end-user's wishes. This strategy is often used in construction when a builder modifies a standard design for particular end-users. When a product is truly made to order, i.e. when even the design is unique for the end-user, this is *pure customisation*.

Many of the strategies discussed above are related to technological development. For example, flexible manufacturing equipment has enabled cost effectiveness in operations to be obtained even when assembly is customised, as is the case in approaches based on customised standardisation. This kind of approach, often referred to as 'mass customisation', postpones the final differentiation of the products until end-user order arrives (Feitzinger & Lee, 1997).

According to Narus & Anderson (1996, p. 112), in order to be more flexible with regard to different end-user needs, forward looking '*companies are experimenting with their distribution channels to make them more flexible and responsive.*' This has to a large extent been made possible by the use of information technology, which makes it possible for firms to be both cost effective in operations and be able to offer customised solutions. In order to accomplish this, sharing resources among firms is essential and this, in turn, requires '*shared information systems and integrated logistics systems*' (ibid., p. 112).

Information technology and flexible manufacturing equipment have also made it possible for firms to have direct contact with end-users and, at the same time, to offer customised solutions and short delivery times. The Internet, for example, is said to have a tremendous impact on the way distribution channels

are organised and is often described as a means of establishing 'direct sales approaches'. Pitt et al. (1999) state that the Internet '*will change distribution like no other environmental force since the industrial revolution. Not only will it modify many of the assumptions on which distribution channel structure is based, in many cases it will transform and even obliterate channels themselves.*' (p. 19) They argue that the use of the Internet will have three major effects on distribution: '*It will kill distance, homogenize time, and make location irrelevant*' (ibid., p. 20). This means that geographical considerations are not seen as important as before, and that time is not critical, as a Web site is 'always open'.

In summary, for firms involved in distribution structures, the issue concerning how to deal with a situation characterised by a great variety of end-user needs, and at the same time be cost effective in operations, is a major challenge. This thesis explores various ways of facing that challenge.

Variety in distribution theory

Above, the logic of individualisation and the logic of aggregation are mentioned. The logic of aggregation is based on:

> *...standardization of taste that allowed for standardized design, standardization of design, that allowed for mechanized mass production, and a resulting standardization of products that allowed for mass distribution.* (Lampel & Mintzberg, 1996, p. 21)

Until the mid-1950s this was the reality of the industrial world. Later, a gradual movement away from this extreme form of aggregation resulted in ideas of 'market segmentation'. However, this did not change the underlying logic of aggregation, which still ruled both production and distribution (ibid.).

With this in mind, it is not surprising that the '*perspective on distribution as a channel running from manufacturer to end-customer is strongly rooted'* (Gadde, 2000, p. 2642). When mainstream models of distribution theory were developed, aggregation was the prevailing logic in both production and distribution. Products were mass-produced in plants and then 'channelled out' to end-users. In order to obtain cost effectiveness in this 'channelling', intermediary actors were used, with the task of creating place and time utility for end-users, as production and consumption are most often separated in these dimensions. By sorting the goods, combining and recombining it from different production units, the intermediaries could see to that end-users were offered an assortment of goods to satisfy the differentiation of tastes (Alderson, 1954).

Form utility was obtained in production, meaning that the form of products did not change in the distribution channel except that the goods were often repacked.

This meant that distribution came to be considered as the 'bridge' between production and consumption, as illustrated in Figure 1.3. With regard to the description above, the channel concept seems as a quite suitable conceptualisation of this kind of production and distribution reality.

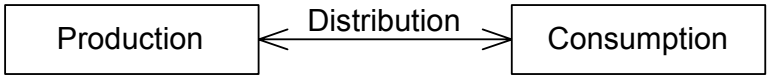

Figure 1.3 Distribution as the 'bridge' between production and consumption

A brief review of textbooks dealing with distribution issues highlights the perspective of distribution as a 'channel'. Both Stern and El-Ansary (1996) and Rosenbloom (1995) take the 'marketing channel' as the point of departure when discussing distribution issues. Stern and El-Ansary (1996) define the marketing channel as a set of interdependent organizations that are involved in the process of making a product or service available for use or consumption. Rosenbloom (1995), in turn, defines the marketing channel as '*the external contactual organization that management operates to achieve its distribution objectives'*. (p. 5) In both these definitions the organisations included in the marketing channel stand between the producer on the one hand and the end-users on the other. Hence, this view strictly separates the actors involved in production from the actors involved in distribution. Most textbooks dealing with marketing in general also bring forward the marketing channel as the main concept for describing distribution structures. For example, Kotler (2000) uses the definition provided by Stern and El-Ansary.

The sharp boundary between production and distribution was questioned already in the mid-1940s. Kristensson (1946, p. 110) states that: '*The study has however illustrated that there is a close connection between the production and distribution structure, and that the boundary between these is blurred.*'[8] Cox and Goodman (1956) also highlight the need to take 'production' activities into consideration when studying distribution. In their study of house building materials, they argue that limiting the analytical scope to the 'finished' product '*prevent meaningful comparisons between alternatives and present a distorted view of marketing*' (p. 37). Thus, production activities need to be taken into

[8] Translated from Swedish.

consideration as well. (ibid.) However, this insight has not been mirrored in how distribution has been conceptualised.

The reality as illustrated above began to change after the mid-1950s. The conditions for both production and distribution have changed along with technological development and changing end-user needs. Many different types of 'channels' now co-exist, some characterised more by the logic of aggregation and some more by the logic of individualisation, as argued by Lampel & Mintzberg (1996). Therefore, the variety offered to end-users today, and the distribution networks that provide this variety, is different from the variety supplied in the 1950s when aggregation was the dominant strategy. It therefore seems probable that the 'channel' is not the best way of conceptualising distribution structures of today. Thus, alternative conceptual frameworks need to be developed to help us understand and analyse the variety characterising current distribution structures.

1.3 The aim of the thesis

The overarching aim of this thesis is to explore variety in distribution. As hinted above, end-users display great variety as regards the context for using products. Firms have to take this diversity into account, which results in different approaches concerning how products are produced and distributed to end-users. This means that variety in distribution is interesting both from a buyer and supplier perspective. It was also argued that mainstream conceptualisations of distribution do not fit with the current variety characterising distribution. Therefore, the thesis aims at developing a conceptual framework to improve our understanding of variety in distribution networks.

1.4 Structure of the thesis

This section outlines the structure of the thesis and its ten chapters as illustrated in Figure 1.4 below.

This first chapter introduces the main themes of the thesis; the empirical area, PC distribution, and the phenomenon being focused - variety in distribution -, and finally, the aim of the thesis.

In chapter 2, the theoretical frame of reference is developed. Based on the aim of the research to explore variety in distribution, two main streams of literature comprise the basis of the framework: the industrial network approach, and the

transvection concept with its related theory. The chapter ends with a number of research issues.

Chapter 3 discusses methodological considerations. This chapter is tightly linked to chapter 2, the empirical chapters 4 and 5, and the analyses in chapter 6 and 7. The discussion focuses on the different methodological considerations that I was confronted with while conducting the study and how I 'chose' to approach them. In order to provide the reader with some understanding of this process I have outlined these issues at a quite detailed level.

Chapter 4 introduces the reader to the PC industry in general terms. Chapter 5, illustrating a more detailed empirical level, follows this. This chapter focuses on the variety in ways in which PCs are produced, sold, bought, and used. Furthermore, the chapter also shows how these different routes to the end-users are interconnected.

Chapters 6 and 7 take chapter 5 as point of departure when identifying and analysing transvections and how transvections cross in 'crossing points' by applying the theoretical framework developed in chapter 2. The two chapters display great variety concerning how transvections are organised and how crossing points are utilised.

From the variety displayed in chapters 6 and 7, chapters 8 and 9 highlight two main themes: sorting and variety. These chapters bring forward some main conclusions from the analyses in chapters 6 and 7 concerning how variety in distribution networks can be understood.

In chapter 10, the concluding discussion sums up the main conclusions drawn in chapters 8 and 9 in relation to the main phenomenon approached, variety in distribution. Furthermore, some implications of the study are brought forward. Finally, at the very end of the thesis, the trustworthiness of the study is discussed.

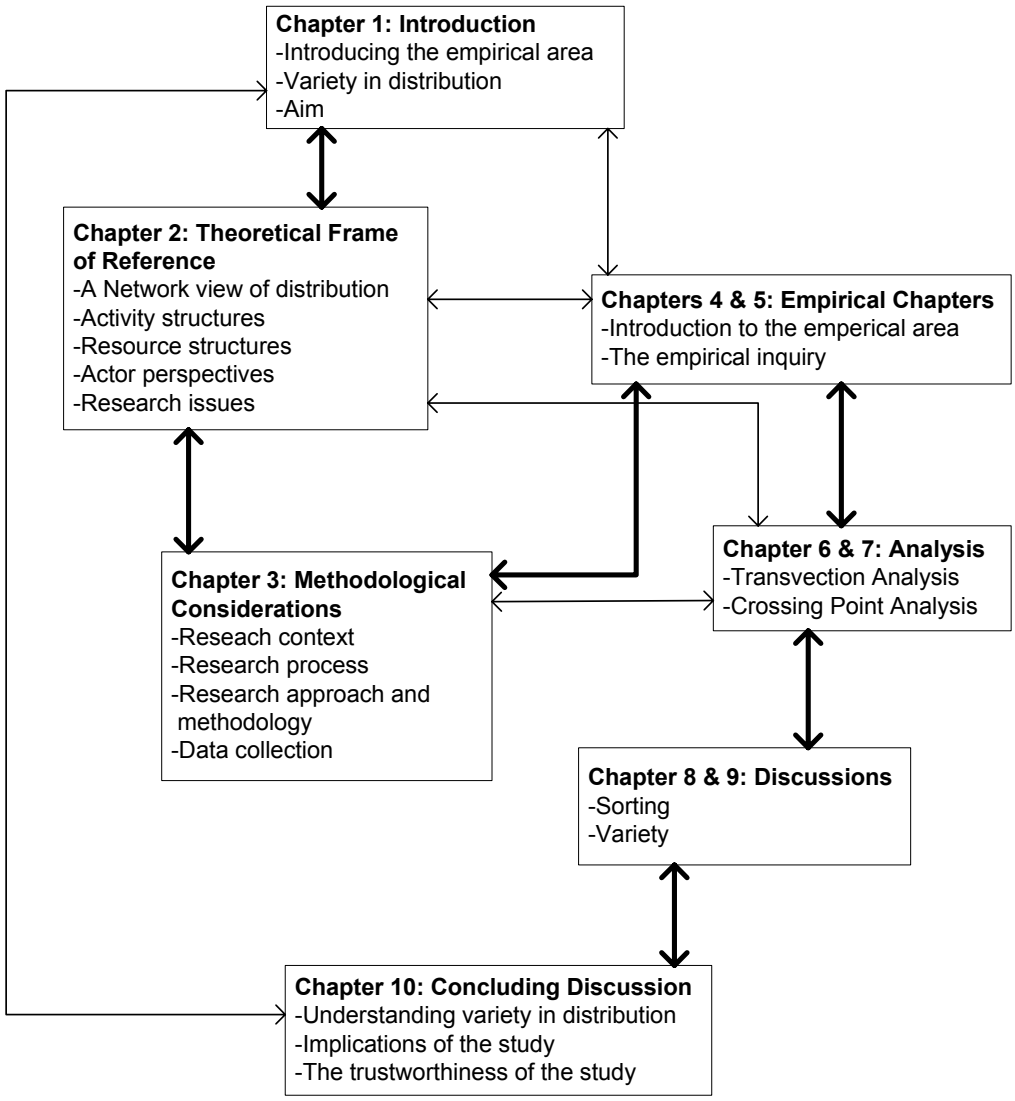

Figure 1.4 Outline of thesis

2 Theoretical Frame of Reference

The main interest in this thesis lies in exploring 'variety in distribution'. In order to do so, we focus on investigating different ways in which a product can find its way to an end-user and the underlying structures that are activated in the process. Therefore it becomes necessary to understand the nature of the 'industrial settings' in which these products are produced, sold, delivered, and used. In the next section we argue for the perspective on industrial markets taken in this thesis and the consequences of this view.

2.1 A network view on distribution

This thesis is based on the view that firms are more or less interconnected to each other in a network-like structure. The specific perspective taken as the point of departure is the Industrial Network Approach (see e.g. Håkansson, 1982, 1987, 1989; Axelsson & Easton, 1992; Håkansson & Snehota, 1995; Ford, 1997; Ford et al., 1998), which has been fruitfully applied to many areas, for example technological development (see e.g. Håkansson, 1987; Laage-Hellman, 1989; Håkansson et al., 1993; Lundgren, 1994; Håkansson & Waluszewski, 2002) and purchasing (see e.g. Pedersen, 1996; Torvatn, 1996; Dubois, 1998; Gadde & Håkansson, 2001). It has also proven useful for analysing distribution issues (see e.g. Hörndahl, 1994; Havila, 1996; Tunisini, 1997; Hulthén, 1998; Rosenbröijer, 1998; Andersson, 1996; Kaplan, 2002).

One central concept in the Industrial Network Approach is business relationships. Firms are engaged in exchange relationships. Since each firm is involved in a number of relationships, this means that the relationships are not independent, but connected. The view of connectedness has its roots in social exchange theory in which Cook & Emerson (1978) describe an exchange network as *'...a set of two or more connected exchange relations'* (p. 725). They go on to say that *'Two exchange relations are connected to the degree that exchange in one relation is contingent upon exchange (or non exchange) in the other relation'* (ibid., p. 725). Referring to the definition of an exchange network of Cook & Emerson (1978), Andersson (1992) argues that this definition:

> *...implies that the characteristics of the exchange relationship and the interaction processes between two distribution actors, e.g. a wholesaler and a dealer, will*

> *be contingent upon*[9] *the other relationships in which the two actors are involved, irrespectively of whether the relationships are defined as being 'horizontally' or 'vertically' connected.* (pp. 50-51)

This means that the nature of a relationship will be more fully understood if it is seen in the context in which it is analysed with regard to how it is connected to other relationships. According to Andersson & Mölleryd (1999) channel relationships are seldom put in the context of the other network relationships to which they are connected. What is important to note is that this applies to both directly and indirectly connected relationships (Andersson, 1992).

Andersson (1992) also points out the result of an empirical investigation of the automotive industry showing how the distribution systems of different car makers are interrelated at certain points of connection. These points of connection were found at different 'levels' of the distribution systems, e.g. assembler, importer, or dealer. Another finding of this discussion is that 'traditional type channels' are just a few of many types of actor configurations in the automotive system and that a network metaphor would be more appropriate to capture this connectedness among distribution systems. This also emphasises that *'...firms at different positions in a focal distribution network are both directly and indirectly connected to actors in other networks…'* (Andersson, 1992, p. 51). If all actors are connected, both 'horizontally' and 'vertically', as is the case when a network perspective is applied, all actors become intermediaries (Gadde & Mattsson, 1998).

In accordance with the Industrial Network Approach[10], the context in which a specific firm is embedded can be described in three dimensions, an activity layer, a resource layer and an actor[11] layer. These layers are interconnected in different ways. Activities are linked to each other in a network-like structure, similarly, resources are tied to each other, and actors are bonded to each other. (Håkansson & Snehota, 1995) Furthermore, actors perform activities and control resources. Activities, in turn, interlink resources. Each firm involved in

[9] The underlined words in the quotation are emphasised by the original author.

[10] This specific part of the Industrial Network Approach is often referred to as the ARA-model, indicating the focus on *A*ctivities, *R*esources, and *A*ctors.

[11] Actors as perceived in the Industrial Network Approach can be discussed on many levels, i.e. individuals, departments, organisations, firms etc. In this thesis the main focus is on actors as firms. However, organisations and departments also appear as actors in the study to a limited extent. Furthermore, when end-users are discussed actors will also appear as individuals.

a production and distribution network as described in chapter 1 and each end-user can, in these terms, be said to be a part of an underlying activity and resource structure. Each actor will both be involved in a number of activities and linked to activities performed by other actors. In a similar way each actor will possess some resources internally, while some need to be accessed from other firms. If each firm is seen as part of a network, the aspect of interconnectedness has implications for how activities and resources are divided among the firm. If it is assumed that firms are interrelated through their relationships with each other, activities performed and resources controlled by firms are not independent but interrelated. This has implications for how activities and resources are organised and coordinated both within and across firm boundaries.

The relationships in a network vary in character. First, the strength of relationships can vary. Mattsson (1983) points out the difference between loosely and tightly structured networks, indicating more or less strong connections in a network. Andersson (1992) uses the concepts 'tight' and 'loose couplings'[12] as a tool to conceptualise the connections in distribution systems and argues that:

> *Put in a channel or marketing system context, the ideas of patterns of loose and tight coupling can help to describe, analyse and develop models of, for example, large global distribution systems, where tight couplings 'within' and loose coupling 'between' systems do not necessarily coincide with the boundaries shown in traditional, theoretically developed models of 'type channels'* (p. 56)

The variation among relationships is also discussed by Gadde & Håkansson (2001) in terms of degree of involvement and continuity. They further argue that a firm needs different kinds of relationships with regard to these dimensions. In line with this, Gadde & Snehota (2000) argue that it is strategically important for a firm to be able to handle a variety of 'strong and weak' relationships. Second, the content of relationships varies (Gadde & Håkansson, 2001). Contents can be discussed with regard to the three 'network dimensions'. This implies that relationships can vary with regard to their functions of linking activities, tying resources, and bonding actors. (ibid.) The relationship content in terms of activity links, resource ties, and actor bonds can

[12] The concept 'loose coupling' was introduced by Weick (1976) in an article on educational systems as loosely coupled systems.

be said to be a result of adaptations made among firms. The adaptations can be of various kinds, e.g. technical, organisational, and administrative (Hammarkvist et al., 1982). For example, the linking and/or adapting of business systems among firms can enable activities to be better planned and can change the activity links in the relationships. This, in turn, can result in more efficient handling of both products and information.

We have now argued for a network view of distribution, pointing out that a production and distribution system can be regarded as overlapping and interrelated activity and resource structures. In order to approach the phenomenon of interest - variety - we need to elaborate more on the nature of these structures and how they can be conceptualised. Consequently, the discussion below is focused on activity and resource structures in distribution networks and how they can be conceptualised and analysed. This is done in the subsequent sections, focusing on activity structures in section 2.2, and resources in section 2.3. Finally, in section 2.4, the actors and their positions in these structures are discussed.

2.2 Activity structures in distribution networks

Recapitulating the introductory chapter it seems reasonable to argue that the variety of ways in which activities can be organised in production and distribution networks is enormous. What have traditionally been labelled production and distribution activities can be performed by a number of different firms, in various ways, using different kinds of resources. Håkansson (1987) argues that '*Actors, activities and resources together form a system in which heterogeneous demands are combined with heterogeneous supply*.' (p. 17). The system referred to in the quotation can obviously be organised in an infinite number of ways. Although the inherent variety is large when regarded in this perspective, each single product that finds its way to an end-user can be traced back in terms of activities and resources activated in the production and distribution of this product.

In order to approach the activity structures in production and distribution networks and their inherent variety we have chosen to use a concept developed by Alderson (1965) - the transvection[13].

[13] The concept of transvection was first introduced at a graduate seminar at Ohio State University in 1958. The word stems from Latin's 'trans' and 'vehere' and was meant to express the meaning of 'flowing through', and more specifically something that flows through a marketing system in one end and out in the other. The fact that the word transvection sounds very similar to transaction was deliberate and emphasises the interrelatedness of the two concepts. (Alderson & Martin, 1965)

The transvection

Alderson & Martin (1965) state that '*The marketing process is the continuous operation of transforming conglomerate resources as they occur in nature into meaningful assortments in the hands of consumers*' (p. 122). In line with this, Alderson (1965, p. 92) defines the transvection as:

> *... a single unit of action of the marketing system. This unit of action is consummated when an end-product is placed in the hands of the ultimate consumer, but the transvection comprises all prior action necessary to produce this final result, going all the way back to conglomerate resources.*

Each transvection is hence related to all the activities required to land a specific end-product in the hands of a unique end-user. This means that '*By definition every sale of an end-product has a transvection behind it*' (Alderson & Martin, 1965, p. 123). Furthermore, this implies that a transvection can only be identified in retrospect, i.e. when it has been 'fulfilled'. The transvection, hence, is a purely theoretical concept that can be used to analyse production and distribution networks, as it '*...provides a means for piecemental analysis*' (Alderson, 1965, p. 94). Alderson (1965) describes a distribution network as consisting of a large number of interconnected branches. By sealing off one transvection and following it through the net of connected branches, the necessary connection points to other connected branches can be considered. This provides a means of focusing on the interrelatedness of the activities involved within a transvection and among transvections, in line with the arguments in the Industrial Network Approach.

Alderson (1965) argues for that transvections can be seen as a complement to transactions:

> *A transvection is in a sense the outcome of a series of transactions, but a transvection is obviously more than this. The transactions as such are limited only to the successive negotiations of exchange agreements. A transvection includes the complete sequence of exchanges, but it also includes the various transformations which take place along the way.* (p. 86)

This concept is now further elaborated on. We start with a discussion on heterogeneity, which is an important aspect in the work of Alderson (see e.g. Alderson, 1954; Alderson, 1965) as well as in the Industrial Network Approach (see e.g. Håkansson, 1987; Håkansson & Snehota, 1995; Holmen, 2001).

Further, linked to the main phenomenon of interest in this thesis - variety in distribution - heterogeneity is an important aspect to consider.

Heterogeneity and transvections

Alderson (1954) suggests that a '*product has a very different meaning for its producer and for the ultimate consumer buyer*' (p. 11). From a consumer's point of view, the specification of the end-product is determined by user requirements of the end-product itself as well as how by how it fits into the total collection of goods[14] of relevance to the user. Consequently, the value of a certain end-product needs to be regarded in relation to its use in a larger setting. From a producer's point of view, the product is an '*expression of his skills and resources*' (p. 11) and an ideal specification would be the one which best utilised the producer's plant, labour and raw materials. This would provide a meaningful heterogeneity from the producer's perspective. In other words, even though products might be related from a production point of view they might be quite unrelated from the viewpoint of the uses they serve[15]. All in all, '*it is a wholly different thing for goods to be found together because of convenience in production as compared to the assortment of goods that are all complementary in use*' (ibid., p. 11).

In order to approach this heterogeneity, Alderson (1965) argues for 'the perfectly heterogeneous market' as opposed to the perfectly homogeneous market often taken as point of departure by economists. He argues that:

> *It has been asserted that real markets are imperfect and advance occurs through market imperfections. This is another way of saying that markets are both heterogeneous and discrepant. A model of the market, abstracted from reality, might ignore these elements of diversity. The economist finds it useful for some purposes to use a model of a homogeneous market. This writer, for quite different purposes, presents a model of a perfectly heterogeneous market.* (p. 29)

In the perfectly heterogeneous market, each unique demand can only be satisfied by a unique segment of supply. This implies that the function of the market becomes to match these segments of supply with the corresponding segments of demand (ibid.).

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[14] Alderson refers to this collection of goods as the assortment of the user.

[15] This has also been discussed by Kay (2000) who argues that the interpretation will depend on the eyes of the beholder just '*as an architect might view a house in terms of style, form, and function, so a burglar is more likely to see it as a pool of assets.*' (p. 685)

Alderson states that '*The product starts out as materials which is relatively raw and unspecified. It ends up as a relatively refined and specialised article, shaped to a type of need fitted to the specific requirements of the individual customer who buys it'* (Alderson, 1950, p. 1). Consequently, from the user's perspective, the product must have some specific qualities and these qualities need to be in line with the user's use of the product. Furthermore, the product has to be physically available when and where the user wants it. In line with this, and inspired by the work of Alderson, Snehota (1990, p. 97) argues that within a market

> *... heterogeneous buyers face heterogeneous problems, seek to fill heterogeneous wants and needs, from heterogeneous sets of resources, available from heterogeneous sources. Matching of these heterogeneous units is achieved within the market; the meaningless ... heterogeneity is being 'sorted' ... into meaningful ...heterogeneity.*

The transvection can be used as a tool to analyse how this heterogeneity is handled. Alderson (1965) argues that each transvection can be illustrated in an alternating sequence of what he refers to as sortings[16] and transformations. The two concepts are described by Alderson (1965, p. 26-27) in the following way:

> *Transformations relate to aspects of utility such as form, place and time, which are modified by the use of certain facilities. Sorting…is the assignment of goods, materials or components to the appropriate facility.*

Taking an industrial network perspective, transformations and sortings can be defined as two distinctively different types of activities. They can be regarded as activities, as they make use of resources for their performance as well as being undertaken by some actor. The next two sections further discuss transformations and sortings and how they interrelate.

[16] Alderson use sort(s) and sorting(s) as interchangeable concepts, see e.g. Alderson & Martin (1965, p. 123): '*First, let us consider sorts or sorting, a concept…*'. In this thesis both are used interchangeably and choice between them is only made on the basis of linguistic considerations.

Transformations

Transformations are related to the creation of utilities in the marketing process. According to Alderson (1965, p. 93):

> *...a transformation is a change in the physical product or in its location in time and space*[17] *which is calculated to increase its value for the ultimate consumer who adds the product to his assortment. In other words, transformations add form, space, and time utility.*

The fact that transformations create utilities in three different dimensions enables us to distinguish three different kinds of transformations. First, transformations involved in refining material to a finished end-product in the hands of the end-user, are referred to as 'form transformation'. This includes different kinds of production, assembly, and packaging activities, i.e. activities related to physical changes in form from raw material to end-product. Second, 'place transformation' is related to the physical movement along the way to the end-user. This includes activities such as transportation as well as various handling operations, e.g. loading. Finally, 'time transformation' is related to storage along the transvection as well as to how the raw materials are transformed 'in time', for example when a certain delivery is needed, not only at a certain place, but also at a certain time. This indicates that time transformation is often combined with other types of transformations.

Dubois et al. (1999), argue that between any two of what is referred to above as form transformations, it has to be a place or time transformation. This is because after a form transformation the output of that activity needs to be handled in one way or another. It can be moved to the next form transformation directly by a place transformation or it can be placed in storage until it is moved to the next form transformation. It might also be the 'last' form transformation in the transvection before the end-product lands in the hands of the end-user and that all remaining activities are place and time transformations. Figure 2.1 below illustrates how two form transformations must be separated by a place or time transformation. However, two place or time transformations can directly succeed each other, as also indicated in Figure 2.1.

[17] In this quotation, Alderson argues that a transformation might result in space utility. However, he is not totally consistent and uses both 'place' and 'space' for this dimension. For example, '*...aspects of utility such as form, place and time*' (Alderson, 1965, p. 26) In this thesis, space will be perceived as equal to place, but 'place' will be the word used for this dimension.

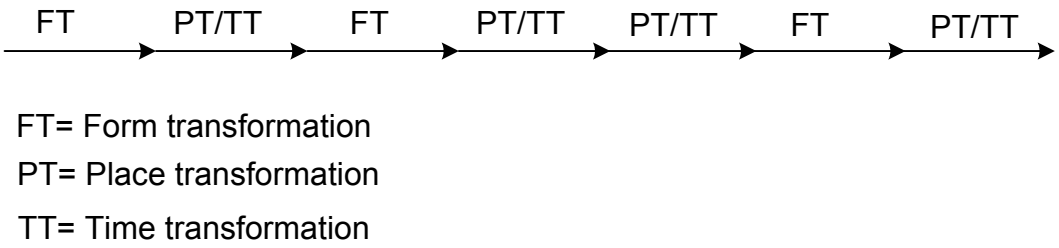

Figure 2.1 Alternating sequence of transformations

Hence, a ‘product’ changes along the transvection as it undergoes different transformations. This means that the ‘product’ is not ‘the same’ throughout the transvection. It begins as conglomerate resources and ends up in the hands of the end-user as an end-product. Consequently, the use of the word ‘product’ is complicated. In order to clarify what is meant, we use the following definitions. First, the shape of the ‘product’ that lands in the hands of the end-user is referred to as the ‘end-product’. Second, the outputs of the different transformations is referred to as ‘transformation outputs’. Thus any transformation results in a transformation output that cannot - by definition - be identical to the transformation output resulting from the previous transformation. This is due to the fact that as a transformation output is confronted with a new transformation it changes in the time, place, or form dimension. Third, the input to the initial transformations in the transvection is referred to as conglomerate resources.

When there is no need to distinguish the three different kinds of shapes in which a product can appear in the transvection we use the term ‘object’. In Figure 2.2 below, a transvection involving three conglomerate resources, six transformation outputs and one end-product is illustrated. All in all, ten objects are included. A transvection does not involve only ‘one changing object’, since after each transformation a new object, with unique features is created. With regard to the different types of objects, a transvection can only have one single end-product, while the number of conglomerate resources and transformation outputs can vary among different transvections.

The word ‘product’ is only used below when discussing products in colloquial sense.

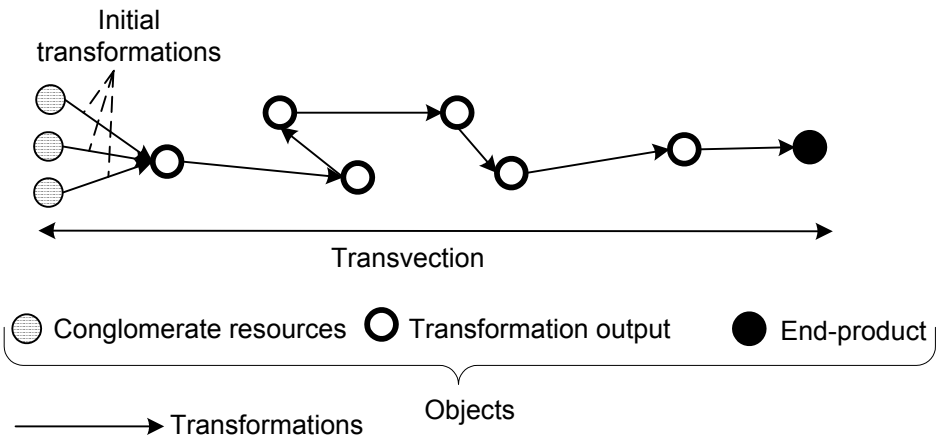

Figure 2.2 Objects illustrating different 'shapes of a product' in a transvection

As indicated in Figure 2.2 above the conglomerate resources and the end-product act as the boundary of the transvection. The identification of the conglomerate resources is consequently crucial and associated with one main problem. For practical reasons, most studies cannot '*go all the way back ...*' as suggested by Alderson (1965, p. 92). Instead, each researcher needs to consider the analytical boundary of the transvection for the purpose of the specific study and delimit the structure to be scrutinized. There are no given conglomerate resources: these have to be defined in relation to the purpose of each study. The definition of conglomerate resources is therefore a crucial part of transvection analysis since this decision sets the boundary of the structure to be analysed. This in turn has an impact on what conclusions can be drawn and at what levels.[18]

The conglomerate resources are transformed from a meaningless heterogeneity from an end-user perspective to an end-product as part of a meaningful heterogeneity from an end-user perspective through different kinds of transformations. The meaningfulness is related to the end-product being combined with other end-products in the 'assortment' of the end-user so that it is meaningful from the end-user's perspective. In the discussion below, we refer to what Alderson calls 'assortment' as a 'collection of objects', because 'assortment' as a concept today is closely associated with colloquial use, i.e. an assortment of standardised mass produced products.

[18] A discussion concerning this issue related to this specific study is held in section 3.4, dealing with methodological considerations related to transvection analysis.

Sortings

According to Alderson (1965) '*The basic function of marketing is sorting*' (p. 34). Sorting can be of two main kinds, assigning or selecting. These two activities relate to the different perspectives of a supplier or a customer. *'The supplier assigns items to classes which are to be treated in different ways thereafter. The consumer selects an item into her assortment in relation to what the assortment already contains'* (ibid., p. 34). Hence, both assigning and selecting are always done in relation to some collection of goods. In our terms, this means that no object should be studied in isolation but only as part of a larger collection of objects.

Alderson (1965) argues that each transformation needs to be preceded by sorting. Consequently, according to Alderson (1965) *'...two transformations cannot appear successively without an intervening sort. Different facilities are required for fabrication, shipment, storage and credit. Thus, there has to be an intervening assignment to the appropriate facilities'* (p. 94). This leads to a reconsideration of Figure 2.1 on page 21. The figure needs to be revised to illustrate the alternating nature of transvections with regard to transformations and sortings. We now turn to a more detailed discussion on the two different kinds of sorting, assigning and selecting.

Assigning is related to directing a certain object to the next transformation and to the resource used to perform it. Assigning is also concerned with the identification of similar features among objects, in relation to either a specific resource or an actor. For example, by assigning objects to the same resource it is possible to obtain economies of scale thanks to improved utilisation of resources when transformations are performed.

The logic of assigning can be illustrated by the following example. A load of products is shipped in a trailer since the objects are bound for the same geographical area. When the trailer arrives at the destination, the objects are unloaded, sorted, and reloaded according to a new logic, e.g. to be transported to different specific warehouses within the geographical area. When the object arrives at the warehouse it is again unloaded and assigned to a specific storage shelf in the warehouse. This assignment in term of place is decided in accordance with yet another logic, for example with regard to a buyer. This brings us to the next kind of sorting, selecting.

Selecting is referred to as the selection of an object to be included in a collection of objects for some specific reason and is done from a buyer or user

point of view. For example, in a store, products that serve a similar function, such as PCs, are collected together. The PCs are similar in their basic function but different in other dimensions, for example different brands and different performance. The objects are selected in a way that aims to create a collection of objects that is valuable from a customer or user point of view. Another example of selection is the creation of a collection of objects that aims at creating stocks of mass produced products in order to secure delivery to customers.

To sum up, in accordance with the preceding discussion, a transvection can be illustrated in terms of an alternating sequence of transformations and sortings as exemplified in Figure 2.3 below. Furthermore, it involves a number of conglomerate resources that are sorted and transformed to an end-product in the hands of an end-user. During this 'process' we can identify a number of transformation outputs. From the end-user's perspective this means that the transvection should result in an end-product having certain features.

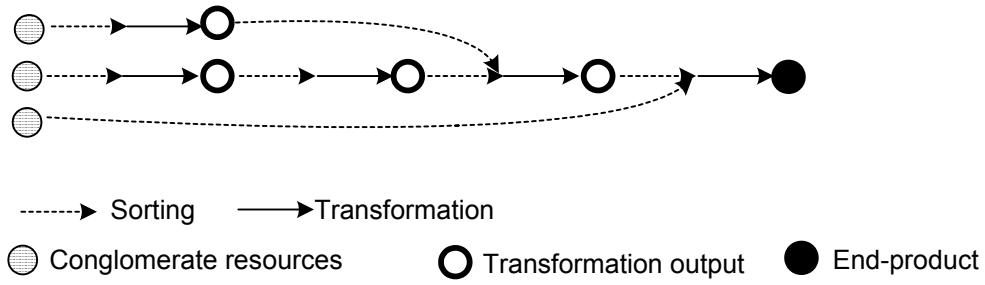

Figure 2.3 Illustration of a transvection

In a transvection, assigning is related to the certain direction in which a specific transvection is heading and can be regarded as a 'vector' in this sense. Hence, after each transformation, the transvection is (re)directed as it gets a new assignment. Assignments, in turn, are the result of a choice made by some actor – a selection. Both assignment and selection are related to the fact that each object needs to be considered in relation to other objects. This means that objects are sorted and transformed together with objects 'belonging' to other transvections to finally end up as an end-product in the hands of an end-user.

Hence, no transvection is isolated from other transvections. In order to capture the connectedness among transvections, each transvection needs to be regarded in its context, as part of the process of recombining objects into collections of objects. The recombination of objects into new collections is a result of the crossing of transvections. These 'crossing points' are a result of objects related to different transvections being assigned to the same resource.

Consequently, sorting takes place in a number of places along the transvection and is essential to the conversion from what Alderson (1965) labels meaningless heterogeneity to meaningful heterogeneity from a user perspective.

Organising activities within and among transvections

In accordance with the discussion above, an alternating sequence of transformations and sortings is involved in a transvection. Transvections are also connected to each other by the sorting activities, as objects involved in different transvections are assigned to the same resources. This interconnectedness, in turn, has consequences for how activities are coordinated both within and among transvections. The way activities are organised affects the type and extent of dependencies among activities within and among transvections. These dependencies, in turn, need to be handled by the involved actors. Based on Richardson's (1972) work on activities, Dubois et al. (1999) distinguish between two kinds of dependencies existing in activity structures, sequential and parallel dependence.

Sequential dependence as a result of activities being complementary

Sequential dependence is related to the fact that activities are serially related within a single transvection as described above. This means that activities have to be performed in a certain order. This kind of dependence exists as a result of activities being what Richardson (1972) refers to as complementary. Activities are complementary when they represent *'different phases of a process of production and require in some way to be co-ordinated'* (ibid., p. 889). Activities are closely complementary if there is a need to *'match not the aggregate output of a general-purpose input with the aggregate output for which it is needed but of particular activities'* (p. 891). This means that these activities are directed towards a specific counterpart. Complementary activities become closely complementary at the point where activities are directed to a particular counterpart. Closely complementary activities can be undertaken within one firm or by several. In the latter case it is necessary that *'... organisations agree to match their related plans in advance'* (ibid., p. 890). This matching may concern both quantitative and qualitative aspects, i.e. it deals with *how much* as well as *what* is produced and exchanged. Activities need to be coordinated through exchanges of information, e.g. orders, confirmations and delivery plans (Dubois et al., 1999).

The counterpart to which the activities are directed can be the end-user or another actor involved in a transvection. The whole transvection or some part

of it can be characterised by close complementarity. In Figure 2.4, this is illustrated in relation to one actor (A). The first sorting in the figure is assigned in relation to actor A and the organising of the subsequent sortings and transformations is affected by the activities being closely complementary.

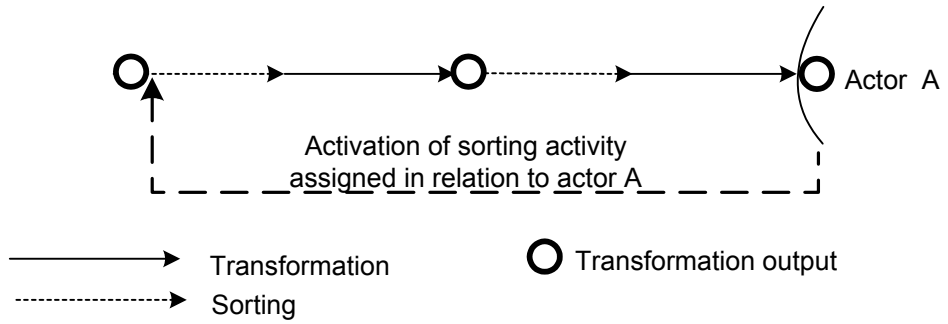

Figure 2.4 Close complementarity in a part of a transvection

Parallel dependence as a result of similarities

Another characteristic of activities discussed by Richardson (1972) is similarity. He argues that activities are similar when they *'require the same capability for their undertaking'* (Richardson, 1972, p. 888). Parallel dependence, in turn, is the result of the fact that activities use the same resources, i.e. that they are similar with reference to resource utilisation.

Let us step back and consider the transformation and sorting activities discussed above. Transformation activities can be similar in three dimensions, form, place, and time. For example, similarities can be found in form transformation when many transformations use the same equipment for assembly or refinement of objects. Similarities in place transformation can be illustrated by co-loading a number of products bound for the same geographical area. Similarities in time transformation can be illustrated by objects being stored in the same warehouse, meaning that the objects can be delivered together at a certain time. Hence, similarities can be created in three dimensions, in form, time, and place. Activities being similar can also be involved in the same transvection as well as in different transvections.

The existence of similarities cannot, however, be explained only by the analysis of transformation activities. We also have to turn to the other kind of activity, sortings.

Similarities are created and captured by sorting. Classifying objects in different dimensions, form, time and place, and sorting them accordingly can create similarities. Hence, it is in the crossing points of transvections that similarities

can be captured, i.e. when objects belonging to different transvections are assigned to the same resource. In Figure 2.5 below, five different transvections cross due to transformation outputs being assigned to the same resource.

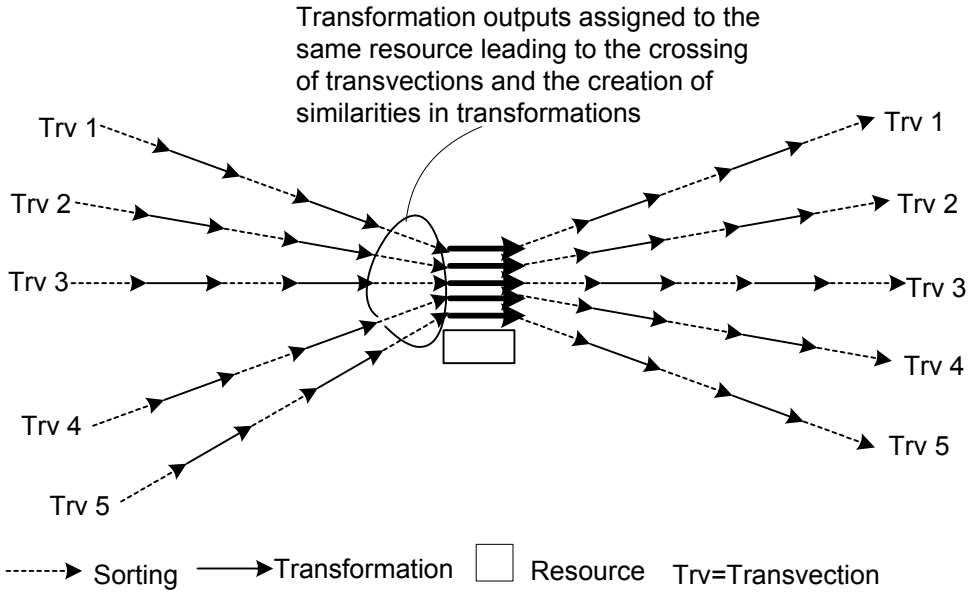

Figure 2.5 Five transvections cross and similarities are created

Postponement and speculation in transvections

Other concepts relevant for transvection analysis are postponement and speculation. The concept of postponement was introduced by Alderson (1950) and further developed by Bucklin (1965), who analysed the principle of postponement in relation to the principle of speculation. Postponement is related to the complementarity among activities and affects the possibilities of capturing similarities. Alderson (1957) describes the marketing process as a series of steps that need to be arranged in the most effective sequence. This process is marked by a definite direction that can be defined in terms of how the product changes along the way.

> *The product starts out as materials which are relatively raw and unspecified. It ends up as a relatively refined and specialised article, shaped to a type of need fitted to the specific requirements of the private consumer who buys it. To serve the private consumer, the product must assume a special character as to its use qualities; these qualities must be adequately identified in relation to the proposed use; and it must be available at a convenient place when the consumer wants it.* (ibid., p. 423)

The ‘special character’ of the object is successively developed in the various steps that constitute the transvection. Differentiation of objects is important because the needs and requirements of users are diverse. The problem indicated by Alderson is that ‘*every differentiation which makes a product more suitable for a specified segment of the market makes it less suitable for other segments*’ (ibid., p. 424). Differentiation is thus associated with risk. In general, therefore, postponement of differentiation reduces this risk by moving the differentiation closer to the time of purchase.

With regard to the discussion above, it has been argued that objects may be transformed in the form, time, and place dimensions. Furthermore, the object also has a certain identity, related to an actor. This implies that the object is assigned to a certain actor, for example when an end-user orders a customised product. In this case, the object is assigned the identity of the end-user and cannot be sold to another end-user. This object is then differentiated in relation to other objects. Differentiation in form can take various shapes, ranging from advanced assembly and combination of raw materials to styles of packaging. Differentiation in form is not necessarily adaptation to individual end-users but can, for example, be efforts to secure a smooth movement of objects along transvections. Differentiation in identity is adaptation of features of the objects to the needs of a specific counterpart. Applying the concepts introduced above, assigning an object a specific identity leads to closely complementary activities since the activities from this point have become directed to a particular counterpart. For example, a specific customer may require a certain quality that is not used by other customers. Differentiation in the place dimension can, for example, be keeping inventories close to customers, thereby securing short delivery times.

When the principle of postponement is applied, differentiation in form should be postponed ‘*to the latest possible time in the marketing flow*’ (Alderson, 1950, p. 1). Furthermore, changes in inventory location should be postponed to the latest possible point in time (ibid.). For a manufacturer the ultimate postponement would be to initiate production activities only when an order from a specific customer has arrived. By doing this the manufacturer can reduce the risks associated with differentiation. However, this is only one of the factors determining economic efficiency in transvections. For example, if transformations in form are postponed as long as possible it becomes more difficult to capture similarities among transformations. This means that the possibilities of capturing economies of scale are circumscribed. Therefore, the principle of postponement has to be balanced against the principle of speculation.

According to the principle of speculation, differentiation '*in form, and the movement of goods to forward inventories, should be made at the earliest possible time in the marketing flow*' (Bucklin, 1965, p. 68). The principle of speculation relies on forecasts of demand. Speculation generally supports the capturing of economies of scale, but may result in substantial inventories. Traditionally, speculation has been the dominating principle (Zinn & Bowersox, 1988). This is because long lead times in production and distribution have made it difficult to rely on postponement. However, the development of information technology, transportation equipment and manufacturing techniques has made this option increasingly available.

Postponement was originally mostly discussed in terms of time and place postponement - taking 'finished products' as the point of departure (van Hoek, 2001). This meant '*...the postponed forward shipment of goods (time postponement) and maintaining goods at central locations in the channel (place postponement)*' (ibid., p. 167). Form postponement was later added and discussed, for example, by Zinn & Bowersox (1988), who identified a number of different types of form postponement; labelling, packaging, assembly, and manufacturing. Postponement can be discussed in three dimensions; time, place, and form.

We have now discussed how distribution networks can be conceptualised in terms of activities, and go on to elaborate on resource structures in distribution networks.

2.3 Resource structures in distribution networks

In this section different kinds of resources involved in transvections are discussed. In the previous section, activities were dealt with and it was argued that the possibilities of capturing similarities are closely related to how objects are assigned to resources, which is related to how sorting is performed by the actors involved. Two different kinds of resources are now further discussed, resources used for transformations and resources used for sorting. The objects, as defined in section 2.2, constitute a third kind of resources when used as input to transformations.

Before elaborating on these different kinds of resources, there is a brief discussion on resource heterogeneity, because the assumption of resource heterogeneity is central in this thesis.

Resource heterogeneity

According to Holmen (2001), in *'...the Industrial Network Approach, 'resources heterogeneity' is put forward as perhaps the[19] most central assumption'* (p. 142). She further argues that different authors have attached different meanings to the concept. She describes a number of different ways in which the concept has been used within the Industrial Network Approach. These are of special interest to the work in this thesis, will be described below[20].

One of the most common ways of regarding resource heterogeneity in the Industrial Network Approach is to say that a resource is heterogeneous when its value is dependent on how it is combined with other resources.[21] This interpretation of resource heterogeneity implies that the value of resources is dependent on how they are combined with other resources and that resources therefore must be analysed in relation to the context of which they are a part.

Resource heterogeneity has also been discussed in the Industrial Network Approach in terms of how a resource can be used in very different ways due to the resource's multifaceted character, its versatility. A resource can theoretically be combined with other resources in an endless number of ways. However, not all these combinations are useful. Relating back to the earlier discussion above on meaningful versus meaningless heterogeneity, it is clear that some combinations of resources will prove to be meaningful for one user but meaningless to another. Versatility is also related to the flexibility of a resource in the way that it can be more or less easy to recombine one resource with others, i.e. to switch among combinations. Holmen (2001) argues that *'...different properties of a resource will be used in the different combinations and, thus, the (known) usefulness and value of the resource in the different combinations, between which it is possible to switch, will differ*' (p. 161).

For a firm, it is often necessary to combine resources in different ways, meaning emphasising some aspects and ignoring others (Håkansson et al.,

[19] The underlined word is emphasised by the original author.

[20] For an extensive review of how resource heterogeneity has been interpreted and used in the Industrial Network Approach, see Holmen (2001).

[21] This interpretation is often associated with Penrose (1959), who points out the importance of studying combinations of resources rather than resources in themselves since a certain resource will provide different services depending on what other resources it is combined with. Alchian & Demsetz (1972) also discuss what they refer to as effects of 'team production' which means that '*...1) several types of resources are used and 2) the product is not a sum of separable outputs of each cooperating resource.*' (p. 779)

1993). However, *'...although actors can 'choose to' disregard some of the heterogeneity, it does not imply that the heterogeneity only exists if actors see it...'* (Holmen, 2001, p. 165). This fact implies that depending on which aspects of resources are highlighted, different resource combinations can be accomplished.

In the previous section, we discussed activities in terms of transformations and sortings. One main difference between these is that they use different kinds of resources. Furthermore, as argued in the Industrial Network Approach, activities link resources to each other. Sortings are linked to the resources used for transformations in the way they direct a certain object to what is labelled a transformation resource. All actors involved in a transvection, in turn, perform sortings, and they need to have some specific knowledge of how objects can be combined. We continue the discussion on resources by elaborating on resources used for transformations and sortings.

Transformation and sorting resources

In section 2.2, activities in distribution were discussed. The transvection and its main types of activities, transformations and sortings were pointed out as key concepts in the activity dimension. Transvections also entail the activation of a large number of transformation and sorting resources.

In line with Heskett et al. (1964) a distribution network can be described in terms of '*fixed points, or facilities*' (p. 43) and other resources that connect these facilities. For example, factories and warehouses can be regarded as fixed points in place. Between facilities there need to be some connecting resources, for example, trailers and trains that physically transfer objects between them.

In this study, resources used to perform transformations are referred to as transformation resources. These can be of both a 'fixed type' and a 'connecting type'. Transformation resources can be more or less difficult to change (Gadde et al., 2002). For example, plants, warehouses, logistics hubs, and heavy machinery used for transformations are not easily transferred, but can be regarded as quite fixed in place in the short run. However, in the long run, this resource structure changes in different ways. Heskett et al. (1964, p. 101) argue that *'the relocation or installation of fixed facilities, especially plants, is an expensive proposition.'* Hence, a distribution network can be said to have a 'skeleton' of the 'fixed' transformation resources. For firms involved in the distribution network, the access to 'fixed' transformation resources becomes crucial. From each firm's perspective, some resources might be internal and

some accessed from other firms. Other transformation resources are more easily changed, for example light vehicles, and material handling equipment (Gadde et al., 2002).

Keeping the definition of the transvection in mind, objects are somehow transformed along it in terms of form, time, and place. Transformation resources are needed in order to accomplish these transformations. Form transformation requires, for example, equipment for material refinement, production, assembly, and packaging, as well as factories. Further, place and time transformations involve resources used for the physical handling of objects, i.e. equipment for transportation, e.g. trailers, fork lifts, and conveyors. Furthermore, facilities for storing and re-loading in terms of warehouses, transfer stations, and storing shelves, are needed. Workers performing transformations in the transvection are also important transformation resources to consider.

Furthermore, as pointed out by Heskett et al. (1964), the facilities of a firm are connected to its suppliers' and customers' facilities. This means that each facility is considered from the viewpoint of many firms. According to the authors, this:

> *...points up the need for close cooperation and coordination between logistics management and the logistics function in firms doing business with each other. No firm can be 'an island unto itself' in the general scheme of business logistics. Coordination and cooperation are more than desirable, they are essential. Although the logistics manager generally has little direct control over the operation of customer and supplier points, the effective planning and operation of his firm's logistics system depends in part on his knowledge and understanding of the characteristics of his suppliers' and customers' fixed facilities.* (p. 49)

Hence, each firm needs to consider its own transformation resources as well as their interdependencies with other transformation resources controlled by other firms. Furthermore, the awareness about facilities is tightly linked to how sorting resources are used, which will be discussed next.

As was discussed in section 2.2, objects are sorted in distribution networks. For example, an object (e.g. a PC) is assigned to a certain transformation resource (e.g. a trailer) since the PC has been bought by an end-user in a geographical area to which the trailer is bound. In order for objects to be sorted some kinds

of resources are needed, sorting resources. All actors need sorting resources, which can be described as resources used for handling information about objects and how objects can be sorted in different ways, and the effects of sorting. Sorting resources link transformation resources and objects to each other. The way objects are sorted is therefore closely linked to the possibilities for actors to access resources for sorting. 'Physical resources' such as computer systems, databases, product catalogues, the Internet, and individuals can provide information needed to make a sorting decision. From the perspective of a firm, these resources can be more or less accessible as some other firm often controls them. The installation of common information systems and the sharing of information among companies have increased the possibilities of 'improving' sorting. However, what is 'efficient' sorting is not given, but is perceived differently by different actors.

From the perspective of a firm the resource structure, in terms of transformation and sorting resources, is perceived as 'given' at a certain time. Within this resource structure, objects are selected and assigned by the use of sorting resources. As each transformation resource requires input in terms of objects, objects are also a kind of resources.

Objects as resources

In section 2.2, three kinds of objects were identified; conglomerate resources, transformation outputs, and end-products.

Conglomerate resources and transformation outputs are resources used as input in transformation activities. These resources come out of the transformations with new features, as transformation outputs. The new features are the result of objects entering the transformation resources and thereby change in the form, time, or place dimension.

As has been indicated above, transvections cross. We can now define, *a crossing point as a transformation resource to which objects related to different transvections are jointly assigned*. In Figure 2.6 below, a part of a transvection is illustrated, and how it is connected to other transvections through crossing points. The figure shows how the transformation outputs 'belonging' to five different transvections are assigned to the same transformation resource. After the transformation, the objects are assigned to other transformation resources and the focal object is assigned to a new and different transformation resource. This assignment is the result of a selection with regard to how the object 'fits' into a collection of objects. The example

implies that it is not only the individual transvection that is interesting but also how this transvection is connected to others.

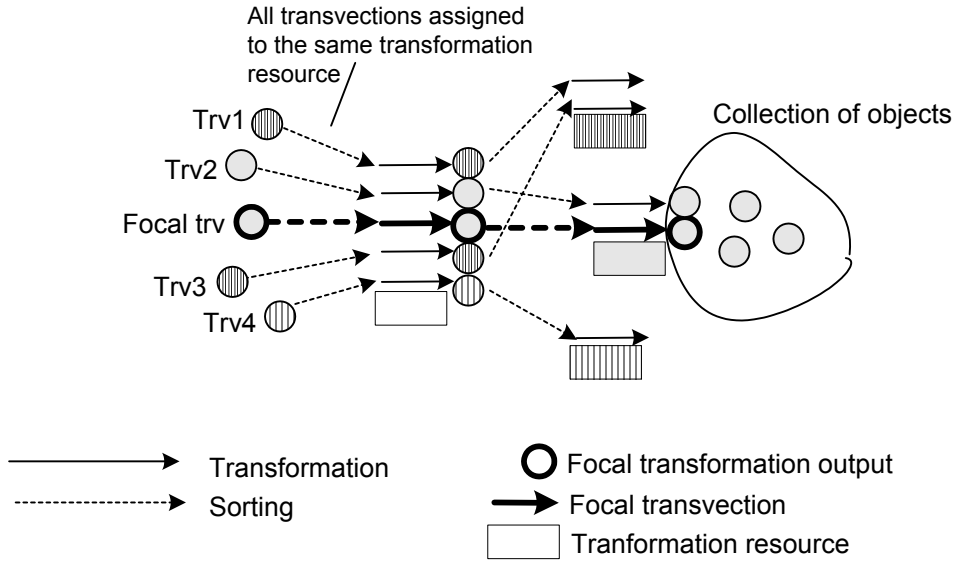

Figure 2.6 An example of transformation and sorting in a part of a transvection

By assigning objects to a transformation resource, the features of objects change. These changes appear in one or more of the three dimensions time, form, and place. However, as indicated above, the object can also change with regard to the actor dimension. This is the case when an object is assigned an identity related to a specific actor. The assignment to an actor, in turn, has an impact on the ways in which the object can be assigned in relation to other objects. Hence, objects can be assigned in the resource dimension, with regard to form, time, and place, and in the actor dimension, with regard to identity, and each object can be said to have a specific set of features in form, time, place, and identity. Furthermore, it is reasonable to argue that objects can be sorted in different ways on the basis of their resemblance in terms of these features.

Each end-user has some requirements concerning the output of a transvection, in terms of an end-product embodied with some features. The end-user performs a selection concerning these features, defining the end-product in terms of form, time, and place.

From a supplier perspective the challenge lies in providing opportunities for a transvection that matches these requirements in a cost effective way. In order to do so, objects are assigned and selected related to the resource structure and given identities related to the actor structure.

Likeness among objects

In line with the discussion above, Alderson (1965) argues that '*Goods are classed together for temporary convenience in shipping, storage, and display. Varying degrees of uniformity are called for at various stages in the production process'* (p. 33). In order to 'class objects together' and accomplish some 'degrees of uniformity', objects need to be sorted. We refer to this as a need to create 'likeness'[22]. The main reason for the need to create likeness is that it enables resources to be shared among objects, and can thus result in more efficient use of transformation resources. Objects can hence be alike in certain dimensions; time, form, place, and identity.

In line with this, an object can be sorted together with other objects with which it is potentially alike in different dimensions. If we consider one specific object we can identify a large variety of possible combinations in which this object can be sorted with others. Some objects are bound for the same geographical area as the focal one, resulting in potential likeness in the place dimension to be taken advantage of. Other objects are potentially alike in the form dimension and can thus make use of the same equipment for refinement and assembly, and thereby likeness can be created. Some objects might need to be delivered simultaneously, leading to that likeness in the time dimension can be created. Furthermore, objects directed to the same actor are alike in identity.

By identifying potential likenesses in the time, form, place, and identity dimensions, creation and capturing of economies of scale is made possible as a result of resource sharing. Figure 2.7 below illustrates 13 objects that are alike in different dimensions. The object ' in the centre' of the figure is alike with regard to all the other objects but in different dimensions. The object in the centre is, for example, alike in identity with regard to the three other objects marked 'A' in the figure at the same time as it is alike with the objects marked bold in the place dimension, etc.

[22] Alderson refers to this kind of uniformity as partial homogeneity. However, we use the term 'likeness'. This is due to the fact that in this study we assume that all resources are heterogeneous - by definition. Hence - no resources can be homogeneous - but they can be alike in certain dimensions; time, form, place, and identity. Therefore, the concept 'likeness' is used in order to discuss situations where objects are 'alike' in different dimensions.

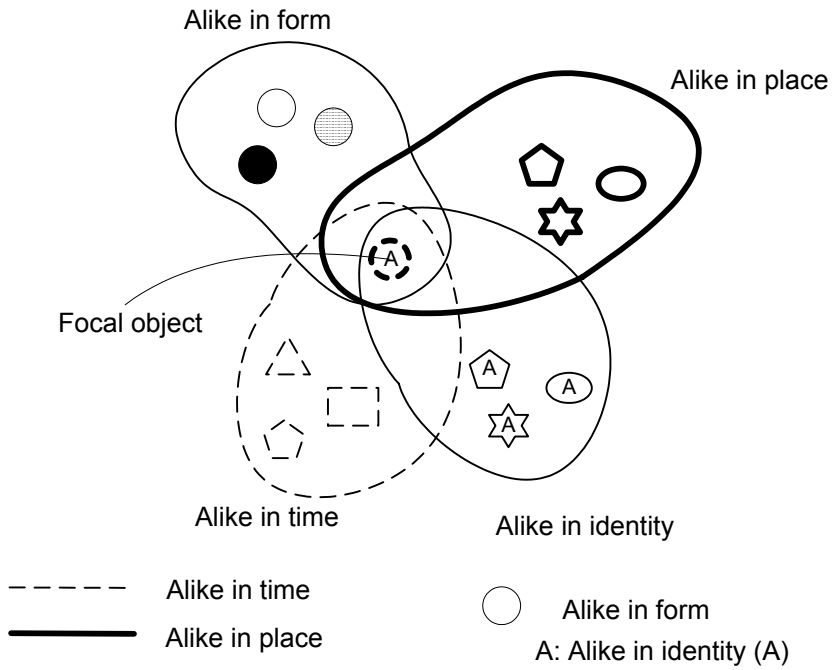

Figure 2.7 Likeness among objects in form, time, place, and identity

Likeness can be related to Richardson's concept of similarity in the way that the identification of potential likeness among objects makes it possible to capture similarities in activities. By taking advantage of objects being potentially alike it is possible to increase the utilisation of resources. This, in turn, affects the efficiency in transvections as the identification of potential likeness is related to the creation of likeness among objects both within and across transvections.

In the preceding discussion the possibility of combining objects on the basis of their potential likeness was stressed. However, the identification of potential likeness among objects is not trivial. The possibility of identifying and making use of potential likeness is therefore crucial. One fact that relates to this issue is that various actors often perceive objects differently. This is stressed by Ballou (1973, p. 90):

> *The product is a collection of perceptions by the logistician, by sales people, and by the customer regarding the characteristics of the product, the customer service associated with the product, the product price and the package.*

We have now discussed three kinds of resources involved in transvection analysis: transformation resources, sorting resources, and objects. To sum up

this discussion an overview of the kinds of resources and how they are connected is provided in Figure 2.8 below.

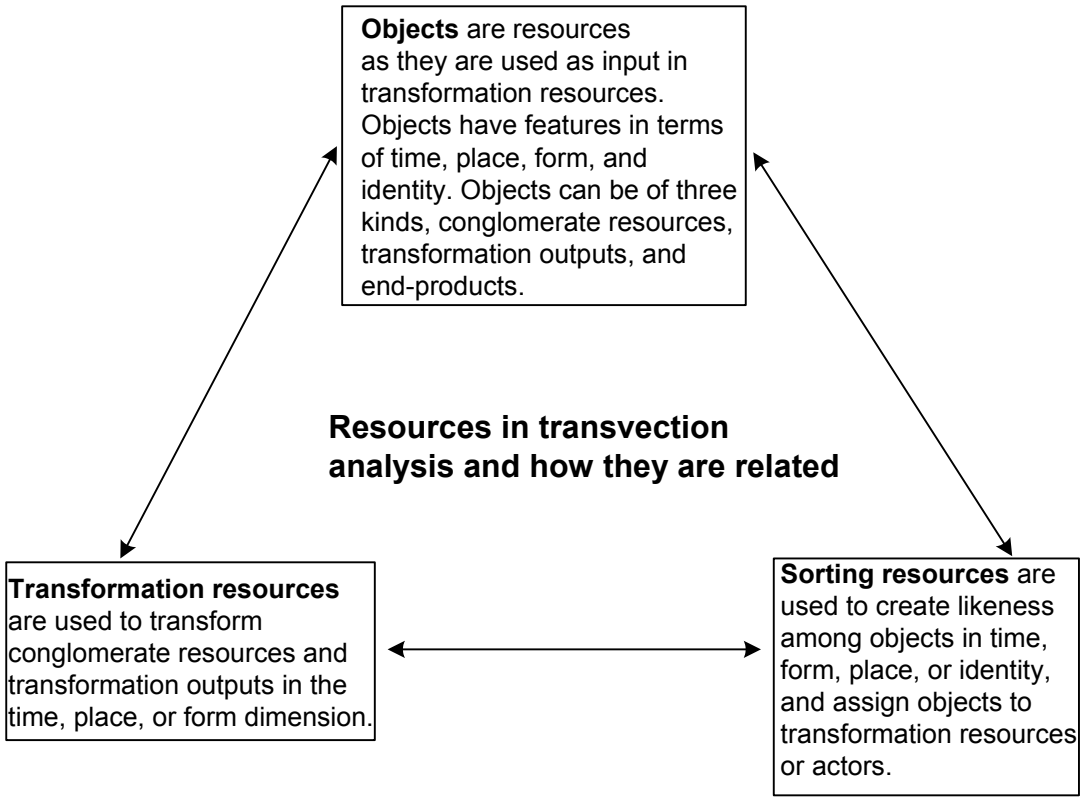

Figure 2.8 Summary of the kinds of resources used in transvection analysis

2.4 Actors' perspectives on distribution networks

As conceptualised in this chapter, a distribution network is seen as a resource structure, which, in turn, is activated by activities, i.e. transformations and sortings. Actors perform activities and they therefore take certain positions in the distribution network. The position reflects the way the actor connects its internal activities and resources to other actors' activities and resources.

Henders (1992) argues that the concept of position implies that an actor is defined as much by the resources of other actors to whom it has relationships as the resources within the legal boundary of the actor. Furthermore, '*It is the position that states that a focal actor is embedded in its context, whatever it might be, or was, or will be*' (ibid., p. 151). With this view, a firm's position in a network is defined by how it is related to its network context. It also stresses the importance of taking into consideration what is beyond the formal firm boundary in addition to what is 'within' this boundary. This is in line with Dubois (1998) who argues that the formal firm boundary needs to be regarded

in the light of how the actor is connected to activities and resources performed and controlled by other actors. This also implies that a firm can be illustrated in terms of its position with regard to how it connects its own resources and activities to other firms' activities and resources, directly as well as indirectly (see Figure 2.9). In this figure, a focal firm is positioned in the centre of the left picture. In the right picture, a cross-section is shown, illustrating four actors and the resource ties and activity links between them, as well as to other actors. Each of the four actors has a position in the network defined by its activity links and resource ties.

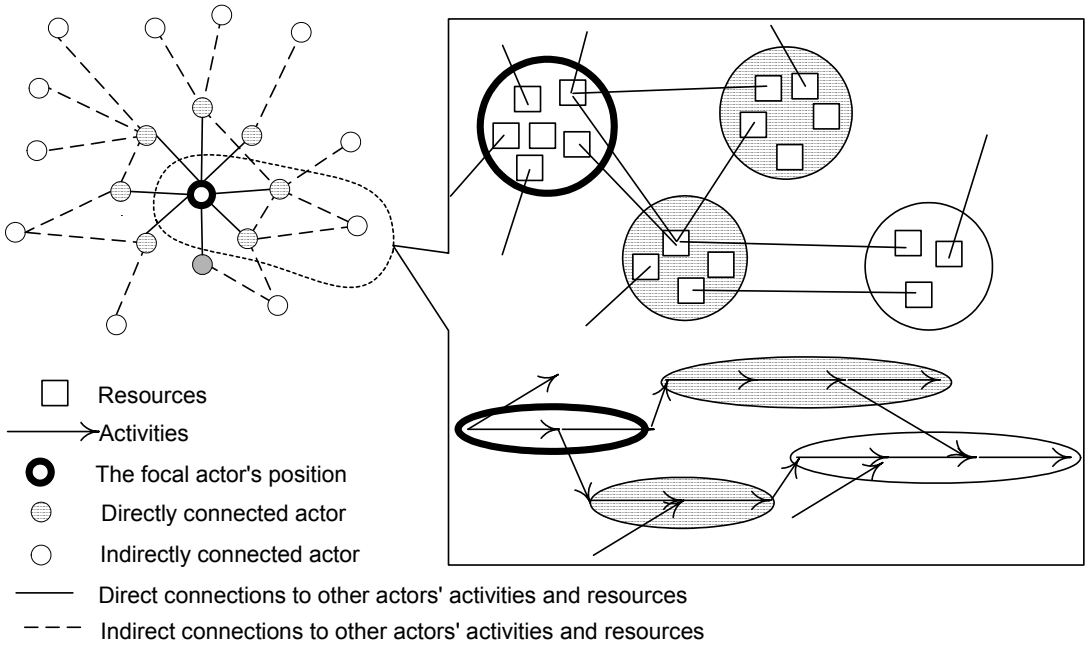

Figure 2.9 Actor positions in a network

In the preceding sections, 2.2 and 2.3, transvections and crossing points have been highlighted as useful for analysing distribution networks. Firms take part in these networks as they perform activities and control resources. For firms, when considered as actors, it therefore becomes a main issue how they can act in distribution networks with regard to their positions.

2.5 Research issues

From the discussion so far, the following research issues are identified:

- The first deals with the activity dimension and focuses on *variety with regard to the organising of transformations and sortings in distribution networks.*

- The second deals with the resource dimension and focuses on *variety with regard to the access and use of transformation and sorting resources in distribution networks.*

- The third deals with the *interplay in distribution networks between the characteristics of the activity and resource structures on the one hand and the features of objects and the creation of likeness among objects on the other.*

Actors perform activities and control resources. This entails that the variety in which activities and resources are organised has implications for actors being parts of distributions networks. Thus, the implications for actors of these issues are also dealt with.

3 Methodological Considerations

The aim of this chapter is to discuss the underlying research process of this dissertation and the four-year study on which it is based. The research environment in which this study has been conducted is discussed in section 3.1. The present study was preceded by another study, resulting in a licentiate thesis, Hulthén (1998). Since this research process had implications for the present study, a brief description and discussion of the licentiate project is provided in section 3.2. This is followed by an outline and elaboration of the research process of the present study in section 3.3 and a discussion about the methodological considerations in relation to the aim of this thesis and the underlying research issues in section 3.4. The research approach and methodology applied are discussed in section 3.5. Data collection is dealt with in section 3.6.

A discussion of the *trustworthiness* of the research is held in the final section of the thesis (see section 10.3). I have chosen to place this part of the methodological considerations in the very end of the dissertation, as I strongly believe that the reader needs to take part of the 'total work' before being able to reflect upon the trustworthiness of this research.

3.1 The research context

The study on which this thesis is based was carried out at the Department of Industrial Marketing at Chalmers University of Technology. The research at the department is mainly focused on the Industrial Network Approach, introduced in section 2.1 above. The approach has been applied to many different areas at the department, e.g. purchasing, distribution, and technological development. This common use of the approach means that the researchers at the department share a conceptual language as well as some central concepts and assumptions. The fundamental assumption underlying the approach is the view of firms being embedded in a network of other firms, implying that when a firm is studied, it is of interest to take into consideration how it is related to other firms.

This theoretical focus has had a major impact on the research process of this study. When I arrived at the department as a recently graduated mechanical engineer my theoretical knowledge concerning marketing was very limited. The lack of an existing theoretical understanding of markets meant that the Industrial Network Approach, which was introduced to me on the very first day

I spent at the department influenced my understanding of markets as it developed during the following years immensely. Furthermore, my background as an engineer also made it easy to accept the view of firms being interrelated, often as a result of technological interdependencies.

The research environment of which I have been a part is not limited to the department at Chalmers, but can be seen as a network of different academic departments and individuals. This 'extended department', with a shared academic base in the Industrial Network Approach, has been an important source of inspiration and an influencing factor during my research process. Our common conceptual language has facilitated interaction with people at research meetings, seminars, workshops, and conferences.

Beyond the 'academic network' I have also been part of an industry related network, which has played an important role in this research process. This network, the ERFA[23] group, consists of about 10 people working as logistics or marketing managers in different industries. The main aim of the group is to exchange experience. This is done at meetings twice a year, where we elaborate on one specific industry-related issue proposed by one of the members. My role in this group has been as secretary and later as a discussant. During the five years I have been part of this group many challenging issues have been dealt with, all more or less directly related to my research interest. The discussions with the group members have therefore come to be a great source of inspiration for my work with the dissertation project. The discussions have challenged my own thinking about distribution and the great diversity in industrial contexts represented in the group has increased my understanding of how the logic of distribution varies in different industrial contexts. Some of the members have also been or are potential contributors to the present and planned research projects. Hence, the group members and my relationships with them are also a potential source of data.

3.2 Implications from the preceding study

Owing to the theoretical focus at the department, the Industrial Network Approach was a natural starting point when the first study was initiated. The study resulted in a licentiate thesis, Hulthén (1998), focusing on a relational perspective on changes in distribution. Two empirical examples from the telecommunications industry were used to analyse the effects of two types of

[23] The ERFA groups are operated by MTC, a foundation aiming at bridging the 'gap' between industry and academia in the field of marketing.

changes. The first dealt with a change in an existing relationship and the transfer of activities between two firms. The second dealt with the establishment of relationships with distributors.

My work with the licentiate thesis inspired the present study in four main ways. First, the study resulted in an increased interest in the Industrial Network Approach as a means of understanding the nature of industrial markets. Second, it led to an interest in exploring distribution issues further. Using the Industrial Network Approach in a distribution setting, it became evident that one change can cause widespread effects, for the actors involved, for the relationship per se, and in the surrounding network. Hence, the study pointed out that distribution networks are characterised by substantial interdependencies, and thus *'...the importance of treating production, distribution, and consumption as interrelated'* (Hulthén, 1998, p. i). I considered this interesting to investigate further and took it as one of my main assumptions when continuing with the present study. Third, during this study that my interest in exploring 'variety in distribution' was generated. Fourth, during my study of the telecommunications industry, an interest in the PC industry developed. This was a result both of the many similarities and of the differences between the two industries that were highlighted during the work with the licentiate thesis. The characteristics of the PC industry in terms of its great variety in how distribution is organised made this empirical field interesting for the present study.

3.3 The research process

When my licentiate thesis was finished in December 1998, my focus turned to finding a direction for the present study. At that time I was introduced to the part of Wroe Alderson's work that later turned out to become a main cornerstone in this dissertation - the transvection. One of my supervisors, Lars-Erik Gadde, who had written an historical review of marketing especially focusing on distribution issues (Gadde, 2000), provided the inspiration for using the concept. During the search for material for his article he 'rediscovered' this concept and introduced it to me as 'something that might be useful…'. It is interesting to note that when faced with this concept I recognised it as a concept being discussed in a doctoral course in my early studies as a doctoral student. At that time, however, I could not see how it could be used. Confronted with it again at this later point in time the situation was totally different. I soon felt that this concept could help me approach the phenomenon of 'variety in distribution'. It helped me describe the 'total chain of activities', taking into consideration the activities involved in production, distribution, and consumption as an integrated whole. There was also some

kind of 'gut feeling' at that time that the division of a transvection into transformations and sortings could help me to understand how variety in distribution networks could be approached. This highlights the importance of timing in the research process and the fact that something you cannot assimilate at one time can turn out to be a central issue later. According to Dubois & Gadde (2002, p. 555), '*...theory cannot be understood without empirical observation and the other way around*' Hence, the first time I was confronted with the concept I had no empirical observations to relate it to and could therefore not assimilate its potential, which I could at the later stage, having an empirical context in which I could see it.

As stated above, I decided early that the PC industry was an interesting area for further study. Then, during 1999, three new areas of interest were identified: the pulp and paper industry, the construction industry, and the industrial tools industry. I conducted some short investigations concerning these areas during the spring of 1999. At an internal seminar on methodological issues in May 2000 the question concerning single vs. multiple case studies was raised. The main question posed to me at this seminar was 'What do four cases tell you that one cannot?' As I had a hard time answering this question it was something that occupied my mind for about six months. For me, this was a rather frustrating period of time, having started to work with all four cases. As I found them all interesting it was hard to give any of them up.

A first attempt to elaborate on the transvection concept resulted in a research proposal presented at a workshop in August 1999 (see Hulthén, 1999). In this paper I tried to link the transvection concept to the Industrial Network Approach, which proved to be fruitful. Furthermore, based on eight interviews with firms in the PC industry performed during the spring of 1999 this area was brought forward as a possible empirical area for the study. In addition an example from the construction industry was brought forward, based on five interviews made in 1998 concerning the production and distribution of mineral wool, see Gadde et al. (2000b). The interviews made me believe that both the PC industry and the construction industry could be interesting areas to explore further if variety in distribution was a main issue.

Three more interviews were made in the PC industry during the autumn of 1999. Based on this data, a first attempt to apply the transvection concept in an empirical context resulted in two papers during 2000. In Gadde et al. (2000a) the concept was used to analyse three different transvections in the PC-industry. At this stage of the study the focus was on distinguishing different transvections with regard to how the activities involved were organised.

Further, in Hulthén et al. (2000) we argue that the transvection concept in combination with the Industrial Network Approach and Richardson's (1972) framework for analysing activities could be used fruitfully as a framework for capturing the forces that drive developments in distribution systems. By combining the transvection concept with other concepts in this way, the theoretical framework developed successively.

I eventually decided to concentrate on the 'PC case' at 'the expense of' the others at the turn of the year 2000/2001. The main reason was that I wanted to probe more deeply into the nature of variety and I considered it more fruitful to explore one empirical area in greater depth than several areas superficially.

One of the main criticisms of the paper by Hulthén et al. (2000) was that we had focused the analysis on individual transvections. This issue had also been discussed at an internal seminar. In addition, some of the firms interviewed were in some way connected to each other, not only within transvections but also across transvections. A choice of direction of the study now appeared. One option was to continue to focus on single transvections. This would probably have meant that the search for variety took other directions, focusing on finding different types of transvections illustrating variety in various dimensions. The second option, the one eventually chosen, was to take another direction, focusing on capturing the connectedness among transvections. This choice was made as a result of my belief that the connectedness among the transvections also had implications for how single transvections are organised. 'Crossing points' then appeared as a second useful and complementary concept to the transvection. Hence, the remaining 19 interviews were focused around both individual transvections per se as well as how they were connected with others. This choice directed the data collection in another way than would have been the case if the other track had been taken. More information about the interviews as well as other sources of data is provided in section 3.6, dealing with collection of data.

The notion of crossing points and their implications for the further work was highlighted in another work-in-progress paper presented at a workshop in August 2001. The ideas presented in this paper were to a large extent a result of some reflections I made in relation to a doctoral course on distribution I attended during spring 2001. In this course I had the opportunity to look extensively into the supply chain literature. This review highlighted that the transvection concept captured something this literature did not take into consideration - sortings. During the autumn of 2001, working with the

developing case and framework, it became clear that sortings would be a key to my understanding of variety and how it is dealt with in distribution.

3.4 Methodological considerations and the phenomenon

This thesis deals with 'variety in distribution'. What methodological implications does this focus bring with it?

The research issues as identified in section 2.5 deal with variety in two main dimensions, activities and resources. The underlying theoretical framework used in this thesis, the Industrial Network Approach, emphasises the interrelatedness among these dimensions as well as within each dimension. The research issues focus on:

1. variety with regard to the organising of transformations and sortings in distribution networks
2. variety with regard to the access and use of transformation and sorting resources in distribution networks
3. interplay in distribution networks between the characteristics of the activity and resource structures on the one hand and the features of objects and the creation of likeness among objects on the other.

All these issues emphasise the importance of capturing aspects of interrelatedness, within as well as among firms involved in distribution. One of the main conclusions of the earlier study was the notion of the *importance of treating production, distribution, and consumption as interrelated'* (Hulthén, 1998, p. i). This implied that the interrelatedness involved both firms within 'distribution' and firms involved in production and distribution.

In chapter 2, the transvection was brought forward as a tool for analysing variety. This concept is especially useful as it takes into consideration the 'whole' process, which was regarded as important as pointed out above. Sorting also came to be seen as a concept useful for understanding variety in distribution. Alderson (1965) describes a distribution network as consisting of a large number of interconnected and converging branches. The transvection concept also emphasises interrelatedness, but, only among the activities involved in a transvection. Hence, the interrelatedness among activities and resources within transvections became one main aspect to explore. However, it became apparent that the interrelatedness does not stop at the transvection boundary, and so interrelatedness among transvections also became a central issue to explore. This led to the identification of what was labelled crossing

points. The notion of crossing points led to a direction of the empirical study as focusing on both transvections and crossing points. These concepts contributed to the understanding of the interrelatedness among the activities and resources in distribution networks. This, in turn, was important in order to explore the main issue - variety in distribution.

The use of the transvection as a conceptual tool brought with it some methodological considerations. Let us recapitulate the definition of a transvection as:

> *... a single unit of action of the marketing system. This unit of action is consummated when an end-product is placed in the hands of the ultimate consumer, but the transvection comprises all prior action necessary to produce this final result, going all the way back to conglomerate resources.* (Alderson 1965, p. 92)

For practical reasons, most studies cannot '*go all the way back ...*' as suggested by Alderson (1965, p. 92). This emphasises the problem of identifying the conglomerate resources, thereby delimiting the structure studied. This issue needs to be regarded in terms of the aim of the study. As the aim of this study is to explore variety in distribution the crucial aspect is related to delimiting the structure to be scrutinised in a way that provides opportunities to identify and analyse different aspects of variety.

A PC consists of a limited number of standardised components with more or less standardised interfaces. This high degree of standardisation has led to the availability of a wide variety of different interchangeable components which, in turn, implies that '*there are many possible ways to organize the value chain*' (Curry & Kenney, 1999, p. 16). A representative PC consists of the following components; chassis, motherboard, memory, processor, hard disc, CD drive, and disc drive. Although these components are often interchangeable, the way they are combined will affect the performance of the PC, both in itself, but also in a computer network context where PCs need to communicate with each other. In this study these 'basic' components are regarded as conglomerate resources. This also means that we delimit the study, excluding the production of components. This limitation results in the components, defined as conglomerate resources, being regarded as 'givens'. However, with the aim of this thesis in mind and the fact that more or less all components are of a standard type, the variety is related to the selection of components and how they are combined rather than how they are produced. Going back to the raw materials of silicon and iron would not improve our understanding of variety in

PC distribution. This limitation is closely related to the empirical context of the study, and if the study had been carried out in another empirical context the delimitation would have been different.

Another problem concerning the use of the transvection as a tool is its definition as comprising '*...all prior action*' (ibid., p. 92). In this thesis, all actions have been interpreted as all activities of relevance on a certain aggregation level, since mapping *all* activities would not contribute to the understanding of the problem. This means that in the analysis of transvections, different levels of analysis are used. For example, sometimes the activity 'assembly' is focused and in other cases the analysis needs to go into 'assembly' and analyse the assembly activities on a more detailed level, for example indicating the order in which operations are performed.

The problems and benefits of delimitations in network studies in distribution have been discussed by Andersson (1992, p.49):

> *The apprehension of embeddedness[24] and connectedness, as presented in network theories, creates methodological problems, but also opportunities to include network relationships outside a fairly clearly defined 'type' channel, i.e. manufacturer, wholesaler, retailer, customer. Focus and network delimitation can be shifted depending on the purpose and the problem studied. For different purposes, the interrelated actors comprising the network can also be defined in several ways. The traditional way of defining distribution actors as institutions of firms can from a network perspective be inadequate or even misleading.*

In line with this, I have tried to refrain from discussing the actors involved in distribution as identified in terms of their vertical and/or horizontal positions with regard to each other. This is stressed in the outline of the 'empirical network' in chapter 5. However, they are still sometimes referred to as reseller, distributor, etc. since this terminology is the 'industry jargon' within the PC industry as well as in mainstream distribution literature. In the analyses in chapters 6 and 7, however, I try not to use this terminology since I do not regard it as analytically useful in this study.

[24] The underlined words in this quotation were emphasised by the original author.

3.5 The research approach and applied methodology

The dissertation is outlined in quite a deductive manner, for pedagogical reasons. However, the layout does not mirror the actual research process as illustrated above. Instead, the research process can be better described by what Dubois & Gadde (2002) label 'systematic combining'. They argue that the '*…main characteristic of this approach is a continuous movement between an empirical world and a model world. During this process, the research issues and the analytical framework are successively reoriented when they are confronted with the empirical world*' (p. 554). This is a very good description of the process underlying this thesis. The study started out with an overarching interest in exploring 'variety in distribution'. From this, as indicated in the previous section, the theoretical framework developed gradually as the study proceeded. The same is true for the development of the research issues, that were a result of a continuous reorientation of the study.

The main objective of this study is theory development. Arguments for theory generation are provided by for example Glaser & Strauss (1967), arguing for a 'grounded theory' approach, and by Brunsson (1982), discussing 'language building'. These authors argue for an inductive approach when the aim is theory generation and development. However, in this study, which can be described in terms of systematic combining, the starting points could be found both in the theoretical and empirical world. Then the study proceeded with a continuous moving back and forth between these 'worlds'. I believe, in line with Miles & Huberman (1994), that every '*researcher, no matter how unstructured or inductive, comes to fieldwork with some orienting ideas'* (p. 17). In my case these ideas were inspired by the Industrial Network Approach.

In accordance with systematic combining, the framework evolved during the study *'because empirical observations inspire changes of the view of theory and vice versa'* (Dubois & Gadde, 2002, p. 558). In line with this, when the transvection concept was introduced, this became a part of the framework and it was linked to the concepts of the Industrial Network Approach. The same was true for the theory dealing with the organising of activities provided by Richardson (1972). By successively linking different theories, the framework evolved parallel with the empirical observations. In this study, one concrete example of this is the identification of crossing points. The need to take into consideration what was eventually named 'crossing points' had its origin in both the theoretical framework and empirical observations.

According to Dubois & Gadde (2002, p. 558), studies aiming at theory developments are characterised by the *'...successive refinement of concepts'*. The research presented in this dissertation provides development of theory, both with regard to the Industrial Network Approach and the traditional distribution literature. For example, the transvection is refined in this thesis, both with regard to the identification of different kinds of resources involved in transvections and also by adding the 'crossing point' concept as a complementary concept. The use and refinement of the transvection concept provides new insights that can help us to understand distribution issues in alternative ways. The arguments for theory development rather than generation are linked to my belief that no theory can be generated totally in isolation from other theories. This implies that each new theoretical contribution needs to be somehow connected to other theories.

The study is based on a case study approach. Brunsson (1982) states that case studies are appropriate when dealing with 'language building'. Furthermore, according to Dubois & Gadde (2002), '*Case studies provide unique means of developing theory by utilizing in-depth insights of empirical phenomena and their context'* (p 555). Furthermore, they argue that systematic combining, where the theoretical framework, empirical fieldwork, and case analysis evolve simultaneously is particularly useful when the aim of the study is theory development.

Miles & Huberman (1994) argue that the research questions *'...may be refined or reformulated in the course of fieldwork*' (p. 23). In this study, preliminary research questions have been formulated in different settings during the research process as a result of the continuous redirection of the study. The research issues have been formulated in conference articles and in internal documents – and they have changed as the empirical fieldwork has continued, the case has been analysed and the theoretical framework developed.

A PhD student's (and perhaps also other researchers') agony related to the specification of research questions is nicely articulated by Kjellberg (2001, p. 7):

> *There is a deeply rooted belief in the import of a clearly formulated research problem within social science. At my own department this is reflected in a question - <u>What is your research question?</u>[25] - which I think has been raised*

[25] The underlined sentence is emphasised by the original author.

> *at every seminar where a doctoral candidate has presented part of his or her thesis. Usually, the question is put by a senior researcher, but younger ones soon catch on and quickly hurl this safe bet at the disenchanted respondent. After numerous attempts during the process of writing this thesis, I have reached the following formulation…*

This quotation perfectly illustrates my own frustration concerning this issue. On the one hand it was obvious to me that the research questions could not be definitely specified early in the research process but that they would evolve during the process. On the other hand, the continuously repeated question concerning 'What is your research question' was a recurrent annoying issue that had to be dealt with over and over again. The positive aspect of this is that it forced me to constantly approach this issue, formulating preliminary questions in my head as well as on paper. My conclusion is that the continuous questions concerning this study's aim and research issues helped me to keep on track (even though which track was not always clear) and to direct the study in new ways as a result of the formulation of new preliminary questions. Hence, although the research questions cannot be specified in advance when applying an abductive[26] approach it is important to often raise the question and 'think about it'. By doing so, the researcher can be aware of the current direction of the study, both empirically and theoretically as well as being able to reconsider the research questions whenever the direction of the study changes. In my case, at the end of the process, the research questions eventually clarified, and at the time of printing they were as stated in section 2.5 on page 39.

Casing - the search for variety in distribution

Miles & Huberman (1994) point out that '*Qualitative researchers often struggle with the questions of 'what my case is' and 'where my case leaves off'*' (ibid., p. 25). Furthermore, Ragin (1992, p. 217) argues that '*The biggest obstacle to clear thinking about 'What is a case?' is the simple fact that the term 'case' is used in so many different ways'*. In line with this, during the process underlying this study, the questions concerning if I actually had a case and how the case could be defined occupied my mind for a rather long time.

[26] Abduction is a research approach that is about '*investigating the relationship between 'everyday language and concepts''*(Dubois & Gadde, 2002, p. 555) This approach is the main source of inspiration behind what they refer to as a research process characterised by systematic combining

The case developed successively during the research process in interaction with the evolving framework. My opinion with regard to 'what is my case?' is that it is *one single* case since the couplings among the elements in the case are related to a *single setting* and that these couplings have a meaning for the analysis of the case.

Dubois & Gadde (2002, p. 558) argue that in systematic combining one important consequence is that:

> *... the case evolving during a study can be regarded as a 'tool', as well as a 'product'. ...Considering the case as a 'tool', the pieces of data added to it may be looked upon as pieces in a jigsaw puzzle. In the beginning, very few pieces fit while patterns become clearer with every effort. One difficulty is that pieces from many jigsaw puzzles tend to show up, which calls for selection during the process.*

In this study, the couplings among the elements in the case became essential for approaching the aim of exploring variety in distribution. The casing process can hence be seen as 'the search for variety in distribution'. With the notion of interrelatedness among firms and their activities and resources, the couplings became essential for the casing in this study. The couplings were not clearly identified from the beginning and this resulted in uncertainty as to whether the empirical data could be seen as one case 'of distribution in the PC industry' or whether the data instead should be regarded as many cases, illustrating different kinds of distribution structures, although all of them in the PC industry. However, the continuous matching between theory and fieldwork led to the couplings becoming a main issue to explore in order to search for variety in distribution. This reorientation of the study led to some of the collected data being rejected during the process and therefore not appearing in the final version of the case. The reason for this is that some data was no longer considered relevant, as it did not contribute to the study after the redirection of the focus. Instead the redirection led to a need for new data that could contribute to the understanding of the phenomenon approached.

In the theory, the importance of the couplings was highlighted by the fact that transvections, and especially sortings, could be better illustrated if couplings between the elements in the case could be explored. This resulted in the boundaries being expanded to focus both on transvections per se and also on how they were connected at crossing points. During the interviews, it also became clear that many of the companies interviewed were somehow

interconnected. This led to a deliberate search for and efforts to identify these couplings. This was done in a process referred to by Ragin (1992) as casing. In this way the case successively developed. Ragin (1992, p. 221) argues that '*…when cases are made the process of casing consists of matching ideas and evidence.*' He also points out that cases are often delimited and found during the course of research that was also the case in this study.

All in all, as the analytical framework and fieldwork progressed the case became more and more visible and I felt increasingly convinced that it could and should be regarded as *one single* case, as the elements included in the case appeared in a single setting. Although I eventually found myself confident that I actually had a single case, labelling the case remained a tricky issue. I chose to approach this by merely referring to it, as illustrated in the title of chapter 5, as 'The Empirical Inquiry'.

3.6 Data collection

Now, why did I end up with this specific data? The 'choice' of companies to interview can be explained in the following way. I started out with one reseller of PCs. The reason for starting with this firm was simply that one of my supervisors already had an established relationship with one of its employees. As it was unlikely that I could do any 'better' sampling this seemed like as good a starting point as any. This interview provided me with a first 'map' to continue with.

Dubois & Gadde (2002, p. 557) argue that '*…the way boundaries are expanded* [in the empirical world] *is of major importance because it determines what will be found. ...In one way the extension of the boundary can be seen as the 'sampling' problem in case studies.'* The main method of data collection used in this study is interviews. By interviewing persons within the PC industry the case successively developed in different directions. The focus when selecting firms to interview was initially to identify and describe a number of different transvections. As pointed out above, the notion of crossing points became a main issue in the end of the data collection. Complementary interviews were performed in order to explore these crossing points greater depth. By expanding the boundaries of the data collection to focus on transvection crossing points, a need of new 'sampling' in line with the quotation above arose. Furthermore, as the data collection proceeded, focus was more and more on actively searching for variety. So when do you stop collecting data? In my case, which in no way can be said to cover all aspects of

transvections, I stopped when I felt that I could illustrate what I perceived to be the central aspects of variety in distribution.

The main aim of the data collection was to illustrate concepts such as transvections and crossing points in order to be able to analyse the material in a way that reveals the variety in distribution networks. As the empirical fieldwork progressed, there was a deliberate search for transvections and crossing points illustrating variety in different ways. According to Miles & Huberman (1994, pp. 29-30) qualitative sampling is often theory-driven.

> *Choices of informants, episodes, and interactions are being driven by a conceptual question, not by concern for 'representativeness'. To get to the construct, we need to see different instances of it, at different places, with different people- The prime concern is with the conditions under which the construct or theory operates, not with the generalization of the findings to other settings.*

In my case the 'choices' of companies and persons to interview was the result of two of the sampling strategies outlined in Miles & Huberman (1994), the 'theory based' and the 'snowball or chain' strategy. The purpose of the theory based sampling is to find '*... examples of a theoretical construct and thereby elaborate and examine it'* (p. 28). For example, as the study aims at exploring variety it was important to identify different kinds of transvections and crossing points, with different characteristics. The purpose of the snowball or chain strategy is to identify '*... cases of interest from people who now people who know what cases are information-rich*' (p. 28). For example, talking to different people led to new tracks, i.e. companies that worked in a certain way that could complement the material or specific persons with a great deal of experience from the PC industry.

One problem related to the 'choice' of people to interview is that the variety in, for example, the need of different end-users in an organisation is much more extensive than any respondent can illustrate. As I was interested in capturing variety among different ways of producing, distributing, and using a PC, greater focus was put on illustrating a broad spectrum of ways rather than digging deeper into a detailed level of variety within each firm. However, I tried to capture this variety by posing questions about the variety of, for example, different end-user requirements and how this was handled within the organisation.

The data collection was focused on understanding structures in distribution networks. In the empirical data presented in chapter 5 there is also some data concerning processes. This kind of data is included as a context for the structures, as it is sometimes helpful to the reader to understand why a certain structure has emerged. This information is, however, not explicitly used in the analyses in chapter 6 and 7.

Sources of data

Eisenhardt (1989) states that: '*Case studies typically combine data collection methods as archives, interviews, questionnaires, and observations.*' (p. 534) In this study three main sources were used: interviews, official company information and articles in PC-related magazines.

Interviews were used as the main source of data, as pointed out above. A total of 30 interviews were performed with 28 individuals, involving 21 firms. The interviews were conducted in 1999 to 2002. These firms represent different 'categories' involved in, for example, using PCs, assembly, warehousing, shipping, and sales. Most of the people contacted were very accommodating and agreed to participate without hesitation. Only in two cases, did I have some trouble getting individuals to contribute. The first said no to an interview right away, on the argument that '..the firm was too busy trying to stay in the market'. The second was reluctant but agreed to participate. However, he only gave me 30 minutes for the interview and was quit unwilling to answer questions and therefore the material from this interview is not included in the thesis. As the aim of the search for informants was to illustrate variety in principle, it was possible to locate other firms and informants who could illustrate similar structures.

The interviews lasted for from 30 minutes to four hours, with an average length of about 90 minutes. The interviewees were informed, by phone or e-mail, of the general interest in the study of understanding variety in PC distribution networks, and that the interview would focus on the firm's position[27] in these networks. In some cases when the interviewee asked for more specific preparatory information an e-mail was sent identifying a number of more detailed questions. The interviews began with a presentation of the research project and myself. I also tried to explain how their specific firm fit into the overall project and why it was of interest for me to investigate this firm. Then I

[27] 'Position' as used here is not related to the theoretical concept, 'Network Positions' but is used in a colloquial sense, indicating the interest in elaborating on how the firm sees itself as one part of a larger structure of firms.

asked the interviewee to start talking about the firm and how he perceived its position and role[28] in the larger PC distribution network. The focus in the discussions with informants varied depending on what kind of firm he or she represented. However, some of the main issues discussed during the interviews concerned supplier and customer structures, information and physical flows, logistical arrangements, and end-user contacts. During the interviews, my aim was to let the interviewee speak freely in order to understand how he or she perceived operations and what was considered the 'heart' of the organisation. If I felt that the discussion was moving in a direction too far from my interest, I tried to redirect the discussion back on track again. Most interviewees seemed to think that the area was of great interest and were very willing to share information. I took notes during the interview and these notes were typed out more or less directly after the interview. By getting information from different perspectives some kind of 'overall' picture developed, as illustrated in the empirical network in chapter 5.

Not all the firms dealt with in chapter 5, the main empirical chapter, were interviewed, as can be seen in Table 3.1 below. Information about these firms has been provided by other firms and from other data sources. For example, the information about Schenker in 5.10 comes from the interviewee at Hewlett Packard. Furthermore, not all firms where interviews were conducted are dealt with explicitly in the thesis. Of the 21 firms where interviews were conducted, six are not described in the thesis. Only 15 of the firms where interviews were conducted are dealt with explicitly in the thesis. These are outlined in Table 3.1. This is mostly related to the fact that the interviews were carried out early in the data collection in order to obtain an overview of the empirical area. Another reason, as described above, is that as the study proceeded, it changed direction and this reorientation resulted in some data no longer being relevant to the study.

A second source of data was official company information provided on websites (see reference list). A third was PC-related magazines and daily papers. The number of articles was about 100 and the main titles of the magazines and Internet sources from which they were taken can be found in the reference list. The written and web-based secondary material provided general information meant to bridge gaps in the interview material and to confirm data from interviews. This data was also used when preparing for the interviews, as it provided some basic material concerning the nature of the firm and its

[28] See footnote 27 on the use of 'position'. The same is true of 'role'.

context that helped me to ask 'relevant' questions at the interviews, which hopefully led to the interviewee developing confidence in me as an interviewer.

In Table 3.1 below, an overview of the firms where interviews were conducted are included as well as how other sources of data were used to develop the empirical description in chapter 5.

Type of organisation	*Number of interviews*	*Job descriptions of interviewees and time of data collection*	*Web-site*	*Articles*
Producers				
Hewlett Packard	3	Information manager - 1999 E-business manager - 2001 Logistics Coordinator - 2001	Yes	Yes
Dell	2	Marketing Manger - 1999 Internet Business Manager - 2001	Yes	Yes
CapTech	1	Managing Director - 1999	Yes	No
Programmäklaren	1	Managing Director - 1999	No	No
Distributors				
Ingram Micro	2	Director of sales - 1999/2001	Yes	Yes
System Specialists				
IMS	1	No information available - 2000	Yes	No
Atea	3	Managing Director - 1999/1999/2001	Yes	No
Resellers				
Dustin	2	Marketing Manager - 2001 Purchaser - 2001	Yes	No
WestiumData	1	Managing Director - 2001	Yes	No
Retailers				
Siba/Computer City	1	Purchasing Manager (PCs) - 2001	Yes	No
Logistic Providers				
Irish Express	1	Distribution Supervisor - 2000	Yes	Yes
ASG	2	Team leader, Dell service parts - 2000 Team leader, Region West - 2000	Yes	No
End-users				
Chalmers	1	IT manager - 2000	Yes	No
Volvo IT	1	Purchasing Manager (PCs) - 2002	No	No
Pharmacia	2	Procurement Manager - 1999/2001	No	No

Table 3.1 Overview of data sources

The organisations in Table 3.1 are classified as follows. Producers are firms that design PCs and, to varying extents, assemble the components into a PC. Distributors, resellers, retailers, and system specialists are classified in accordance with Kaplan (2002):

- Distributors buy large numbers of computers and peripherals from various suppliers, aggregate the assortment and then sell to small resellers and retailers.

- Resellers sell standard desktops, notebooks, and servers to small and medium sized businesses. Resellers buy both from distributors and also directly from producers if they are large enough.

- Retailers sell standard desktops and notebooks to private individuals and small businesses. Retailers buy from distributors, and buy directly from producers if they are large enough.

- System Specialists sell all types of computers, but they are mainly focused on high-end business critical systems for medium and large businesses.

Furthermore, Logistics Providers are firms engaged in the physical and information flow without taking title to products.

In this chapter I have tried to outline the research process underlying this thesis. I have focused the effort on giving as clear picture as possible of how the process has developed during the years and its continuous 'going back and forth' between the empirical and theoretical world. I have tried to be 'straight forward' in my description of the process but it has inevitably been outlined from my own personal perspective. I have also tried to highlight different crossroads that I was confronted with and how I tackled these and why I 'chose' a certain direction.

4 Introduction to the Empirical Area

The aim of this chapter is to provide an overview of parts of the history of the development of the PC. It is not intended to be exhaustive, but merely to give the reader some idea of the nature of the contexts in which PCs are sold and bought.

The introduction of the PC was preceded by earlier development in computers. The development of 'modern computers' took off after the Second World War and was driven mainly by governments and the military. The first modern supercomputers were highly specialised and meant for use by governments and very large companies. A major event in the history of computers was the development of the microprocessor in the early 1970s. This new kind of processor could be manufactured and then programmed to meet a number of varying demands. Earlier, each processor had been designed and manufactured to fit specific purposes. This development meant that computers were no longer reserved only for large organisations and governments. In the mid-70s microcomputers entered the arena, giving small companies and households access to the new technology.

4.1 Setting the standard

The 'original' PC was developed by IBM and introduced in the USA in 1981. A PC consists of a very limited number of hardware and software components. One of the most interesting aspects of the introduction of the 'IBM PC' was that it had an 'open architecture'[29]. This means that the components have standardised technological interfaces and that the specifications are public. The reason for the 'open architecture' was that it would be easy for other manufacturers to develop peripheral hardware and add-ons[30]. This, in turn, would mean that the PC could readily be used in many applications, and its expandability was fostered.

What was new for IBM in this project was its heavy reliance on outside suppliers as opposed to the traditional internal sourcing policy. Even the actual fabrication of the PC was outsourced to suppliers through 'competitive bids' some of which were won by IBM departments (ibid.). Intel supplied the

[29] The advantage of an open architecture is that anyone can design add-on products for it. By making the architecture public a manufacturer allows others to duplicate its product.

[30] Add-ons refer to products designed to supplement other products. For example, there are numerous add-ons to connect to a PC to give it additional capabilities.

processor used in this first PC. An outside supplier, a 32-person company called Microsoft, supplied the operating system. Microsoft had bought the operating system from a local Seattle software house and modified it slightly. The operating system was renamed PC-DOS and sold to IBM. However, the agreement allowed Microsoft to sell this software to other companies. This meant that competing firms to IBM could enter but also helped to make the operating system 'a standard' (ibid.). According to Langlois (1992):

> *The IBM PC called forth a legion of software developers and producers of add-on peripherals. Its early phenomenal success also generated competitors producing compatible machines.*[31]

When the PC was introduced in the USA in 1981 IBM had already established sales subsidiaries with direct sales to customers for its existing computer systems and mainframe[32] computers. However, IBM realised that alternative routes to the customers were needed for PCs, as they were intended for smaller companies and organisations. Therefore, as a complement to the direct sales force, IBM started to use retailers for the first time, such as Sears and Computerland.[33] By 1987 the number of channel middlemen in Europe was 4000 (Gabrielson, 1999). By this time IBM's own subsidiaries sold large mainframe computers and PCs to large customers. In addition to the subsidiaries, value added resellers (VARs) sold smaller mainframe computers and PCs to small and medium sized enterprises (SMEs). Dealers, in turn, had begun to focus on sales to small customers.

4.2 The emergence of 'clones'

The 'compatible machines' were called clones, or IBM-clones. The first clone that was 100% compatible with the IBM standard was a 'portable' PC designed by Compaq, launched in 1982. Clones as well as the original IBM PC are what we refer to as PCs today and they are defined by their ability to use peripherals or software designed to function according to the standards set by the original IBM PC. When Compaq introduced the first clone they did not have a structure similar to IBM's subsidiary structure. Instead, they sold only indirectly, using

[31] This quotation is from page 10 of a downloaded 'full-text' version from the database ABI/Inform by ProQuest. No PDF version was available for printout.

[32] A mainframe computer is a computer with extensive capabilities and resources, to which other computers may be connected so that they can share facilities. The computer is usually placed in a computer central. Definition from www.ibm.com.

[33] This information is from the IBM web page: http://www1.ibm.com/ibm/history/history /year1981.html (2001-04-18).

authorised resellers with trained salesmen and technically educated service personnel.

Alongside the 'brand-clones', such as Compaq, there were assemblers of 'non-brand-clones'. These firms bought standard components, assembled them into PCs, and sold them through mail order or storefront dealers (Langlois, 1992).

In the beginning of the PC era most of the large PC manufacturers tried to keep the development and design of key components in-house (Magretta, 1998). However, owing to the modularity and open architecture, '*as the industry grew, more specialized companies developed to produce specific components*' (ibid., p. 74). Hence, the open architecture paved the way for manufacturers of peripheral equipment, and eventually manufacturers of PCs almost entirely outsourced the production of such components. This was very different from the mainframe and minicomputer manufacturers, who manufactured many of their own peripherals and components in-house (McKendrick, 1997).

In 1984, Dell was established, and focused solely on direct sales using direct-response advertising and telemarketing, and not traditional middlemen at all. Another major difference was that whereas other PC manufacturers built standardised PCs to estimated demand, Dell built and configured to individual customer orders. When Dell entered the PC industry they decided not to integrate backward into components manufacturing but to partner with reputable component suppliers. According to Magretta (1998), Michael Dell, the founder of the company, explained:

> *...if you've got a race with 20 players that are all vying to produce the fastest graphics chip in the world, do you want to be the twenty-first horse, or do you want to evaluate the field of 20 and pick the best one?* (p. 74)

So the standardisation of interfaces led to a specialisation in component manufacturing. Most PC manufacturers then became assemblers of third party components rather than manufacturers who designed, developed and manufactured components in-house.

The open architecture and the standardised interfaces of components made it quite easy to combine components into a functioning PC. This, and the fact that many companies use the same components, led to the commonly-held view that 'a PC is a PC' regardless of brand, which created the market for 'white-box' or 'non-brand' PC's. However, according to Iyengar (1996) the belief that a 'PC is a PC' is misleading since although many of the components are shared the

way they are integrated is critical and two systems with 90% identical parts can perform and behave rather differently, depending on how the remaining 10% are integrated (ibid.). Hence, not only the performance of individual components but also how they are combined is of importance to the performance of the PC as a whole. The view of the decreasing importance of the actual 'PC brand' is also highlighted by Borrus & Zysman (1997). They point out that PC producers, such as Compaq and IBM, emphasise components or software in their advertisements, e.g. 'Intel Inside' and 'Microsoft Windows installed', rather than the unique features of their own brands. Thompson & Strickland (1999) stress the importance of the components. They argue that the brand of components can be as important, or even more important, than the brand of the PC itself. For example, many PCs are marked with 'Intel Inside', indicating that the PC has an Intel processor. The importance of the components became even clearer when many PCs were integrated into larger networks. It then became crucial that the PCs could readily interact. For example, following the introduction of 'PC server products', Compaq introduced system resellers in 1991. These resellers had more extensive training and were better able to cope with customers' more complex needs and environments (Gabrielsson, 1999).

4.3 Individual consumers - the new challenge

In the early 1990s the use of PCs for consumers increased and both IBM and Compaq used retailers more. This expansion in indirect sales meant that there were thousands of business partners. Therefore, both IBM and Compaq began to use distributors in 1992, to manage the growing number of resellers and retailers. At this point, Compaq had 4200 'channel partners' in Europe alone (Gabrielsson, 1999).

Dell, with their policy of direct sales only, faced difficulties in the early 1990s when the number of private consumers increased, as it proved to be hard for Dell to manage so many customer relationships. Consequently, in 1991 Dell went into indirect sales in order to reach the increasing number of small businesses and individuals. The first step was to use retailers, such as CompUSA. This step was followed by the use of VARs, OEMs, and system integrators (Hayes et al., 1996). The entering into indirect sales was not uncomplicated, as the traditional dealers were very suspicious of Dell entering this 'channel'. The chairman of Computerland explained in an interview why they do not sell Dell products:

> *...we want to commit to someone who wants to be our partner. Dell doesn't really want to do that. They want to run the business and then try to find some cracks and crevices they can use us for, but whenever possible they want to go to the direct channel.* (ibid., p. 54, Case 4)

In 1995, IBM took a decision to rely only on indirect sales for its PC business. The main reason was that the 'channel partners' viewed IBM as a competitor, which led to conflicts (Gabrielsson, 1999).

Dell then reconsidered its marketing strategy and made the opposite decision, withdrawing from all indirect sales in 1994 and returning to direct sales (Thompson & Strickland, 1999). Since it was very hard for Dell to manage so many private consumers with its indirect telesales approach, it focused on sales to companies and organisations. At this time a new phenomenon had entered the arena – the Internet. The importance of the Internet to Dell was substantial. Michael Dell, the founder of the company, has expressed this by stating that '*…if the Internet hadn't emerged, we would have been forced to develop it.*'[34] This is not surprising since the Internet provided Dell with a new tool to reach many customers in a more cost-efficient way than the telephone.

In 1994, Dell launched 'www.dell.com' but not until 1996 could customers purchase from the website[35]. With the Internet as their tool, Dell refocused on the private consumer. In 1997 they created a special group to handle private consumers introducing a product line especially directed at this kind of customer (Thompson & Strickland, 1999). It became apparent that the most interested customers were those who already had a high degree of computer competence and were buying their second or third PC. These customers did not need a lot of support and could order exactly what they wanted and have it delivered to the door. However, the most interesting advantage with the Internet as perceived by Michael Dell is illustrated as follows:[36]:

> *But online commerce, and the use of the Internet as a sales channel, represent only a fraction of the Internet's value to business. The real potential of the Internet lies in its ability to transform relationships within the traditional supplier-vendor-customer chain. We are using the Internet to openly share our own applications*

[34] Interview with Björn Involdstad (2001-06-08).

[35] Information from: http://www.euro.dell.com (2001-04-25).

[36] Collaborating in a Connected Environment: The Power of Virtual Integration, Speech held in Vienna, Virginia, 1998-06-24. Information from http://www.euro.dell.com (2001-04-25).

with suppliers and customers, creating true information partnerships.

The most important effect of Dell's way of working may be the fact that it implies a very limited level of inventory. This, in turn, puts pressure on the companies working with more 'traditional structures' and relying on what is often referred to as a 'two-tier' channel, constituting a 'distributor level' and a 'reseller level', both of whom hold inventories. One fact that is often emphasised in the PC industry is the high speed of technological development. Owing to this fact there are constant releases of upgraded components, leading to major price reductions. This fact makes inventories crucial to all companies involved. Components may be out of date by the time a PC reaches the reseller or the customer. '*In an attempt to reduce inventory exposure a number of the largest PC assemblers such as IBM, Compaq, and Hewlett Packard are shifting some final assembly operations to distributors, thereby bringing the final product closer to the customer.*' (Curry & Kenney, 1999, p. 23). As indicated in the quotation, companies working with these 'two-tier' channels started to try to reorganise their structures into what has been labelled 'channel assembly programs'. These kinds of new strategies were partly a response to direct-selling PC suppliers such as Dell.

The introduction of 'channel assembly programs'

IBM set up its 'Authorized Assembly Program' (AAP) in 1995. This new approach meant that IBM manufactured and shipped partly assembled PCs to certain authorized distributors and resellers, who installed the final components to customer specifications. In 1997, IBM launched the 'Advanced Fulfilment Initiative' (AFI), which is a further development of the AAP. This meant that IBM appointed 12 partners who were given an increased responsibility for component inventory management and final assembly. They receive components directly from manufacturers and IBM and assemble the PCs to customer specifications. The activities are coordinated by an extensive EDI-system, which links IBM, the suppliers and the assembly partners. The objective of the program was to:

> *...improve every step of the supply and fulfilment cycle, from product design and parts procurement to forecasting, inventory management, assembly, shipping and delivery. The goal of AFI is to permanently reduce both piece-part and finished product inventories at IBM and reseller locations.* [37]

[37] http://www.pc.ibm.com/us/customsols/aap_afi.html (2001-05-02).

A manager at IBM has stated that: '*we are creating a virtual enterprise so that we can operate more efficiently, increasing speed and removing cost.*'[38]

In order to facilitate final assembly at the partners' locations, IBM redesigned the chassis of some PC models so components could easily be snapped on rather screwed in. It also became important to be able to replace one component without having to remove all of the rest. For example, in one model, the motherboard, which contains all the core electronics, could be slid out of a socket without removing cables first. In the same PC, the hard disk drive and CD drive were placed in a 'cage' that could be flipped out of the way of other components.[39] They also work with 'co-location', meaning that the partners perform assembly activities at IBM's manufacturing facility. From there, they can ship assembled PCs directly to the end-customers without shipping them through the partner's location.[40]

In 1997, Compaq reorganised its distribution strategy in a similar way to IBM. The objective was to reduce inventories, internally and also at the channel partners of which it was estimated in 1996 that there were about 40 000[41]. The new strategy, labelled Optimized Distribution Channel, incorporated three different 'levels' of customisation. The first, called 'Built-to Order' (BTO), means that part of the assortment can be built and shipped on receipt of a specific order. This was followed by 'Configure-to-Order' (CTO), which means that a variety of commonly requested PCs can be configured by Compaq according to end-customer requirements. Then the reseller can do the final customisation by installing specific components requested by end-users. The last step, called 'Channel Configuration Program' (CCP), enables resellers to build PCs to individual customers' specifications from components provided by Compaq.

Hewlett Packard introduced a revised distribution program in 1997 called the 'Extended Solutions Partnership Program'. The program comprises four distribution models; the traditional 'push-model' through distributors and resellers, 'Channel Assembly', 'Economy Program', and 'Vendor Express'[42] The channel assembly program is similar to Compaq's CTO program meaning

[38] http://news.cnet.com/news/0-1003-202-321711.html (2001-0502).

[39] ibid.

[40] 'Here's how the models compare'. *Electronic Buyers' News*, (1997-12-15).

[41] This figure is taken from Gabrielsson (1999) p. 167.

[42] Zimmerman, M. (1997), 'Hewlett Packard Pulls out the Stops to Attract Small, Medium-size Business Users', *PC Week*, (1997-09-09).

that Hewlett Packard provides the partners with semi-assembled 'bare-bones' PCs which are then finally assembled and customised by Hewlett Packard's partners at their locations with authorised components supplied by Hewlett Packard.[43] The partners have access to local inventories, which are owned and managed by Hewlett Packard. These inventories are replenished by Hewlett Packard and contain the 'bare-bones' as well as the components needed for customisation and final assembly. In order to coordinate these activities, the partners are connected to, and have access to, Hewlett Packard's inventory system.[44] The economy program involves the production of certain top-selling models, labelled 'Top-Value' PCs. These are produced to forecasts made by the partners and Hewlett Packard together.[45] In Sweden, Hewlett Packard has introduced about six 'Top-Value' models. These are priced very competitively and are offered to four distributors. By connecting to the distributors' inventories Hewlett Packard can place orders on-line according to certain inventory levels. The goal is to reduce inventories so that distributors will not get 'stuck' with unsold products. If a distributor cannot sell the PCs kept in stock, there are two possibilities: either to send the PCs back to Hewlett Packard or to lower the prices. Both these alternatives are 'bad' from Hewlett Packard's perspective, which is why Hewlett Packard is very anxious to reduce inventories at distributors' facilities.[46] The fourth distribution model is called 'Vendor Express' and provides large customers with dedicated web-pages, called 'Hewlett Packard Enterprise Web Page', from where the customers can configure and order products, track deliveries and submit service requests. This new way of working was initiated in response to customers who wanted more direct contact with Hewlett Packard rather than with the 'reseller channel'.[47] They also wanted a wider variety of ways to receive Hewlett Packard's different products and services (ibid.). In this case the products are shipped directly to end-users and the reseller becomes more of a service provider. [48]

[43] 'Here's how the models compare'. *Electronic Buyers' News*, (1997-12-15).

[44] Condon, R. (1996), 'Hewlett Packard Reseller will Assemble Systems'. *Computerworld*, (1996-05-06).

[45] Knowles, A. (1998), 'Hewlett Packard Streamline PC Delivery, Service Programs'. *PC Week*, (1998-01-28).

[46] Interview with Anders Garberg (99-10-26).

[47] Niccolai, J. (1998), 'Hewlett Packard to Offer Direct Sales Over Web to Enterprise Customers'. *NetworkWorldFusion*, (1998-07-20).

[48] 'Here's how the models compare'. *Electronic Buyers' News*, (1997-12-15).

The move towards direct sales

IBM relied on indirect sales only until 2000, when they announced that they would start both direct sales via the Internet and telesales. This new strategy was first introduced in the USA and later implemented in Europe, first approaching small and medium-sized companies and later private consumers. The main reason, according to the Swedish IBM manager for PCs is that:

> *...there are customers who want to buy directly and inexpensively without needing to integrate the hardware with different additional services. If that is the case we naturally want to offer them this possibility.* (Bohlin (a), 2000)[49]

This decision was received in very different ways by the existing 'channel partners'. A manager at one of the resellers compares the new approach to going behind your partner's back and being unfaithful in a marriage. He argues that IBM has been very unclear in its strategy recently, arguing one day that the 'channel partner' is the company's most important resource and selling behind the reseller' back the next. (Bohlin (b), 2000)[50] Another reseller argues in the opposite direction, stating that:

> *IBM is doing the right thing, starting up direct sales through the Internet...It is only resellers who do not believe in their own capability to add value who need to be worried...* (Bohlin (c), 2000)[51]

This section has mainly focused on the 'large and global' actors and their ways of working. The reason is that they have had a great impact on the development of both the product itself and the way it is sold. However, many small and local actors have also played an important role in the development of the ways in which PCs are made available to users. In Sweden there are 2000-2500 local PC assemblers. Furthermore, 25% of all PCs sold in Sweden are 'non-brand' PCs, implying that they are not designed and assembled by one of the big firms like Hewlett Packard, Dell, Compaq, or IBM. These local firms are further explored in the next chapter.

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[49] Bohlin, S. (a) (2000), 'Kunderna vill handla via nätet'. *Computer Sweden*, Issue 63, 2000-06-19. Quotation is translated from Swedish.

[50] Bohlin, S. (b) (2000), 'IBM går bakom ryggen på åf-ledet'. *Computer Sweden*, Issue 63, 2000-06-19.

[51] Bohlin, S. (c) (2000), 'Återförsäljare kan inte stoppa utvecklingen'. *Computer Sweden*, Issue 67, 2000-07-11. Quotation is translated from Swedish.

4.4 Summing up

This chapter introduced some important characteristics of the PC industry that are important to bear in mind in the later discussion. Most important from our perspective, and also indicated in chapter 1, is that companies have chosen to approach the assembly and distribution of PCs in very different ways and the ways that this is approached has also changed over time. This has led to there being a great variety of suppliers for end-users to choose from. It was also hinted that the variety in end-user contexts is extensive. Two main categories can be identified, individual consumers and business users. However, each of these two categories also involves a great variety in end-user context. In the next chapter this variety is illustrated in greater detail.

5 The Empirical Inquiry

The aim of this chapter is to describe the empirical material on which this thesis is based. The description establishes a foundation for the analyses in chapters 6 and 7 where a number of transvections and crossing points are discerned and discussed.

The PC industry was briefly introduced in the previous chapter. We now continue with a more in-depth description of the operations of some firms involved in producing, selling, buying, and using PCs. A representative PC consists of a chassis, motherboard, memory, processor, hard disc, CD drive, and/or disc drive. To be able to use a PC, a monitor, keyboard, and mouse are also required. Beyond the hardware, software is needed, including an operating system as well as programs used in different applications. The aim of the present chapter is to describe different ways in which these 'conglomerate resources' end up in the hands of different end-users.

5.1 Outlining the empirical data

As the aim of this thesis is to explore the inherent variety and complexity in distribution networks, it is important to outline the material in a way that enable this complexity and variety to be captured. Below, we illustrate this variety by describing different firms as connected into 'networks' that can be described as collections of transvections rather than 'isolated channels'. However, there is no 'given' way in which this description should be outlined. I have chosen a certain starting point as well as how to continue the 'story'. This is illustrated in Figure 5.1 below.

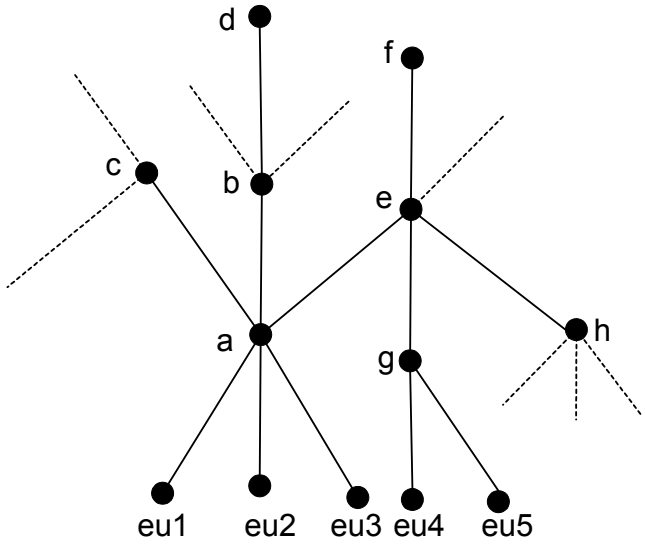


Figure 5.1 A general illustration of the outline of the empirical material

In Figure 5.1 the black dots mark focus element of interest in the empirical material. These include end-users, firms, or facilities related to a firm, for example the warehouse of firm X or the order administration unit of firm Y. The lines mark connections between two such elements. These elements and their connections can be said to illustrate transvections. For example, the sequence *eu1-a-b-d* illustrates one transvection. In turn, *eu2-a-e-f* illustrates another transvection, which is connected with the previous one at *a*. This element, *a*, also connects *eu1, eu2, eu3, c, b,* and *e* to each other. Such an element, connecting two or more transvections is referred to as a crossing point. The relative placements of the elements in the figure do not tell us anything about their relation to each other except that they are somehow connected. Hence, the reader cannot tell from the picture only which firms are 'sellers' and 'buyers'. This is however, explained in the relevant text.

Our description begins with one specific end-user, *eu1* (indicating end-user number one). From there, we successively add to this picture as the 'story' continues. The crossing points of importance are coded in line with the illustration above and marked in italics in the text. The graphics, as exemplified in Figure 5.1 also include connections as solid and dotted lines. The dotted lines point out connections of importance that have been identified but not yet described.

One problem related to the successive emergence of the empirical material is that it can sometimes appear as irrational from the reader's point of view.

However, the decision concerning the sequence in which the 'story' is told is taken dependent on the nature of the crossing points - some things need to be told before others. This can sometimes result in what the reader might perceive as 'leaps' in the description. Nevertheless, it is our hope that the reader will understand why these 'leaps' were necessary after reading the 'full story'.

It is important to note that such graphics only depict the emergent picture of the 'network' in line with the principles for the outline of the empirical material. Hence, they only serve as means of presenting the material in a certain way, but do not illustrate the development of a network as such. Furthermore, the sequence in which the structure develops in the empirical description is not related to any linear course of events. The structure could very well have been described in a different sequence, starting and ending at some other point.

5.2 Introducing the involved actors

In the descriptions in sections 5.3 - 5.18 a number of firms and end-users are involved. In order to enable the reader to follow this description the actors are presented and categorised below in accordance with the prevailing terminology used in the PC industry (see Table 5.1 below). The table also indicates where in the empirical description most of the information regarding the different actors can be found.

Each firm is also given one or several codes. The fact that some actors have more than one code is that some departments or facilities are given individual codes. For example, Hewlett Packard as a whole is referred to as *c* but HP's production site in Grenoble is given an own code *(s)* as well as the order administration unit *(t)*. In the same way, the local Siba store (*a*), the Siba warehouse (*i*), the purchasing organisation (*j*), the Internet shop (*e*) are all parts of the overall Siba organisation (*g*). Furthermore, ComputerCity (*f*) is also a part of the overall Siba-organisation (*g*).

In order to facilitate for the reader to follow the empirical description below and the following analyses in 6 and 7, some foldouts are included in the appendix in the very end of the thesis. The appendix includes two pages, outlining Table 5.1, a modified version of Table 5.2, and the 'empirical network' that can be seen as the output of this chapter.

Producers	**Code**	**Section**
Hewlett Packard	c	5.9-5.12
-Production site	s	
-Order administration unit	t	
IBM	o	5.6, 5.15-5.16
Dell	p	5.8, 5.11, 5.12, 5.14-5.16
-Production site	q	
-Customer service	ö	
CapTech	α	5.17-5.18
ProgramMäklaren	β	5.13-5.14
Distributors		
Ingram Micro	k	5.4-5.5, 5.10
Scribona	n	5.5, 5.9, 5.7
C2000	ø	5.7, 5.16
System Specialist		
Atea	γ	5.15-5.16
IMS	l	5.5-5.6
Resellers		
Westium Data (business store)	w	5.17-5.18
Dustin	m	5.7, 5.14
ComputerCity (part of Siba, g)	f	5.3-5.4
Retailers		
Siba	g	5.3-5.4
-Purchasing organisation	j	
-Local store	a	
-Warehouse (Siba.se)	i	
-Siba.se Internet shop	e	
Hewlett Packard's Internet shop	v	5.9, 5.11
-Sales department	x	
Westium Data (consumer store)	δ	5.17-5.18
Logistics providers		
Posten Logistik	h	5.4
Irish Express	r	5.8-5.9, 5.11-5.12
-Local office	å	
Schenker	u	5.9-5.10
-Logistic hub	ε	
ASG	y	5.8, 5.11-5.12
-Goods terminal	z	
Service providers		
ICL	ä	5.8, 5.12
Call centre	b	5.3
Repair shop	d	5.3

Table 5.1 The involved firms in the study

In addition, a number of end-users are described and discussed, as illustrated in Table 5.2.

End-user at the following organisation:	Individual consumer customer at:
Chalmers University of Technology (eu5)	Local Siba store (eu1)
Pharmacia (eu4)	Siba's Internet shop (eu2)
Volvo Car Corporation (eu7)	Hewlett Packard's Internet shop (eu6)
Volvo Group (eu8)	ComputerCity (eu3)
Westium Data business store (eu9)	Westium Data consumer store (eu10)

Table 5.2 End-users involved in the study

All these actors are in one way or another involved in the different transvections that will be identified and analysed in chapter 6. In the following sections, the firms involved are described and an illustration of how they are connected into a 'network-like' structure is provided. Based on the empirical 'network' described in this chapter, a total of 15 transvections and eight crossing points are identified, described and analysed in chapters 6 and 7.

5.3 The starting point – the local Siba store

We begin this empirical description with a supplier called Siba - a national store chain in Sweden - and the exchange between a specific end-user and one of Siba's local stores. However, before turning to the exchange between these two actors a more general description of Siba is given.

Siba was founded in 1951, when the focus was on selling cut-glass chandeliers. This soon developed to include other kinds of lamps, radios, and later television sets. In the 1960s the company developed into a pure radio and television retailer and later, in 1989, computer and telecommunication products were introduced into the product range. The third business area, involving household appliances such as refrigerators, stoves and washing machines, was introduced in 1994. The first PC was sold in the late 80s, but the sales in large volumes did not take off until the early 90s. Siba has 32 stores in Sweden, making them one of the largest chain stores in home electronics.

Siba sells two brands of desktop PCs (Hewlett Packard and Fuijutsi/Siemens) and two brands of laptops (Compaq and Toshiba). Hence, all PCs sold by Siba are 'branded PCs'. Siba offers a number of performance levels of each brand. The reason for offering two brands of each type of PC is to be able to offer the customers a choice among similar products.

Siba only sells standard products: no adaptations are made for specific customers. All desktop PCs are sold together with a predefined combination of keyboard, mouse, and monitor in a 'box'. Furthermore, the PCs are pre-installed with basic software such as Windows and Works. The commonly used Office package, including programs such as Word, Excel, and PowerPoint, is not included, although it can be purchased separately at Siba. However, the customer has to install it, as Siba does not provide any software installation services. Beyond the actual PCs, Siba offers complementary products in terms of different kinds of hardware and software, e.g. cables, loudspeakers, scanners, printers, and PC games.

The main way Siba approaches customers is by advertising campaigns in daily newspapers and advertising leaflets in letterboxes. These advertise certain special offers with a strong focus on price. In this way Siba tries to direct the customers to specific offers. For the customer, this type of information can act as a first attraction that makes him or her choose to go to a Siba store in the first place. Once in the store, the customer can compare different alternatives. Siba also has an Internet site with information about what to consider before buying a PC as well as information about the product range and special offers. Customers can use this kind of information to prepare before going to the store.

The sales personnel at Siba are important, as they have the knowledge needed to guide the customer, in terms of translating the needs of the customer to a matching solution. They can also point out alternative solutions and argue for their pros and cons in relation to the customer's needs. When the customer has decided on a solution, it is there, ready to take home, right of the shelf. In the discussion below, we take our point of departure in one focal end-user (*eu1*) and the exchange interface with one local Siba store (*a*) (see Figure 5.2).

Figure 5.2 The starting point in eu1

The local Siba store's exchange interface with an end-user

When an end-user (*eu1*) comes to the store, he or she starts discussing with a salesperson what she thinks she needs. Together they discuss the customer's needs and identify different available options (see (1) in Figure 5.3). We assume that they discuss different options (2) from the products available (3)

and decide upon (4) a desktop PC from Hewlett Packard (*c*). The end-user then takes the PC home, right of the shelf (5). In other cases the end-user knows exactly what he or she wants and goes directly to (5).

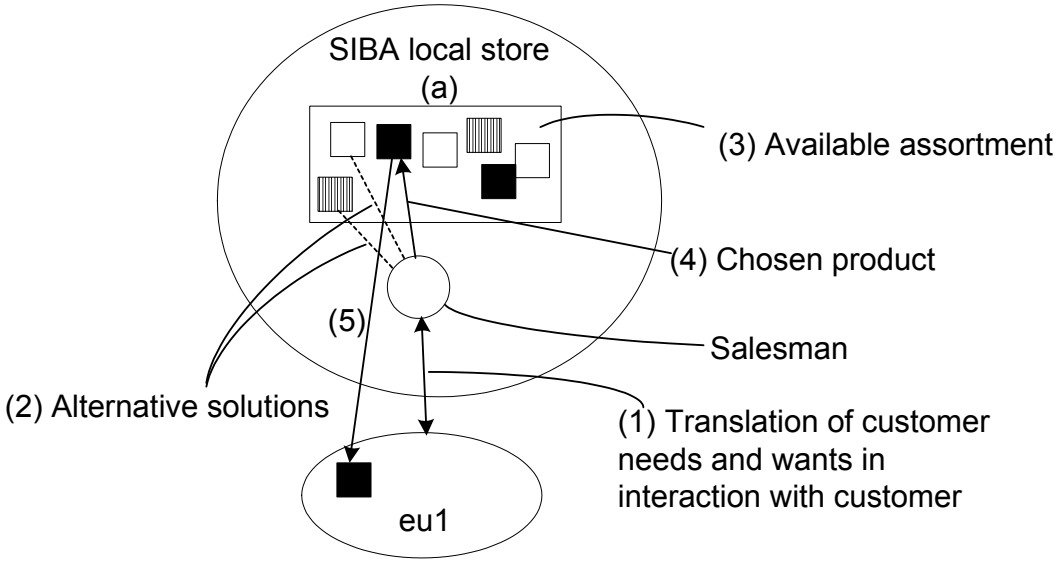


Figure 5.3 The interaction between the Siba store and the end-user

In addition, the end-user can sign up for a support agreement that offers telephone support 24 hours a day, all days a year, at a fixed cost. This service involves help with software issues related to the most common applications, such as the Office package. When the customer gets started and runs into problems with a specific application she can call this support number. The support service is run by a call centre (*b*), which acts under the name of Siba but also provides this service to a number of different other companies. If a repair is needed the end-user takes the product to the closest Siba store. The store then sends the product to a repair shop (*d*) where it is decided if the product is to be replaced or repaired. The repair shop is authorised by the producer of the specific product, in this case Hewlett Packard. Each producer has its own way of handling repairs and hence uses different repair shops. Because the end-users are directed to the Siba store for repairs, the end-users do not have to deal with this difference, because Siba acts as the common interface.

The important actors involved from an end-user perspective are illustrated in Figure 5.4 below.

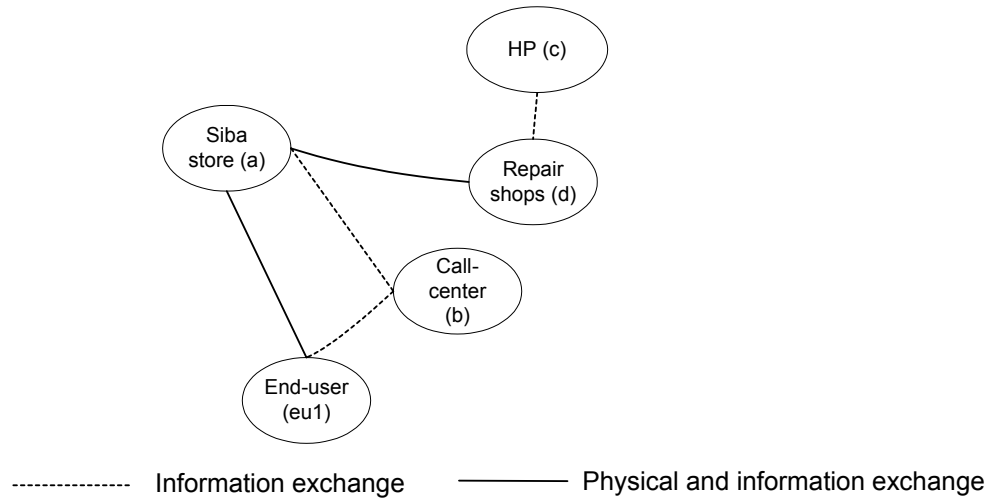


Figure 5.4 The important actors and exchange interfaces from eu1's perspective

We have now illustrated one kind of exchange interface between Siba and its customers - the local store. However, as illustrated in Figure 5.5, Siba also provides two alternative exchange interfaces to other end-users (*eu2* and *eu3*), the Internet site 'www.siba.se' (*e*) and an affiliated firm, ComputerCity (*f*). Siba can therefore also be discussed as a larger organisation (*g*), including (*a*), (*e*) and (*f*). The discussion so far is summarised in Figure 5.5 in line with the general illustration of the empirical outline provided in Figure 5.1.

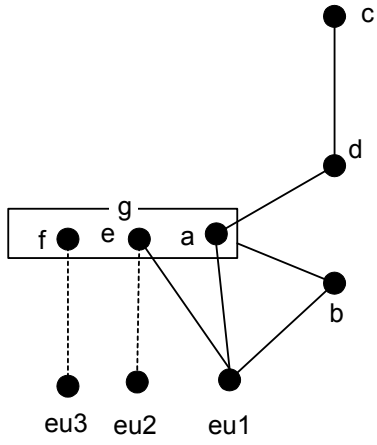


Figure 5.5 An empirical summary of the discussion

In the discussion above, two alternative exchange interfaces are identified, and illustrated in Figure 5.5 by dotted lines. These are further described in the next two sections.

An alternative exchange interface -'Siba.se'

The Internet site 'Siba.se' provides information as described above, and it also offers customers a limited number of products as direct purchases from the site, as well as different 'offers of the week'. Siba also provides a function that

allows customers to compare different offers in terms of technical performance and price.

For an end-user buying through Siba.se (*eu2*), there are various delivery options. All deliveries are handled by Posten Logistik (*h*) from the 'Siba.se - warehouse' (*i*) in Gothenburg, but they differ in terms of what time during the day delivery is guaranteed. For example, if a customer wants to have the PC delivered between 5p.m. and 9p.m. it is more expensive than delivery before 4p.m. If the customer is not at home at the time for delivery, the PC is transferred to the nearest post office, where the customer can pick it up. Also, if the customer requires Posten Logistik to call before delivery to ensure that the customer is at home, there is an extra charge. The least expensive alternative is for the customer to pick the PC up at the nearest post office. The delivery time can be from one to five working days depending on where in Sweden the end-user is located. This is to be compared with the immediate 'delivery' when the end-user goes to the local store, and the specific product is available.

If a product bought through Siba.se is in need for service or repair the end-user (*eu2*) is directed to the closest local store (*a*), as in the previous example. The updated 'empirical network' is illustrated in Figure 5.6.

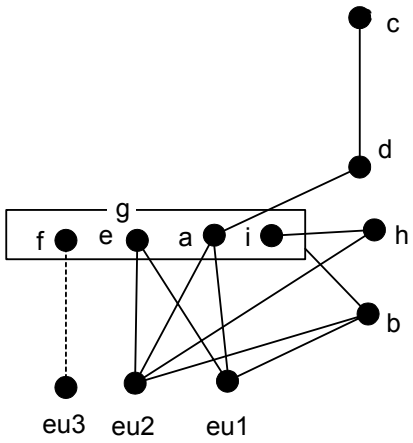


Figure 5.6 The Internet end-user as part of the 'updated network'

It is important to note that the end-user who buys a PC in the store (*eu1*) and the Internet buyer (*eu2*) can very well end up with identical PCs with regard to physical features. Before tracing this PC further back, describing how it ends up on the store shelf in the local Siba store or in the hands of the Internet buyer, we detour to a description of the other exchange interface, involving a Siba affiliated – ComputerCity, because the ways the PCs bought by *eu1* or *eu2* end up at these buyers are affected by the fact that Siba and ComputerCity belong to the same parent company – the overall Siba organisation (*g*).

An alternative exchange interface - ComputerCity

In 1997 Siba acquired ComputerCity, a chain store and supplier of IT products. This supplier directs its attention to a somewhat different customer group than Siba. ComputerCity aims at two types of customers, small and medium-sized enterprises (SMEs) and more advanced private customers than those approached by Siba. In contrast to Siba, ComputerCity is only involved in IT products, e.g. computers and computer related products and mobile phones. Moreover, ComputerCity's range of PCs and related products is both broader and deeper than the Siba range, although they overlap. For example, exactly the same PC models from Hewlett Packard can be found at the local Siba store, the Internet shop and at the ComputerCity store. The two companies, Siba and ComputerCity, are strictly separate in terms of their exchange interfaces with end-users.

ComputerCity has five stores in Sweden and five in Denmark. When new products are introduced they are first launched at ComputerCity. This is due to the fact that the customers of ComputerCity are more interested in the latest technology than Siba's main customers and less price sensitive. When these products mature and the price is lowered they are transferred to Siba's assortment. The incorporation of ComputerCity brought with it improved product knowledge within the whole organisation, which was very valuable for Siba. The two companies have the same purchasing organisation (*j*), divided into three product groups, of which PC and telecom related products belong to one group. There is a manager responsible for each of these product groups plus, five purchasers who work with different suppliers.

The PC suppliers used are Hewlett Packard (*c*), Compaq, Fuijitsi/Siemens, and Toshiba. The interfaces with each of these are arranged differently. With Compaq, there is an agreement that lets Siba (*g*) (henceforth used to designate the parent company incorporating both Siba stores and ComputerCity stores) buy directly from Compaq, who deliver the PCs directly from its central warehouse. Siba has no central warehouse, which means that all products are shipped directly to each store (*a*) or to the 'Siba.se - warehouse' (*i*) in Gothenburg, which is the warehouse for Siba's Internet store. The PCs from Compaq are truly standard models that can be found at many different resellers. This is also true of the Hewlett Packard and Toshiba products. However, these PCs are bought from the distributors Ingram Micro and Scribona, respectively, with whom annual agreements have been set up which, as a result of the large volumes, have led to what Siba regards as favourable arrangements. The only supplier that makes any adaptations of the product is Fuijutsi/Siemens. They

produce PCs in accordance with Siba's specifications, and with specific model numbers.

As indicated in this section the PCs from Hewlett Packard, offered by Siba, are bought from Ingram Micro. We have identified three different kinds of end-users, *eu1, eu2*, and *eu3* using different exchange interfaces, who might buy a PC from Siba. In Figure 5.7 we illustrate the part of Siba's network that is related to the exchange interfaces described.

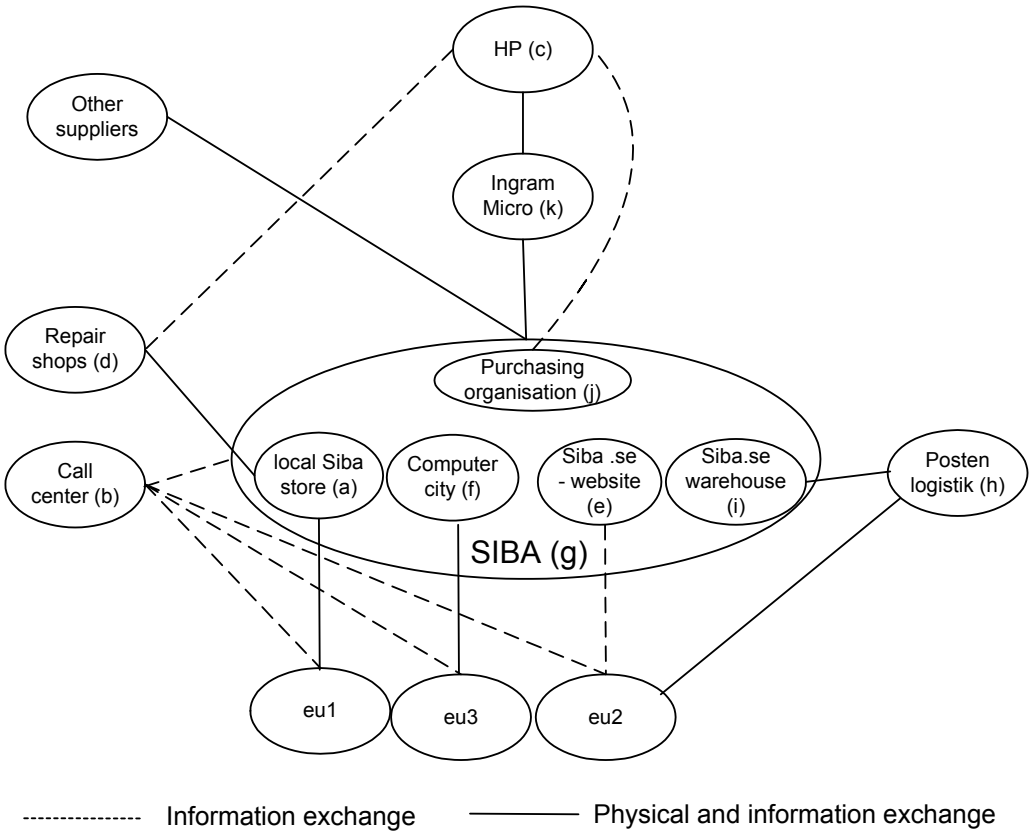


Figure 5.7 Siba's network related to the three exchange interfaces

Our attention is now directed to Ingram Micro (*k*) and how the PCs are handled before they end up at Siba. Before turning to Ingram Micro, we sum up the discussion so far in Figure 5.8 below, illustrating how the structure has been extended from our first identified exchange interface between the local Siba store (*a*) and the end-user referred to as *eu1*.

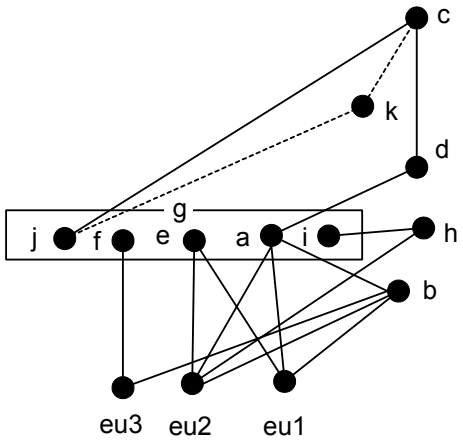


Figure 5.8 The empirical 'network' around Siba

5.4 Ingram Micro – a supplier to Siba

Ingram Micro (*k*) was established through a merger between two US distributors in 1989. The company has grown by acquisitions and since 1998 it is the world's largest distributor of IT related products. Ingram Micro has offices in 36 countries, and is active in over 100 countries. In 1994, Ingram Micro entered the Swedish market through the acquisition of the Swedish distributor Datateam.

The Swedish company has about 2000 customers and 100 suppliers of hardware and software. All of the large IT-related suppliers that sell to distributors are represented by Ingram Micro, including Hewlett Packard, Compaq, IBM and Microsoft. Each of these suppliers usually works with about four to five different distributors, of which Ingram Micro is one. Ingram Micro has one warehouse in Sweden, situated in Stockholm, with a total area of 11,000 square meters, and 35,000 different items. However, through its connection to the 'global Ingram Micro organisation' in reality it has access to 400 suppliers through 'inventory sharing'. This can be seen as a common company inventory, which all offices can access. All Ingram Micro divisions are connected to the same information system, which enables anyone of the companies to search for products and have them delivered from any country. Stockkeeping is one of the main issues for a distributor like Ingram Micro. Ingram Micro also offers other kinds of services to its customers, e.g. Siba, for example pre-sale and post-sale services, granting of credits, renting of storage space, invoice services and seminars (by themselves or together with a producer). Ingram Micro's customers are different kinds of resellers, selling to organisations and companies, and retailers selling to individuals. The customers are divided into three main categories: large, small & medium-sized, and small.

For Ingram Micro, one of the main issues is to balance the level of inventory in the warehouse. It is important to have a sufficient amount of products in stock in order to offer the customers the required delivery times. However, owing to the nature of the products in terms of life cycles and decreasing values, it is important not to have an inventory that cannot be sold before the products get 'old'. In order to handle this, one of the most important tasks for a distributor such as Ingram Micro is to be sensitive to needs and trends in the end-user market. This kind of information is acquired through interaction with customers. In addition, information from the producers is important. This information involves historical data about sales, and information about coming releases of new products.

Hence, one problem relates to keeping the right 'level' of the inventory of different products. This problem is also linked to the issue of having a broad and deep range of products. This is especially important since most customers are trying to limit the number of counterparts they work with. This has resulted in Ingram Micro actively trying to influence its suppliers to limit their product ranges to some extent, since it is very costly, and risky, to keep a 'total' assortment from each supplier, which would be very extensive.

The customers register 20% of their orders electronically. Customers can access parts of Ingram Micro's information system and thereby access the inventory status. Ingram Micro offers its customers five different kinds of e-commerce solutions that provide different kinds of value for the customers. These solutions range from standardised web-based solutions, to EDI solutions, and tailored direct connections between the information systems of Ingram Micro and the customer. The aim is to make the smallest customers use Ingram Micro's web-based e-commerce site as much as possible in order to make the interaction with these customers cost effective.

Sales personnel at Ingram Micro place the remaining 80% of the orders over the telephone after interacting with their customers. Each salesperson has a special product area, such as PC sales. When the order is placed it is immediately locked and reserved for this specific order and a pick ticket is printed in the warehouse.

The order is then picked up and packaged. 90% of the products are shipped by Posten Logistik and the rest by couriers. Posten Logistik has employees at the Ingram Micro warehouse who take over the responsibility when the packages enter Posten Logistik's area in the warehouse. The packages are then sorted

according to zip codes by Posten Logistik's employees and shipped to customers. Within Stockholm, the goal is to be able to deliver from the warehouse the same day as the order is placed, and to the rest of Sweden the next day. The number of pieces of goods delivered from the inventory is 550,000 a year which result in an average number of 1500 pieces of goods per day. Ingram Micro never sells directly to end-customers, i.e. the customers of Ingram Micro's customers, but more than 50% of the orders are shipped directly to end-customers from Ingram Micro's warehouse. However, this only applies for shipments to business end-customers, not individual consumers. In extraordinary cases, where end-customers have ordered a very large volume of identical products, shipments directly from producer to end-customer can be arranged. (see Figure 5.9 for an overview of the operations of Ingram Micro)

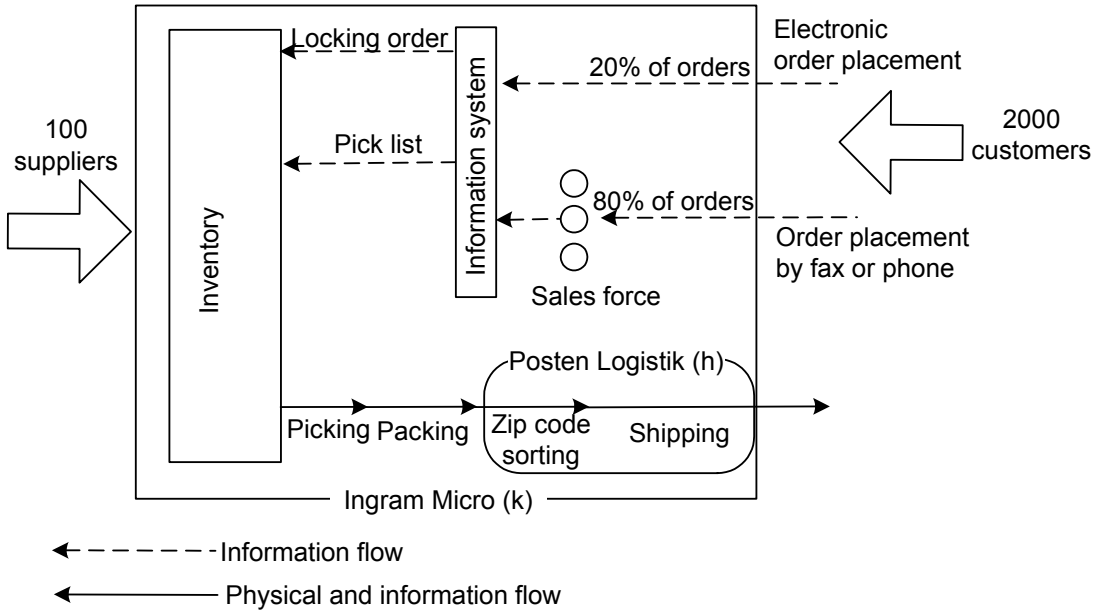


Figure 5.9 Operations of Ingram Micro

The exchange interface between Siba and Ingram Micro

The PCs bought by *eu1, eu2*, and *eu3* were ordered as parts of larger batches of physically identical PCs. It is also possible that the PCs of *eu1* and *eu2* were from the same batch. From Siba's perspective these customers do not order an individual PC but a larger batch that is to be split and distributed to different local stores or to the Internet warehouse. As Siba can access parts of the databases of Ingram Micro it is easy to get information about what and how much is available in stock and the price of a certain product. The order can be placed either by calling the salesperson at Ingram Micro responsible for Siba's purchasing of PCs or electronically. In either case the order is locked in the inventory and a pick ticket is immediately printed in the warehouse, and the

batch of PCs collected and packaged. The boxes are then marked with order information and delivered to Posten Logistik's area in the warehouse where they are sorted to different postal code areas. The PCs are then loaded onto trailers together with other products bound for the same postal code area. Hence, the PCs bought by the three end-users can very well have been loaded onto the same trailer if they were bound for the same postal code area. If this is not the case they are loaded onto different trailers. The PCs are then delivered to the Siba store, the ComputerCity store and the 'Siba.se warehouse' together with other products bound for these locations. The PCs are then unpacked and kept in the store until the end-users come to buy them or until they are delivered to the end-user from the warehouse. (see Figure 5.10)

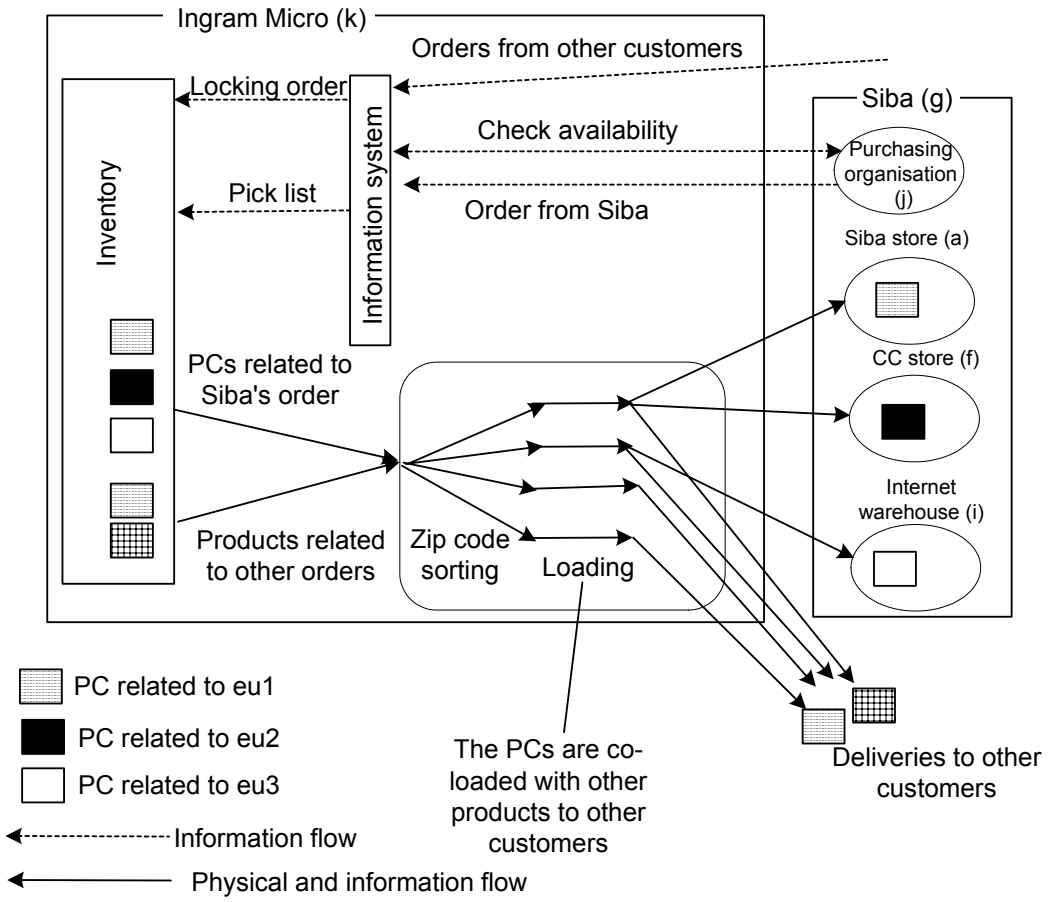


Figure 5.10 The exchange interface between Ingram Micro and Siba

In this section we have described Ingram Micro (*k*) and its exchange interface to Siba (*g*). In order to further explore Ingram Micro we continue with some other firms to which they are connected. First, one of Ingram Micro's suppliers of PCs - Hewlett Packard (*c*) is explored further since PCs originating from Hewlett Packard were purchased by the three end-users in the examples. Second, two other customers of Ingram Micro are described: IMS (*l*) and Dustin (*m*). In Figure 5.11 the 'emergent' empirical 'network' is illustrated. As

can be seen in the figure, we have chosen to aggregate Siba into (*g*) in this picture, although also indicating its constituent parts as *g*(*a, f, i, e, j*). There are two reasons for this. First, as we get further away from the initial exchange interface between *a* and *eu1* the other firms view Siba as one organisation (*g*). Secondly, it is also convenient to reduce the complexity of the graphic presentation in Figure 5.11.

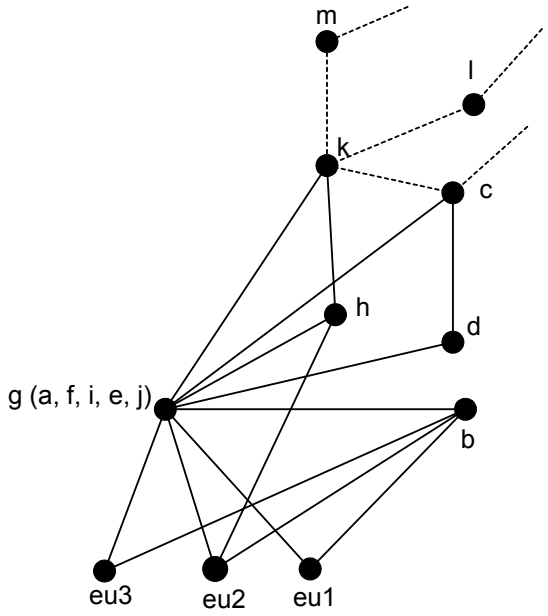


Figure 5.11 The emergent picture of the empirical 'network'

The further exploration of Ingram Micro begins with the exchange interfaces to another customer of Ingram Micros, IMS.

5.5 IMS - a customer of Ingram Micro

IMS Computer Products (*l*) is part of IMS, a large Swedish actor in the IT business. IMS has 500 employees at 16 different sites in Sweden. IMS Computer Products, henceforth referred to as IMS, supplies customised IT solutions to companies and other organisations. The main customer group is 'large and sound' firms. IMS has a total of 1800 customers of which 200 'preferred customers'. Of these there are a number of 'A-customers' considered the most committed customers. In 2001, 50% of the orders were placed through 'IMS-e', the e-commerce system.

The aim of IMS is to have profound knowledge of customer needs and to develop solutions to fulfil them. This can involve anything from the translation of customer needs into a solution in terms of hardware and software implemented at the customer's site, to customised deliveries of the product.

Other examples are customised stockkeeping, customisation of software and hardware, and making products theftproof.

IMS has developed from being a traditional reseller, keeping inventory and handling orders, to a more service related company. This development was most clearly revealed in a change in the relationship with its largest distributor, Ingram Micro.

The exchange interface between IMS and Ingram Micro

Before 1999 the exchange interface between IMS (*l*) and Ingram Micro (*k*) had been of a traditional type, resulting in both firms holding inventory and performing order handling, and where Ingram Micro was one out of a handful distributors. The problem with this kind of structure was considered to be that a lot of similar work was performed repeatedly, in different places and by different firms, i.e. holding inventory, order handling, and invoicing. Another important related fact was the short life cycles of the products, which made it important that the time between the assembly of the product and delivery to the end-user should be as short as possible. The fact that the products were stored in a number of different places before reaching the end-user was therefore a problem. Further, the margins on hardware have steadily decreased which, in turn, means that it is becoming more and more important to reduce and reorganise activities related to the handling of the products in order to reduce costs.

In line with this, IMS and Ingram Micro came to an agreement in autumn 1999 by which Ingram Micro was to take over all physical handling of the products, order handling and invoicing from IMS. IMS, in turn, would specialise in sales activities and services such as installation and support as well as the design of solutions for customers. IMS would also focus on customer relationships by maintaining a local presence and contact with the customers. Further, IMS was supposed to use Ingram Micro as its exclusive distributor.

As a result, the 22 IMS warehouses were terminated and all stockkeeping was centralised to the Ingram Micro warehouse. The information systems were also integrated. This means that when a customer order is placed in the IMS information system, the order is in fact placed directly in the Ingram Micro information system and a pick ticket is printed out directly at the warehouse. A confirmation of the order is immediately sent to the customer. The order is then handled in accordance with the description of Ingram Micro in section 5.4. Additional activities, for example configuration services, can also be performed

before the order is shipped. The difference compared to the exchange interface between Ingram Micro and Siba is that both products and invoices are sent directly to customers from Ingram Micro, but with both firms' names on them. Hence, Ingram Micro performs all physical handling of the product. Furthermore, the integration of the information systems gives the customer of Ingram Micro access to real time information about prices, delivery times, purchase history, and stock availability.

In order to effect this change, 35 employees working with customer support at a 'Sales Centre' were transferred from IMS to Ingram Micro. This led to an increasing number of interfaces for the customers of IMS. The Sales Centre at Ingram Micro handled the day-to-day contacts related to orders, invoices, and deliveries. IMS, in turn, handled issues related to sales. Some customers found this confusing and illogical from their perspective. They wanted one single interface, as had been the case before, i.e. IMS.

The deal between IMS and Ingram Micro was evaluated and reconsidered in December 2000. Two major changes were implemented. First, the personnel who had been transferred to Ingram Micro from IMS were transferred back again. The reason for this was the very different perspectives of the two companies, which had resulted in a culture clash. Ingram Micro, the distributor, aims at making the product flow more efficient by standardisation. The reseller, IMS, instead aimed at customising the flow according to different customers' unique needs. When these two ways of working were mixed, it led to too many compromises from both sides. Another related problem was that other resellers and retailers came to regard IMS as part of Ingram Micro. This meant that these customers interpreted Ingram Micro as selling directly to end-users, which made some of the customers reluctant to place orders with Ingram Micro. Second, the requirement from Ingram Micro that IMS should have Ingram Micro as its sole distributor was abolished. The reason for this was that it became obvious that Ingram Micro could not provide IMS with the kind of 'total assortment' IMS needed. IMS started to work with a supplementary distributor, Scribona (*n*). However, Ingram Micro is still the main supplier of IMS, with 80% of the purchased volume. The relationship with Scribona has been organised in the same way as that with Ingram Micro. The Sales Centre that was transferred back from Ingram Micro now acts as a connecting point between the two supplier relationships[52]. In Figure 5.12 below the three

[52] Some of the information in this section has been gathered from *Computer Sweden* (2001-05-23, 2000-12-21).

different phases of the exchange interface between IMS and Ingram Micro are illustrated.

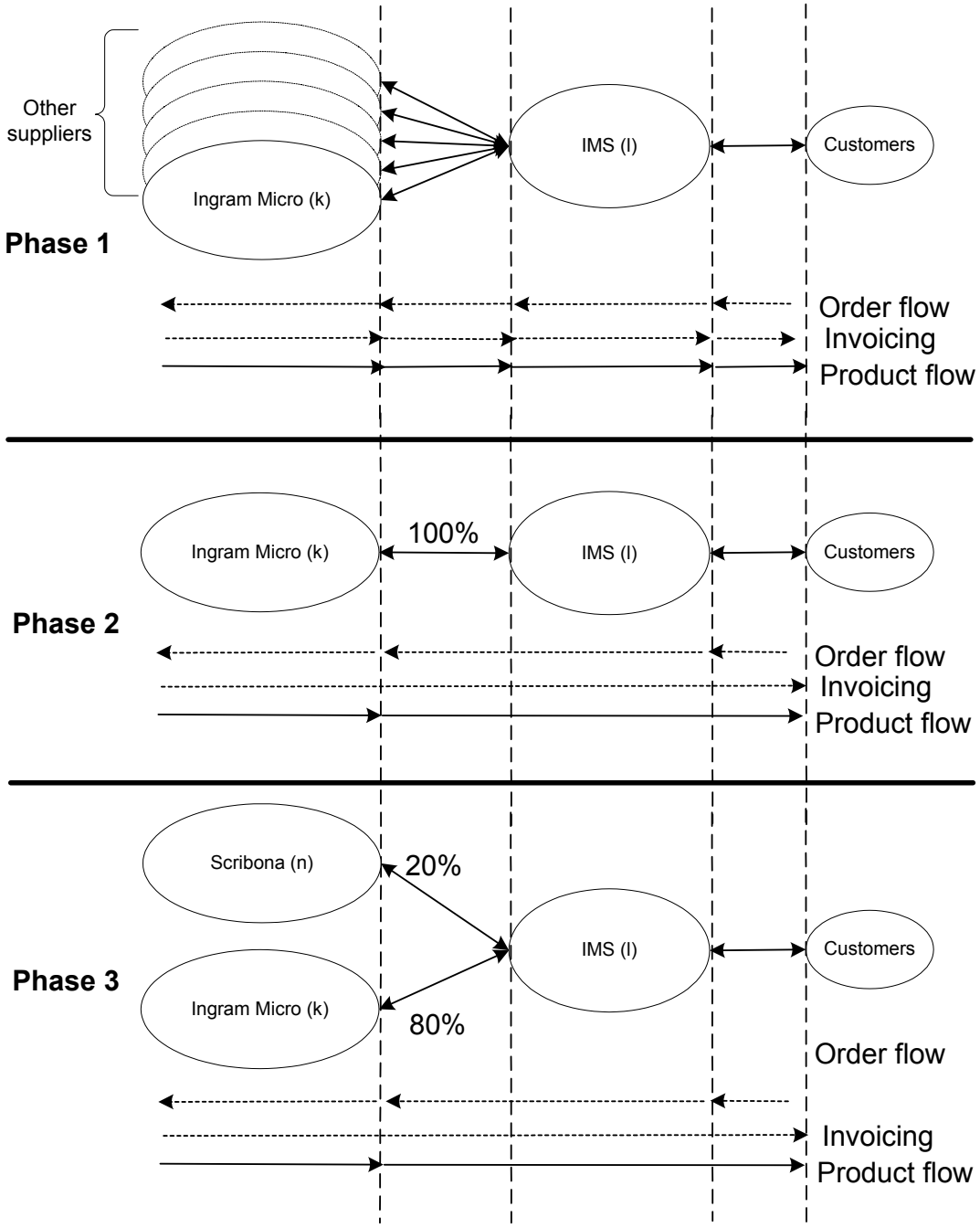


Figure 5.12 Phases of the exchange interface between IMS and Ingram Micro

At the end of section 5.4 we identified still another customer of Ingram Micro to explore further, Dustin (*m*). Before turning to this firm we continue the exploration of IMS with one of its customers, Pharmacia (*eu4*). However, first we update our developing picture of the empirical 'network'. (see Figure 5.13)

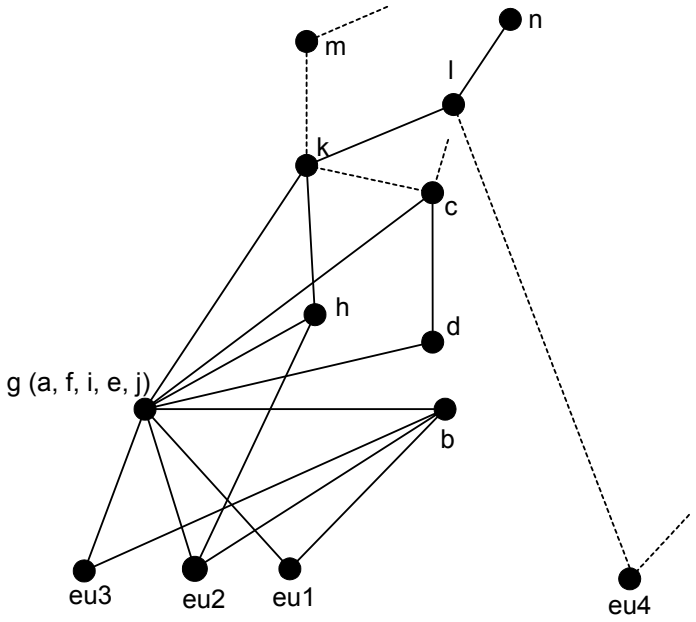


Figure 5.13 The updated empirical 'network'

5.6 Pharmacia – a customer of IMS

Pharmacia (*eu4*) is a pharmaceutical company with subsidiaries worldwide. Consequently, many PCs are needed at the organisation. In Sweden, 30 persons work at the purchasing department for products that are not used as input in production, ten as strategic purchasers. The department is divided into four areas, of which 'IT & Administration' is responsible for the purchasing of PCs.

In the past, Pharmacia had a decentralised purchasing strategy for PCs, resulting in agreements with eleven resellers. This meant that the departments bought many different brands and models from various hardware suppliers. This became problematic since it resulted in a lack of standardisation. The view of purchasing efficiency was also to buy at as low a price as possible in each transaction. This resulted in frequent switching among the eleven resellers to the one that had the lowest price at the time of the purchase.

The IT manager decided to reduce the number of hardware suppliers to two as a consequence of a 'total cost perspective'. Having a limited number of standardised configurations would make it easier to serve and support the network as well as the users. The procurement department was requested to implement this new strategy globally by closing deals with hardware suppliers in interaction with the IT department. In Sweden, the procurement department saw an opportunity to improve the purchasing efficiency with regard to PCs by

reducing the number of resellers from eleven to two. By doing so, there was a belief that the strong price focus could be reduced and other aspects than price could also be considered.

The need for PCs was estimated to involve 6000 employees and include 4200 desktops and 1800 laptops. The need for new acquisitions of PCs was estimated to a total of 2500.

One of the main issues was to find hardware suppliers who were willing to make the preferred PC configurations (models) available at the same time worldwide. This was considered important owing to a desire for global standardisation of models. This proved to be problematic since the producers usually launch models at different times in different parts of the world. However, two producers, Compaq and IBM (*o*), were willing to arrange it. Another influencing factor was that IBM was willing to perform service and support on other brands and thereby take on total responsibility for the set of PCs. IBM was also willing to make customer adaptations in terms of configurations at the IBM plant in Greenock, Scotland.

Pharmacia wanted to reduce the total number of configurations, i.e. models, from each of the producers. Each supplier was asked to provide one high performance PC and one with more moderate performance, to be available worldwide, with separate provision of portable and stationary PCs, or a total of 8 different models from two producers.

Some researchers require extraordinary performance for scientific calculations, which could not be satisfied with these two models, and they were therefore excluded from the agreement. Another exception from the agreement was a result of the demands from the marketing department for an extra small laptop for the sales force. These departments buy their PCs separately.

Once the decision was made to focus on two brands, IBM and Compaq, the question concerning which resellers to use was tackled. Pharmacia had identified a list of requirements to be fulfilled for the chosen resellers.

- They should be authorised to sell IBM and Compaq.
- They should be able to support and provide service to all Swedish Pharmacia sites.
- In extraordinary cases, they should be able to deliver within three hours.
- Normally, the time of delivery should be three to five days.
- Previous experience of the supplier should be positive.

- They should have Internet service.
- They should be able to handle reclaims and repairs.
- They should have a complementary assortment.
- They should be financially sound.

One important aspect when evaluating the reseller was to try to consider the total costs of using a certain reseller instead of focusing, as before, on mainly price. Service and delivery time were considered more important than price in the long run. In negotiations with suppliers, the issue concerning what is efficient purchasing was highlighted. The aim was to try to rethink this matter and get away from sub-optimisation and inefficiency in the purchasing of PCs.

All 11 resellers submitted tenders, but four were immediately rejected, as they did not meet the predetermined requirements. The remaining seven were asked to modify and clarify their tenders, after which three more were rejected. The remaining four were invited to make an oral presentation of the offer. After this presentation, one was rejected owing to a poor presentation as well as price. The last three potential resellers were evaluated internally by a number of representatives from different parts of the corporation. The evaluation was based on different dimensions, partly mirroring the requirements set. Two resellers were chosen, Merkantildata and IMS (*l*). Agreements were entered with them in July 1998.

One of the important aspects determining the choice of IMS was that they were involved in an international cooperation project called ‘Globalserve’. This project could be used to help customers who, for example, need standardised support for their international subsidiaries.

One of the main aims of Pharmacia was to begin developing the relationships with the chosen resellers. Three different possible solutions were identified with different degrees of added value:

- The reseller delivers standardised PCs in ‘boxes’.
- The reseller delivers theftproof PCs installed with company specific software.
- The reseller takes total responsibility, including installation services, training and coordination with end-users, service and support.

Pharmacia’s relationship with Compaq diminished for different reasons and in 2001 Pharmacia was working with IBM (*o*) and Dell (*p*) instead. The introduction of Dell as a supplier had to do with the merger between Pharmacia

and Monsanto in 2000. As Monsanto used Dell as a supplier, this became a reasonable choice. The PCs from IBM and Dell are delivered in accordance with the second solution above, i.e. delivery of theftproof PCs installed with Pharmacia's standard software. This means that the software is specified by Pharmacia and given to the suppliers on CD. The suppliers then use this CD when installing the software.

Dell installs the software in its production facility in Ireland when the PC is assembled and they also make it theftproof. There has been continuous discussion with IBM regarding the possibilities of performing software installations and configurations at the IBM facility, but it has proven to be impossible. Instead, this is administrated by IMS who, in turn, have outsourced the activities to Ingram Micro, who perform them at the Stockholm warehouse. Irish Express (*r*), a logistics company contracted by IBM, supplies the transportation from the assembly site in Scotland to Ingram Micro. The PCs have to be unpacked, installed with software and made theftproof, and then packed again. For Pharmacia, it is not important whether IMS or Ingram Micro perform these activities. Pharmacia is only interested in IMS delivering in accordance with the agreement.

As argued above, one of the main problems with decentralised purchasing is the lack of standardisation. For a company the size of Pharmacia, connecting thousands of PCs worldwide, it is of utmost importance that the network in which these PCs work functions satisfactorily. The need for standardisation of both hardware and software is great.

Hardware is standardised by only permitting a total number of eight models, which are carefully tested in interaction between Pharmacia, the resellers, and the hardware suppliers. Pharmacia has agreements with IBM and Dell in order to be guaranteed the same components worldwide. This is difficult to manage since components are regularly taken off the market, forcing the producer to replace them with others. These substitutions have sometimes led to problems with regard to the interaction between hardware and software, since the software has been developed and tested to match a certain hardware configuration specified by Pharmacia.

The software is company specific and pre-installed by the suppliers. The end-users are prohibited from changing any software in the PCs, for reasons of standardisation. This is also why software is pre-installed. The standardisation of software also facilitates the service and support functions, as the technicians working with these issues know what is installed in every computer and that the

same software is installed throughout the entire company. In order to monitor the software, the IT-department can track and detect changes in the software. To reduce the problems related to changes in software even further, the IT-department is working on a solution that 'locks' the software so that users cannot make any changes.

IBM has taken over the responsibility for helpdesk, support, and installation. The personnel are employed by IBM but work at Pharmacia and help the users with their computers from the time they are delivered to the loading dock. They unpack and install the PCs and provide support to the users of both Dell and IBM PCs.

If the end-user at Pharmacia needs a new PC he or she will log on to the Intranet to see what PCs are available. A total of eight models are most often available: two laptops and two desktops each from IBM and Dell. The PCs are described, with information about technical data and price. If a certain supplier has delivery problems, Pharmacia tries to encourage the users to choose other models by displaying warnings on the site. When the user has decided on a certain model, he or she fills in an order form on the Intranet and it is then electronically sent to the IT department. The order is registered and sent to the user's manager, who approves or not approves to it. The order is then sent to another part of Pharmacia, General Service, who feed the order into the business system of Pharmacia, SAP R/3. So users never have any contact with suppliers. General Service has the responsibility for suborders to suppliers. The users only have contact with the helpdesk, operated by IBM.

To sum up, Pharmacia works with two suppliers, IMS (*l*), for the provision of PCs from IBM (*o*), and Dell (*p*). IBM[53] is not described in detail, but we come back to Dell in section 5.8. The picture of the empirical 'network' is updated in Figure 5.14 below.

[53] Some general information about IBM and its 'exchange interfaces' is available in chapter 4.

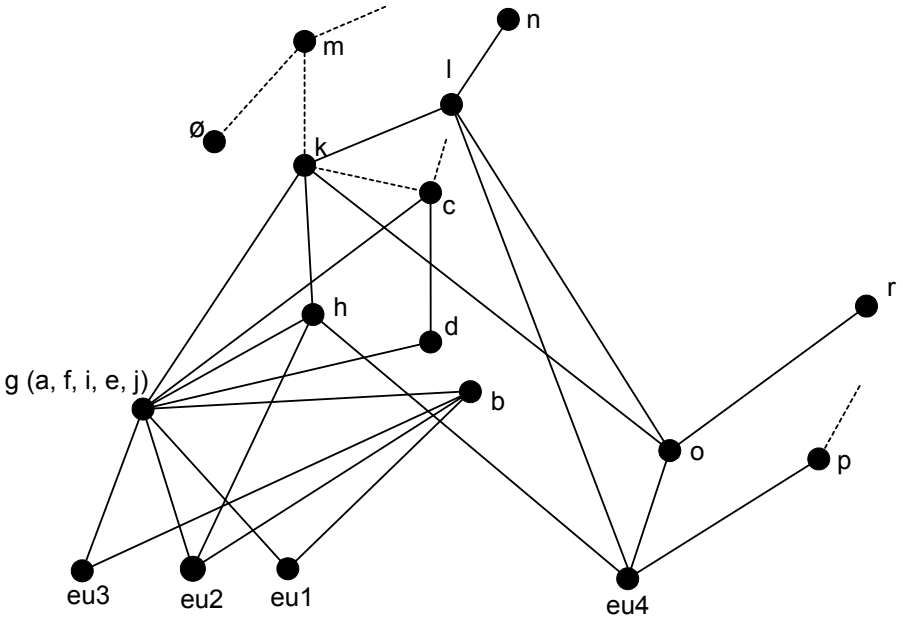


Figure 5.14 The updated empirical 'network'

We now turn to another customer of Ingram Micro, Dustin (*m*), and its exchange interface with Ingram Micro (*k*). Another distributor used by Dustin, C2000 (*ø*), is also introduced.

5.7 Dustin – a customer of Ingram Micro

Dustin is a reseller of PC-related products, and started out as a mail-order company in 1986. The idea was to provide standard software in a more cost effective way than the 'traditional value added resellers' could offer. In 1991 the product range was supplemented with hardware. By 2001, Dustin had identified six main product areas, PC, Software, Networking, Monitors, Components & Multimedia, and Printers. Hence, generally speaking, Dustin offers 'everything' that can be connected to a PC.

Dustin's main way of reaching out to customers has traditionally been, and still is, the product catalogue, which is distributed 11 times a year, as 650,000 copies, one to every registered company in Sweden. The catalogue has come to act as a 'price presser', which has led to many smaller resellers using the Dustin catalogue as a point of departure for their own pricing. One important aspect with regard to the nature of the Dustin product range and displayed prices is the need for the catalogue to be printed not long before it reaches the customers. Dustin decides the contents of the catalogue in consultation with distributors, e.g. Ingram Micro (*k*) and producers, e.g. Hewlett Packard (*c*). From the producers it is important to get information about new products as well as products that are intended to be sold in large volumes, 'volume

products'. For example, Hewlett Packard has what they call 'Top Value Models', priced especially favourably in order to create high volumes[54]. The product manager at Dustin and a representative of the manufacturer, e.g. Hewlett Packard, meet once a month to discuss coming products and how they can be included in Dustin's range and catalogue. The distributors are crucial as it is important that the products advertised in the catalogue can also be made physically available. Distributors also play an important role in the pricing of the products.

The prices in the catalogue are decided on Monday and Tuesday, the catalogue is sent to the printer on Wednesday, is printed on Thursday and is thereafter distributed to the customers. This means that when the customers receive the catalogue the prices are less than one week old.

In 1994, one of the employees at Dustin had an idea about how a computerised business system could support the Dustin way of doing business. The management supported the idea and he was encouraged to start developing a system that could supplement the catalogue as a customer interface. In 1995, an e-commerce system, 'Dustin.se', tailored to fit Dustin's business operations, was launched. The original idea was to establish a database that could be used in a WEB application as well as for internal sales support. Since then, the system has been expanded in line with the growth of the Dustin business. The system has developed into the cornerstone of the Dustin operations, with supporting activities such as sales, purchasing, stockkeeping, handling of product information, and web applications. Accounting and finance have recently been integrated into the system, so now almost all operations are connected to this system.

Dustin's customers

Dustin has a focus on business customers, e.g. Chalmers University of Technology (*eu5*) (henceforth referred to as Chalmers). In some cases private consumers turn to Dustin but they only account for 1-2% of the sales and tend to be people who design and build their own PCs. They turn to Dustin for their broad range of components. Furthermore, consumers who know exactly what they want are another group of customers who turn to Dustin.

Dustin focuses on customers who know what they want and have the competence to design, install, and support systems internally (or who have

[54] This is further discussed in section 5.9 on Hewlett Packard.

outsourced these functions). This is also reflected in the product range, which does not include products intended for private consumers, e.g. the Hewlett Packard models available at the local Siba store (*a*). In line with this, three different kinds of customer groups can be identified:

- Consultancies: These firms are interested in supplying a solution to customers who do not care about which components are included in a specific system but only in the function of the system as a whole. Hence, these firms need components as parts of these systems.
- IT-departments: These customers have the knowledge to choose and assemble their solutions themselves and need reliable delivery of specific components.
- Customers who want an alternative supplier in addition to their main suppliers when the main supplier has problems with delivery or when very fast deliveries are required.

The common requirements of these customers are that they want cost-efficient solutions and do not want to pay for services they do not need. They also want secure deliveries. This does not necessarily mean fast deliveries but information about when delivery can be expected so that they can plan their own activities. For example, Dustin provides a service with an automatic e-mail sent to the customers with information about delivery status.

Hence, Dustin is a 'pure product supplier' and does not provide any services related to installation or configuration. The two main interfaces with customers are the catalogue and the website. In addition, 15 people work at the support department, five of whom answer questions of a technical nature from customers and the rest handle issues related to returned goods and reclaims. The different producers have very diverse ways of handling returned goods and reclaims. The 'Pre-sales department' supports potential customers in their choice of products and can also take order directly over the phone. Otherwise, the customers place the order themselves on the e-commerce site.

The order process

In 2001, 50% of the orders were placed in the e-commerce system and the rest via telephone or fax. When an order is placed in the business system, either by a salesperson or by the customer, two situations can occur, depending on whether or not the product is available in stock. If the product is available, a pick list is printed in the warehouse and order information is generated in the system. The product is then picked in the inventory and marked with a sticker

containing order information. These stickers contain bar codes that are scanned by an automatic reading device and the information is then automatically sent to the business system. The products are then packed and shipped. If the product is not available in the inventory a 'back order' is generated and placed in the business system in a list of purchasing orders. This list includes all orders that are not in stock.

Before 1999, Dustin kept a stock of its most frequently sold products on the same premises as the head office. This meant that the products were simply reloaded on site and were sent to customers. As the business grew the facilities on the premises became too small, and in 1999 a separate warehouse was established. The warehouse is 4000 square meters, and 4000-5000 of the total of 24,000 product numbers are now kept in stock.

Dustin works with about 100 distributors. Of these, four large distributors, Ingram Micro (*k*), Scribona (*n*), C2000 (*ø*), and SMG, account for 60% of the purchase value. There has been an effort to reduce the number of distributors owing to the fact that the assortments overlap to a large extent. However, this has proven to be difficult since Dustin considers a broad range of products as well as availability important and this was hard to accomplish with a small number of distributors.

The decision of what products to keep in stock is mainly determined by what is in the catalogue and how it is presented there. It is of utmost importance that the 'right products' are available in the warehouse for shipment. This makes the purchasers' work important, since they set the level of inventory. There are no predefined inventory levels for the products. Instead, the purchasers work in accordance with a well-developed 'gut feeling' for how many of each product to order. The purchasers have access to all information and statistics in the business system. Each purchaser also specialises in a certain product group, which helps them to acquire experience. The purchaser has contact with one or more persons at each distributor who in turn, specialise on selling this kind of product, e.g. PCs. The purchasers talk to these people several times per hour.

Inventory is always associated with a risk of not being able to sell the products at the 'right price'. In order to reduce this risk Dustin has an agreement with its distributors that, for example, a PC can be sent back to the distributor within two weeks, thus transferring the risk to the distributor.

The list of purchasing orders as described above also needs to be handled by the purchasers. When a product is listed as a back order and put on the list of

purchasing orders the purchaser checks the availability of the product at the different distributors. The business system is automatically updated in relation to the distributors' inventory levels and prices every 30 minutes, so the information is never older then half an hour. He then decides how many products to order. This decision is based on factors such as whether the product is in the catalogue, and on recent sales statistics. Depending on price and number of available products at each distributor, orders to the distributors are then made. The aim is to place the whole order with the distributor with the lowest prices. However, if this distributor does not have as many products as needed, others are used as well. Orders are then generated and sent to the distributors by fax. The order receiver at the distributor confirms the price and sets an estimated date of delivery. The order confirmation is faxed to Dustin within a couple of hours. When the order confirmation has been received, the list of purchasing orders is updated and an e-mail is sent to the customer about delivery date if requested. One of the distributors, C2000 (ø), offers electronic order placement. The others have EDI solutions, in which Dustin does not want to invest, and they fax.

Deliveries from the distributors arrive along certain pre-determined routes. Each of the four largest distributors delivers approximately 3 - 4 trailers daily to the Dustin warehouse. For example, Ingram Micro works according to the following time schedule.

Order to Ingram Micro before:	*Trailer leaves Ingram Micro's warehouse:*
10:00 a.m.	11:00 a.m.
01:00 p.m.	02:00 p.m.
05:00 p.m.	07:00 a.m. (next day)

It takes about one hour and 30 minutes for the trailer, operated by Posten Logistik, to arrive at the Dustin warehouse. There are also fixed prices and times for couriers (three hours) and taxis (one hour) from the Ingram Micro warehouse to the Dustin warehouse.

Some large customers have their own price lists and can access the inventory of the distributors, which give them an extended assortment. The purchasers cannot change the prices displayed to a customer on the e-commerce site even when the distributors have changed their prices to Dustin. This means that it is important to constantly update the customers' price lists in line with the distributors' price lists.

Every day, 2000 items are sent to customers from the warehouse. The products are shipped by Posten Logistik (*h*) who comes to collect shipments six to seven times a day. If the order is placed before 5p.m. the product is delivered to the customer before noon the next day. Within Stockholm, Posten Logistik can deliver the same day if the order is placed before 10a.m. In exceptional cases, products can be sent by courier from distributors directly to Dustin's customers but 99% of the deliveries are transferred via Dustin. Dustin charges about $10 per order placed by the customer and does not charge extra for partial deliveries. This means that it is important to Dustin to deliver as complete orders as possible. Hence, Dustin's strength is in delivering small orders frequently. For an overview of Dustin's information and physical flow see Figure 5.15 below.

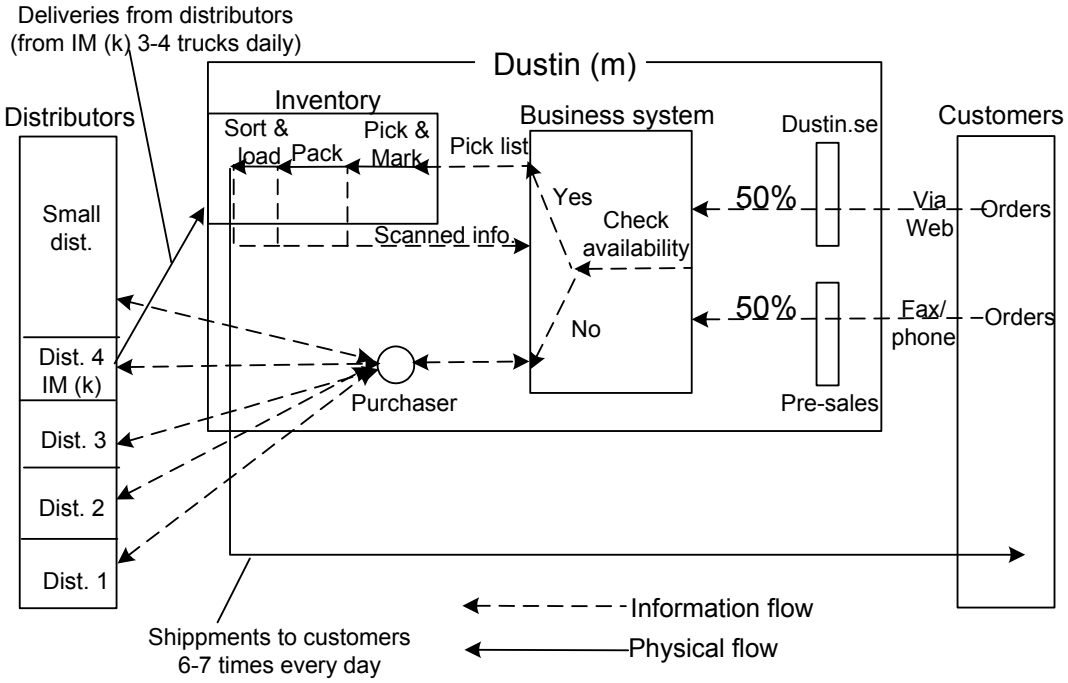


Figure 5.15 A summary of Dustin's information and physical flow

In Figure 5.16 below the network has been updated in accordance with the discussion in this section.

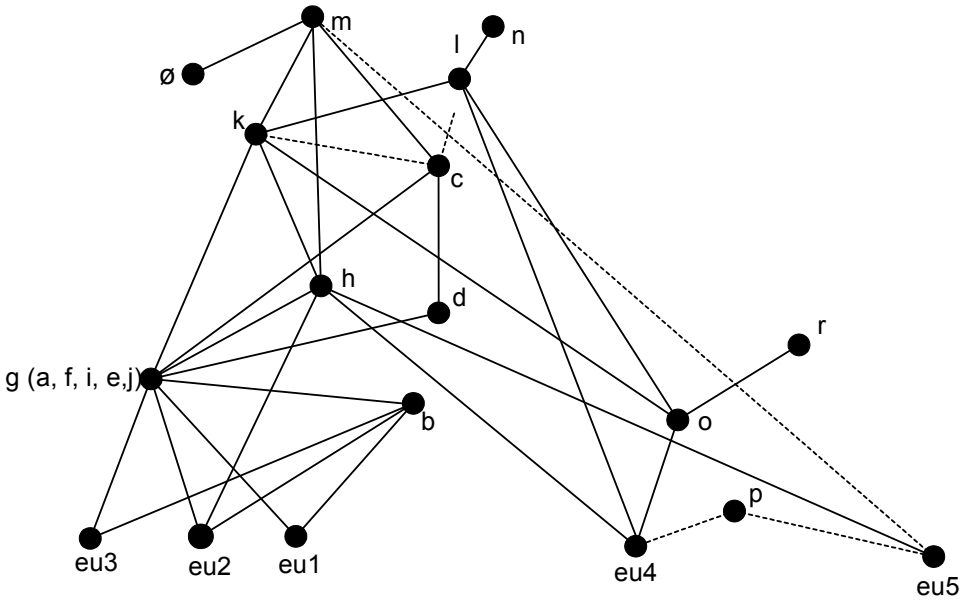


Figure 5.16 The updated empirical 'network'

Before turning to one of the identified customers of Dustin (*m*), Chalmers (*eu5*), we turn to Dell (*p*), a supplier of PCs to both Chalmers and Pharmacia (*eu4*).

5.8 Dell - a supplier of PCs

Dell focuses mainly on business customers as well as advanced consumers who are not first time buyers. The website reflects this focus in the way it is designed. The customer needs to be very familiar with the characteristics of a PC in order to evaluate different options available and make a choice on the basis of this information. As every phone call is quite expensive Dell is currently trying to restructure the website in order to improve flexibility in relation to different kinds of customer needs. A private consumer can contact Dell either by telephone, fax, e-mail or the Internet. Large business customers have one or more specific personal contacts who are responsible for them. These employees' tasks are to help the customer to find suitable solutions. These customers also have their own 'Premier Page' on the website that is only accessible to them. Hence the customers are provided access to limited parts of Dell's business system. On this site the customer can access information concerning, for example:

- The persons responsible for different areas and how to contact them?
- Sales history and information about the existing PCs from Dell in the customer's organisation. This information includes configurations, price, date of purchase, etc.
- Available configurations allowed by the customer.

A more advanced service, not available to all customers, is called 'Image Watch'. This service lets the customers access more of the business system and provides information about coming industry related changes that may affect the customer's PC environment. For example, changes in software or processors can have implications for the way PCs communicate in a network setting. By getting this information early, the customer can plan for this technology transition in advance and be able to try out new configurations that match the existing ones.

Configuring the PC

All PCs sold by Dell are produced to customer order. Dell can also customise the PCs within certain limits. This means that from some predefined 'bare bone' models, the customer can choose between alternative options for each type of component. Dell distinguishes between two main models, Dell Dimension and Dell Optiplex. The Optiplex is developed to fit in a network setting, while the Dimension is not. This is also reflected in how they are directed to different customers. The Dimension, which is offered in four different basic models, is directed to private consumers and small companies that do not have a network. The Optiplex, in turn, is offered in three basic models and is directed to small and medium sized companies with a need for a network connection, and to large business customers. From these seven basic models the customer can customise 'its own' PC by choosing from a number of available components.

When a customer has decided on a specific configuration, either alone or in interaction with a contact person at Dell, he or she places an order.

Order processing

The order can be placed either by e-mail, telephone, fax, or on the website. Either way, the order sheet is transferred to an incoming orders clerk at the head office in Stockholm. This person then manually inputs the order into the Dell business system where it is given an order number. After this an order confirmation is sent to the customer by post. The orders are collected in the office in Stockholm and sent twice a day to the production site in Limerick, Ireland. The manual handling of orders increases the possibility of error, as the transfer of information from the customer's order to the order sent to the production site depends on the person making this transfer. The main problem is that the confirmation to customers is sent by post, and so the customer does not have a chance to detect errors before the order has entered production.

Dell is therefore currently working on a way to make it possible for the orders to be sent directly to the production site with no manual handling. The problem, however, is related to the many possible combinations of components as described above. Theoretically, millions of combinations can be put together but not all these are physically possible since not all components can be combined. Hence, there are some 'forbidden' combinations that do not work well. The order system in its present layout is not able to detect these 'forbidden combinations'. This is the reason orders have to be checked manually. Another problem is that new components are constantly being introduced, and so it is necessary to continuously update the database.

Another aim is to better integrate customers' business systems with Dell's, in order to be able to reduce the cost of order administration. A study at Dell showed that an order passes through 42 'stations' at the customer end, and the cost of handling this was estimated to about $100 per order.

At the assembly site

The production site (*q*) in Limerick handles all assembly of PCs bound for Europe, Middle East and Africa and is one of a total of nine production sites worldwide. The component suppliers are located in stock 'hubs' within 15-45 minutes drive by car. Each hub can host a number of suppliers. The suppliers are connected to Dell's business system and get information in real time concerning required deliveries in terms of quantity and time. Dell has reduced its number of suppliers from 300 to 50. More than one supplier is used for each component except software (Microsoft) and processors (Intel). The main reason for using more than one supplier is to be safeguarded against natural disasters like earthquakes and other unpredictable events. Dell does not have any inventory of components of its own. Instead, exactly the 'right' components are delivered to the assembly site from the hubs. Dell takes possession of the component when it is removed from the inventory of the hub, which is about one hour before it is picked to be input on the assembly line. Consequently, when Dell takes possession of the components, the PC in which they are included has already been sold. No assembly is done without an order.

When the order arrives at the production site it is put on a waiting list until it has been verified that all the components needed are available and that the customer is creditworthy if payment is being made by credit card. When this information has been verified, a 'traveller' is generated showing the components to be picked, the serial number of the order as well as a

corresponding bar code. This traveller is then printed out at the assembly line, where a factory worker collects it. He then picks and assembles the chassis, memory, motherboard, and processor. The module is placed in a box on the assembly line together with the traveller. The box is transferred to a number of different locations along the assembly line at which the remaining components are attached to the module. For example, at the hard disc location there is a storage rack where all the different alternative hard discs are available. The worker reads the traveller, picks the right kind of hard disc from the rack and inserts it in the module. After this he scans the bar code and this work operation is registered in a specific server connected to the business system. As all work operations are scanned like this it is possible for the customer to trace the product. This can be done on the Dell website by entering the order number and customer number. The customer can then get information about where in the process (five phases are distinguished: Order administration, Pre-assembly, Assembly, Pre-delivery, Shipping) the PC is at present. For Dell this is a cost saving service since the most common question from customers relates to when the PC will be delivered and it has been estimated that the cost of one such telephone call is about $3-12.

The pure assembly work for each PC only takes about five minutes. After assembly, the PC is transferred to a storage rack for downloading of software and testing. The software can be of a standardised type or customised in accordance with specific customer requirements. In the latter case the customer has provided a CD and the software is downloaded together with the standard software. Customers may also require some other kind of customisation, for example theftprotection, specific stickers to be attached or advanced testing. If so, the PC is removed from the main assembly line and transferred to a connected sideline. The additional services are performed and the PC is then transferred back to the main assembly line. This extra service is called ‘Dell Plus’ and is used, for example, by Pharmacia (*eu4*), as described in section 5.6.

Packing and loading

The PCs are then packed in cardboard boxes. Dell wants to keep orders together as much as possible but the customers don’t want to wait for one PC if the rest of the order, of say 200 PCs, is ready for shipment. Therefore, Dell tries to break down orders into sub-orders of about ten items. This means that 190 out of the 200 PCs in the example above can be shipped as sub-orders before all the other sub-orders have been completed. If the PC is part of a larger order it is automatically placed in a storage rack and is kept there until the rest of the order or sub-order is complete. The PCs are then transferred to a work table

where manuals, cords, and other country specific components are added. Each box is also marked with order information including customer name and address, bar code, serial number, and information about the number of parcels in the order, the number of each box, and weight. The boxes are then sorted in geographical order and transferred to the loading areas where trailers bound for different countries or regions e.g. the Nordic countries, are waiting to be loaded. Three days have now passed since the order was placed by the end-user. In Figure 5.17 below, an illustration of the discussion in this section is provided.

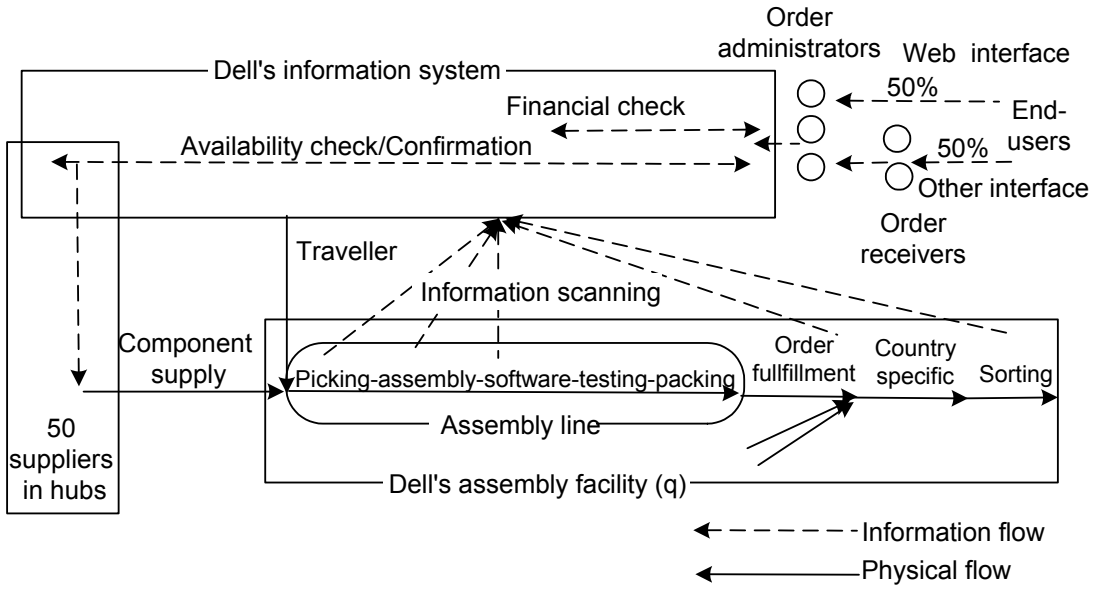


Figure 5.17 Dell's information and physical flow from end-user order to shipping

When the boxes leave the production site area, responsibility for the products is taken over by a firm called Irish Express (*r*) who remain responsible for the PCs until they are delivered to the end-users. This firm also handles some parts of Hewlett Packard's (*c*) distribution of PCs, which is dealt with in section 5.11.

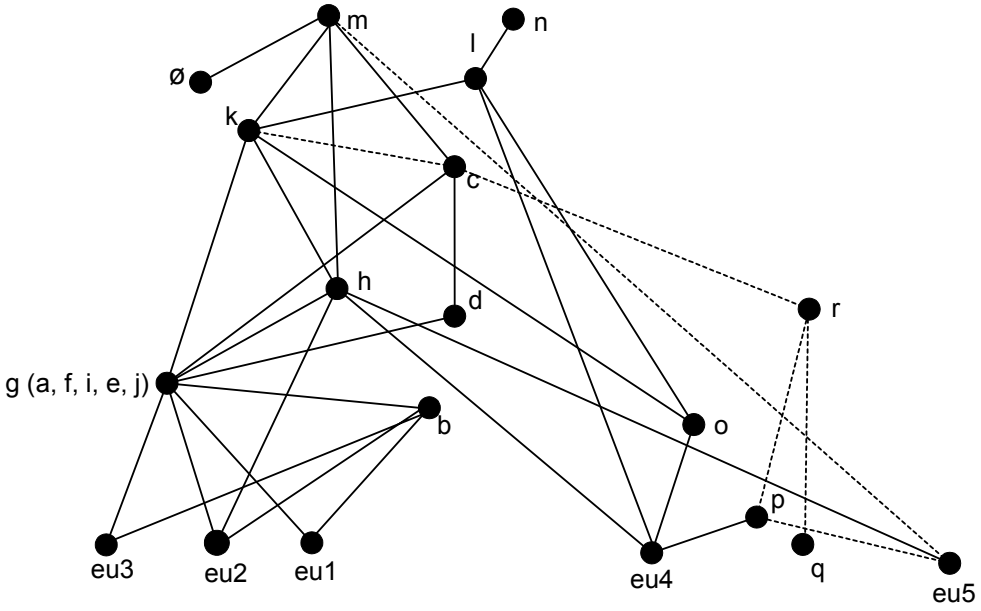


Figure 5.18 The developing picture of the empirical 'network'

Before continuing the elaboration as to how the PCs from Dell are delivered to the end-users after the point where Irish Express takes over, we take a step back to another firm, Hewlett Packard (*c*). This firm was identified as an important node earlier in this chapter in relation to its connections to a number of firms (see Figure 5.18 above). Hewlett Packard also has a connection point with Dell in that they both use Irish Express as a supplier of logistics services.

5.9 Hewlett Packard – supplier to Ingram Micro and a customer of Irish Express

Hewlett Packard (*c*), was founded in 1939 and was at that time a company focusing on measurement equipment. During the 60s and 70s one of the main business areas was scientific calculators and in the early 70s Hewlett Packard entered the business computing area, introducing its first minicomputer. This was followed by a mainframe computer in 1982. In 1984, Hewlett Packard entered the printer business, which became one of its main business areas. The LaserJet printer, which had sold more than 35 million units in 1999, is Hewlett Packard's most successful product ever.

In 1979, the computer related part of the company was larger than the measurement related part for the first time. This development continued and in 1999 the measurement part was separated from Hewlett Packard and established as a new company, Agilent. The rest of the company remained under the Hewlett Packard name. In 1999, Hewlett Packard was listed as the

second largest IT company in the world. In 2000 the company had 88,500 employees and was active in more than 120 countries.

In the early 80s three important strategic decisions were taken. First, Hewlett Packard would focus on the printer industry. Second, Hewlett Packard would focus on industry standard interfaces in the computer area, not trying to create their own solutions and standards. Third, and related to the previous one, they would go from a focus on 'make' to a focus on 'buy'. In 1991, the first PC was introduced by Hewlett Packard but the real breakthrough in this area came in 1994 with the launch of the Pavilion PC, intended to the consumer market.

Hewlett Packard's range of PCs

Hewlett Packard only supplies predefined standard models. Hence, Hewlett Packard makes no adaptations of the physical PC in relation to individual customer needs. Instead, the distributors make all customer specific configurations. Ingram Micro, for example, can help their customers with this kind of service. However, in order to cover different types of customer needs, Hewlett Packard offers different models directed toward different 'aggregated' end-user needs. The Pavilion PC is intended for consumers needing a PC at home. This computer comes prepared for Internet use and is sold with special offers from different Internet Service Providers with whom Hewlett Packard partners. It is also delivered with software for word processing and image handling, and is the product group where the PCs bought by *eu1* and *eu2* can be found. Further, the Brio PC is intended for small companies not in need of standardisation or network connections. The Vectra, on the other hand, is intended for larger organisations and companies that need a PC to be stable in a networking environment and where standardisation is important because of service and support issues. These two kinds of PCs are aimed at users such as *eu3*.

Hewlett Packard works with five different distributors in Sweden, of which Ingram Micro and C2000 are two. These work as intermediary actors between Hewlett Packard and the resellers. Beyond this, Hewlett Packard also works directly with two major resellers, Atea (γ) and Point, that sell directly to large organisations. (see Figure 5.19 below).

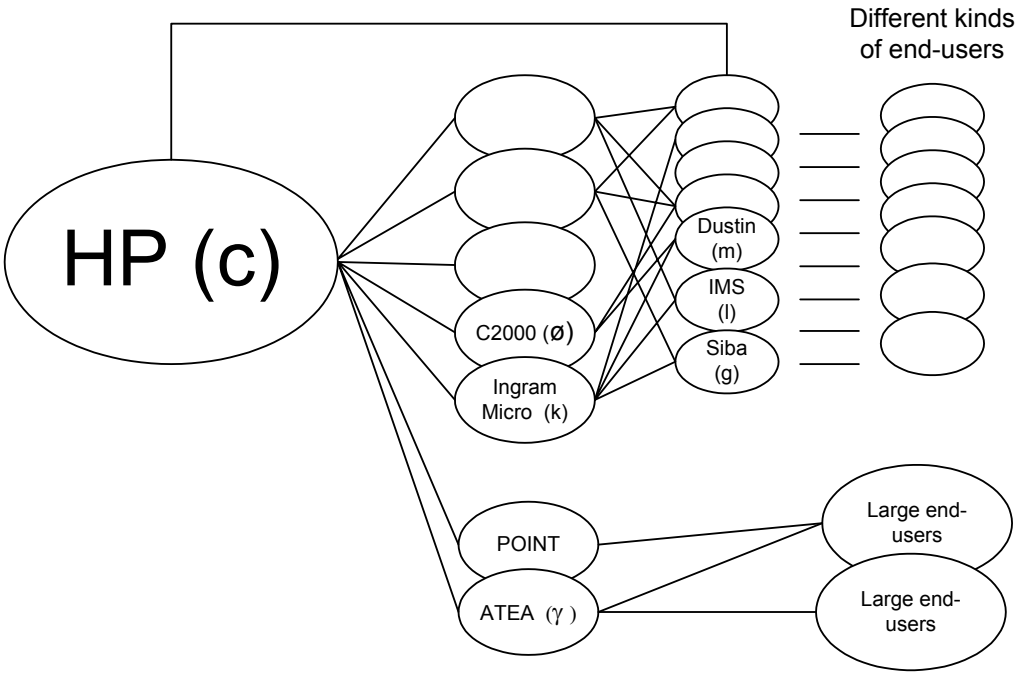


Figure 5.19 Hewlett Packard's distribution structure

Hewlett Packard has tried to get closer to the resellers with different kinds of partner programmes. They distinguish between resellers and partners. In order for a 'reseller' to be labelled an Authorised Hewlett Packard Business Partner, the resellers' staff have to pass one or two certification programs. There are two levels, Hewlett Packard Star Sales Professional and Hewlett Packard Star Technical Professional. Hewlett Packard arranges these two courses of authorisation for the resellers' sales and technical personnel respectively. This results in three levels altogether: resellers, partners with sales authorisation, and partners with both sales and technical authorisation.

Hewlett Packard has tried to find alternative ways of working in order to reduce the costs associated with stockkeeping. As a result, Hewlett Packard introduced a revised distribution program in 1997 called the 'Extended Solutions Partnership Program'. The program comprises three distribution models beyond the traditional 'push-model' sold through distributors and resellers: 'Channel Assembly', 'Economy Program', and 'Vendor Express'[55]

In the channel assembly program, Hewlett Packard provides the partners with semi-assembled 'bare-bone' PCs that are final assembled and customized by Hewlett Packard partners at their facilities. The partners have access to local

[55] *PC Week*, 1997-09-09, Michael Zimmerman, 'Hewlett Packard Pulls Out the Stops to Attract Small, Medium-Size Business Users'.

inventories, owned and managed by Hewlett Packard. These inventories are replenished by Hewlett Packard and contain the 'bare-bones' as well as the components needed for customisation and final assembly. In order to coordinate these activities the partners have access to Hewlett Packard's inventory system. The distribution model 'Vendor Express' provides larger customers with a dedicated web-page, called 'Hewlett Packard Enterprise Web Page', from which they can configure and order products, track deliveries and submit service requests. This new way of working was initiated in response to customers who wanted more direct contact with Hewlett Packard rather than with the 'reseller channel'. The customers also wanted a wider variety of ways to receive Hewlett Packard's different products and services. In this case the products are shipped directly to end-users, while the partner's role is service.

In Sweden, the only program that has been introduced is the Economy Program, which involves the production of certain top-selling models, labelled 'Top-Value' PCs. These products are manufactured on the basis of forecasts made by the partners and Hewlett Packard together.[56] This was also discussed in section 5.7 dealing with Dustin and their interaction with both Hewlett Packard, and with Ingram Micro for the contents of their catalogue. In Sweden, Hewlett Packard has introduced six 'Top-Value' models. These are priced very competitively and are offered to four distributors, of which Ingram Micro is one. By connecting to the distributors' inventories, Hewlett Packard can place orders on-line with regard to certain inventory levels. The goal is to reduce the inventories so that the distributors will not get 'stuck' with stock. If a distributor cannot sell the PCs in stock, there are usually two possibilities, either to return the PCs to Hewlett Packard or to reduce the price. Both these alternatives are unfavourable from Hewlett Packard's perspective and so Hewlett Packard is very anxious to reduce the stock kept at the distributors' facilities.[57]

Order processing and the assembly site

Hewlett Packard has 12 assembly facilities in Europe. The one that assembles products for Sweden is in Grenoble, France and the PCs bought by *eu1, eu2*, and *eu3* were therefore assembled there. This assembly facility is referred to as (*s*).

[56] *PC Week Online*, Anne Knowles, 1998-01-28, 'Hewlett Packard Streamling PC Delivery, Service Programs'.

[57] Interview with A. Garberg.

The distributors, e.g. Ingram Micro (*k*), send their orders to Hewlett Packard through an EDI based system called 'connect-on-line'. The orders are transferred directly to a central Hewlett Packard unit (*t*) in Germany where three employees work with orders from Sweden. All incoming orders during one day are collected and aggregated to one single assembly order, placed with the assembly facility in Grenoble. When the order arrives it is processed together with other incoming orders from other countries. This results in an assembly order, the setting of a 'release date', as well as a preliminary shipping date from Grenoble and a preliminary delivery date to the customer, e.g. Ingram Micro. The release date indicates the date when the assembly of the order will begin. All this information is then transferred back to Germany and this unit informs the customer of the dates. The assembly plan is a result of sorting the orders so that orders of PCs of the same model are gathered together and assembled at the same time. The time from when the unit in Germany sends the assembly orders until it can inform the customers (distributors) is 24 hours. One problem in this process is that the order is not traceable. This means that if the customer wants to change something in the order it is impossible. There is no stock of finished products, as all assembly activities are made in relation to a specific order from a distributor, e.g. Ingram Micro, and all products are shipped directly from the assembly line. However, Hewlett Packard has its own stock of components. (see Figure 5.20)

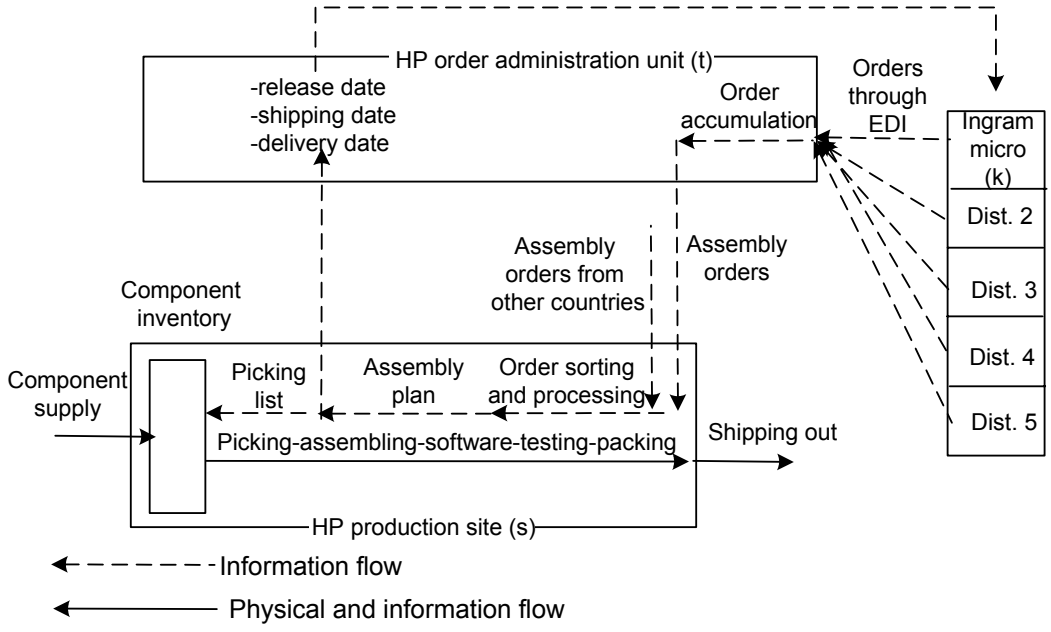


Figure 5.20 Order process and assembly at Hewlett Packard

Hewlett Packard works with Schenker (*u*), a logistics provider, for physical delivery to customers. Before we turn to Schenker, an alternative exchange interface to end-users of Hewlett Packard products is described.

Hewlett Packard's exchange interface to end-users

One important issue for Hewlett Packard has been the increasing demand from end-customers to provide a greater variety of alternative exchange interfaces. For this reason, Hewlett Packard introduced the Internet based web solution 'Hewlett Packard Shopping Village' in 2000. This was later renamed the 'Hewlett Packard Store', intended for private consumers, and 'Hewlett Packard Business Store', intended for small and medium size firms. 50% of the orders come from firms with less than five employees. On these websites a limited range of products is offered. The assortment include different parts of Hewlett Packard's total range: not only PCs but also, for example, printers. This exchange interface is thus comparable to the web-shop 'Siba.se' provided by Siba, except that the Hewlett Packard website (*v*) only provides PCs from Hewlett Packard.

The end-user can use the Internet interface and place orders directly on the website or place orders by telephone. In the latter case, the salesperson places the order on the Internet. The telesales department is run by an external company (*x*) situated on the island of Gotland, Sweden and the salespersons taking calls have the same degree of authorisation as the partners in Hewlett Packard Star Sales Professionals. Of the total number of orders placed through the 'Hewlett Packard Store' 60-65% are placed by phone and 35-40% directly on the Internet by end-users (*eu6*). This kind of end-user is most often consumers that buy their second or third PC and that have some idea of what type of PC they want.

The Internet and telephone can be seen as complementary since many customers first study the products on the website and then call in to discuss some questions of, for example, a technical nature, and place their order over telephone. If the order is not placed correctly this may be very expensive for Hewlett Packard. If the customer discusses the purchase with a salesperson, who then places the order, the risk of making mistakes in the order placement process is considerably reduced. The order system is designed so that it is impossible to place an order that is not available in stock. When either the end-user or the salesperson has placed the order, it is transmitted directly to the information system of one of Hewlett Packard's partners, Irish Express (*r*). This firm is responsible for handling the orders as well as for the physical delivery to end-users. Irish Express has no facility for stockkeeping in Sweden, but work with another company, ASG (*y*), that has a fleet of trailers as well as facilities for stockkeeping and reloading. Hence, the stock of PCs is kept at one of ASG's facilities, a goods terminal (*z*) in Gothenburg, where Irish Express

also has a small local office. Schenker (*u*), a logistics provider, ships PCs from Hewlett Packard's production facility (*s*) in France to this warehouse. The level of inventory kept in Gothenburg is decided by Hewlett Packard (*c*) on the basis of sales figures and predicted sales. For an illustration, see Figure 5.21 below.

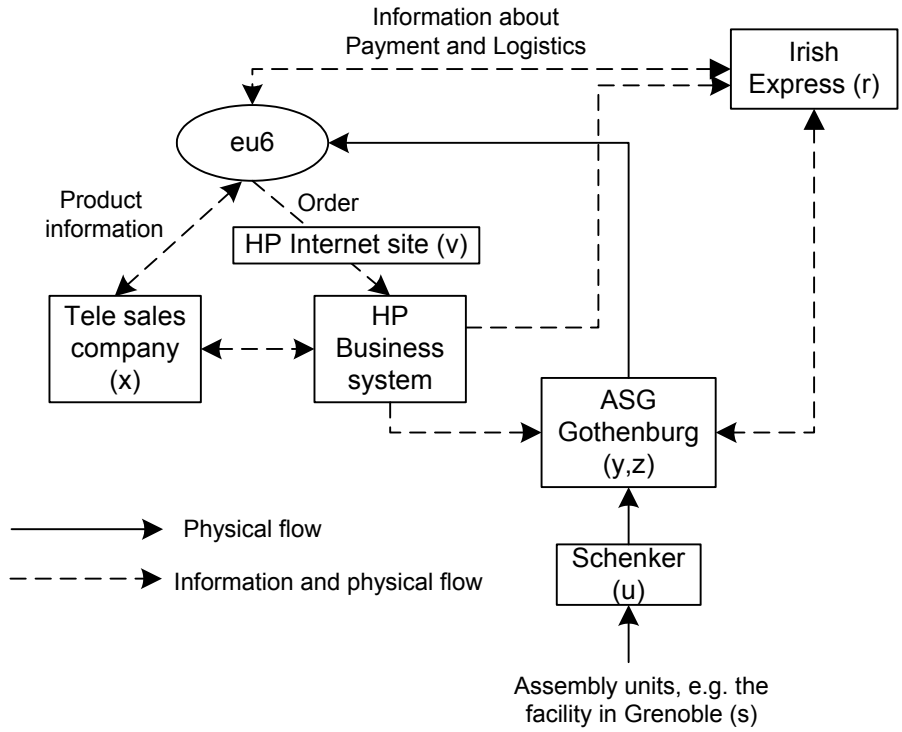


Figure 5.21 The information and physical flow related to Hewlett Packard's Internet store

The description goes on to portray Schenker (*u*), the logistics provider used by Hewlett Packard. First, an update of the emergent picture of the empirical 'network' is given in Figure 5.22 below.

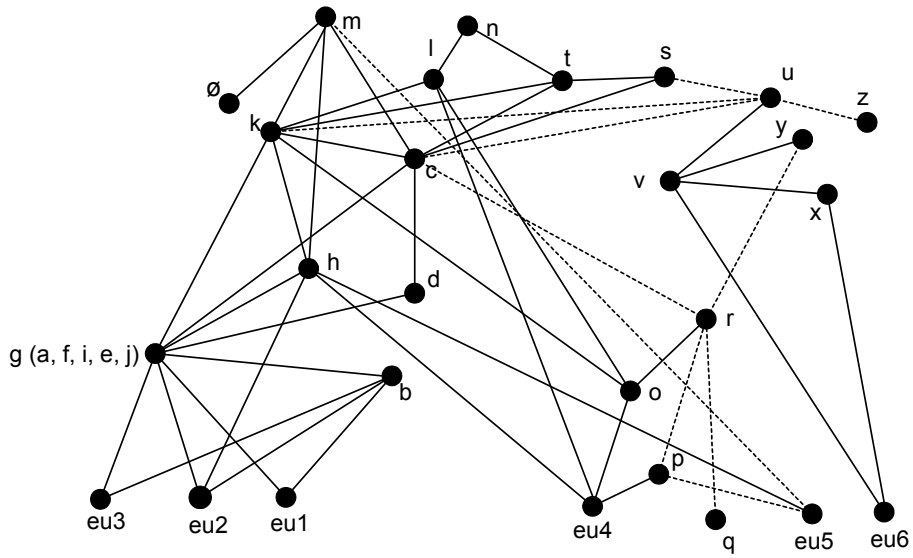


Figure 5.22 The updated empirical 'network'

5.10 Schenker – a logistics partner to Hewlett Packard

Schenker is a large pan-European logistics service provider. This section describes Schenker's involvement in the delivery of Hewlett Packard's PCs and how it functions as an interface between Hewlett Packard *(c)* and distributors, such as Ingram Micro *(k)*.

Schenker (*u*) receives information about shipments from Hewlett Packard's assembly site in Grenoble (*s*) 24 hours before the products are to be collected. The information is transferred by EDI and contains information about how many pallets are to be picked up the next day. The trailers of PCs are loaded in Grenoble and transported to Schenker's hub (ε) in Copenhagen where they are sorted and reloaded. All shipments are transferred through this central hub where all the necessary order information is generated. When trailers arrive before 3p.m. the goods leave the hub in Copenhagen the same day and reach the customers or the ASG facility, as described in the previous section, the next day. The customers, e.g. Ingram Micro, get information about exact delivery time the day before so that they can plan. A preliminary delivery date was given to the customer earlier, as described in section 5.9, page 108. This information is important since a distributor such as Ingram Micro works with many suppliers and receives many deliveries every day. All these shipments therefore need to be managed in a structured way. Information about delivery in terms of weight, order number, and 'box numbers' is important in case some parts of the order are missing. This information enables the rest of the order to be traced. Consequently, Schenker plays an important role in informing and coordinating with the customers. In the case of very large deliveries to one customer, often involving 'top-value' PCs, the shipment arrives in Copenhagen where delivery documents are collected without reloading. In extraordinary cases, 'special deliveries', the PCs can be shipped directly from Grenoble to the customer. Each day, 22-25 trailers leave Copenhagen with about 2500 'boxes' bound for different destinations in Europe. Of these, as many as two to three trailers per day are delivered to Ingram Micro's warehouse in Stockholm.

Schenker has made special arrangements for Hewlett Packard in the hub in Copenhagen by installing a conveyer belt that automatically handles the boxes and sorts them by country and customer. This facilitates the reloading and sees to that the trailers are loaded in a way that is efficient from a transportation point of view. The conveyer belt is only used for Hewlett Packard's products and the products are never co-loaded with products from other suppliers. However, the conveyer belt is not designed to fit only Hewlett Packard's products, which means that it would be possible to use it for products from

other suppliers as well. In addition to PCs, a lot of different Hewlett Packard products are transferred through the hub in Copenhagen. Hewlett Packard's main products, printers, are also transferred through this hub. However, the printers are not sorted in the same way but they arrive on pallets bound for a certain customer. These pallets are therefore not 'broken down' and reloaded, but are handled parallel to the conveyer belt. For an overview of the work operations in the Schenker hub in Copenhagen, see Figure 5.23

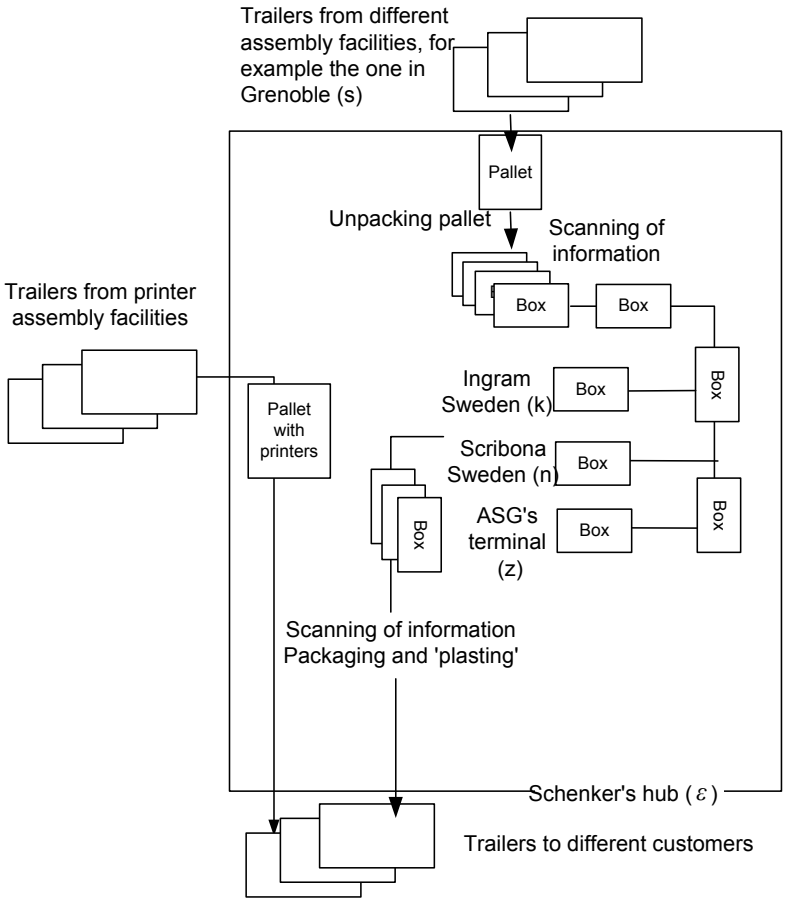


Figure 5.23 The Schenker hub in Copenhagen

The aim is to load the trailers so as to keep the number of stops to a minimum. Therefore, efforts are made to fill up a trailer with boxes bound for one customer. This is, however, not always possible, so products to different customers are sometimes co-loaded. In this case, the loading of the trailer is planned in accordance with the route so that the boxes can easily be unloaded successively.

Another adaptation made for Hewlett Packard was to have two drivers in each trailer so the transportation time could be reduced. It takes six to eight days from the time when customers place their orders until delivery. The time from when the shipment leaves Grenoble to delivery is 3 - 4 days.

5.11 Irish Express – a logistics partner of Dell and Hewlett Packard

Irish Express (*r*) is a freight and logistics company founded in 1972 in Dublin. This section deals with its involvement in two PC producers' operations, Hewlett Packard and Dell.

Irish Express and Dell

In section 5.8 the order process and assembly process of Dell were described. When the PCs leave the assembly line, Irish Express takes over the responsibility until the PCs are delivered to the end-users. Irish Express gets information concerning how many trailers are needed two days before the trailers are to be loaded at the Dell facility. The trailers dock to the loading ramp and a roller conveyor extends into the trailer and loads the boxes. Again, the bar codes are scanned and the customer can now get information on the website that the 'shipment phase' has begun. Irish Express operates the trailers and each trailer has two drivers so that a non-stop drive can be accomplished in order to reduce the time to the customer. This was decided in interaction with Dell who wished to reduce the time of transportation. A lot of planning has also been done concerning the actual route in terms of speed limits and alternative routes.

Irish Express takes the trailers to Immingham in England, from where Irish Express uses another company, DFDS, to ship the trailers to Gothenburg, Sweden, by sea. There is one daily departure from Immingham to Gothenburg and when the trailers arrive the next morning they are transferred to a goods terminal (*z*) operated by still another logistics firm, ASG (*y*). Both DFDS and ASG work by order of Irish Express and they coordinate the handing over of the goods at the terminal.

Irish Express has a local office (*å*) with five people in Gothenburg located at the ASG terminal. The companies have a three party agreement where ASG has the responsibility for the physical handling of the PCs after their arrival at the terminal. In some cases Irish Express holds stock of PCs from Dell for some end-users. These end-users might want to order a larger batch and then suborder from Irish Express.

Of the five people in the Irish Express office, Dell employs one. An interesting point is that Irish Express is also responsible for some of Hewlett Packard's (*c*) delivery of PC's. One person in the local Irish Express office is therefore responsible for the relationship with Hewlett Packard.

Irish Express and Hewlett Packard

As was illustrated in section 5.9 Irish Express is only involved in the delivery of Hewlett Packard PCs sold through the Internet store. The other PCs are transferred to customers, e.g. Ingram Micro, by Schenker, as illustrated in section 5.10. Schenker is also involved in the PCs sold through the Internet store since they are responsible for them until they are delivered to the ASG goods terminal (*z*) in Gothenburg. At this point Irish Express takes over the responsibility for the PCs. As also pointed out in section 5.9, some PCs are sent to Gothenburg without their being ordered by customers. These PCs therefore need to be kept in stock until orders from customers arrive. Irish Express rents space in the ASG terminal for this. Irish Express also handles reclaims and the delivery documents for Hewlett Packard.

Both Dell and Hewlett Packard use Irish Express[58] as a logistics provider (see Figure 5.24). However, Irish Express does not have the resources to physically deliver products in the Nordic countries. Therefore, Irish Express has a partnership with ASG for deliveries in the Nordic countries. ASG is discussed below.

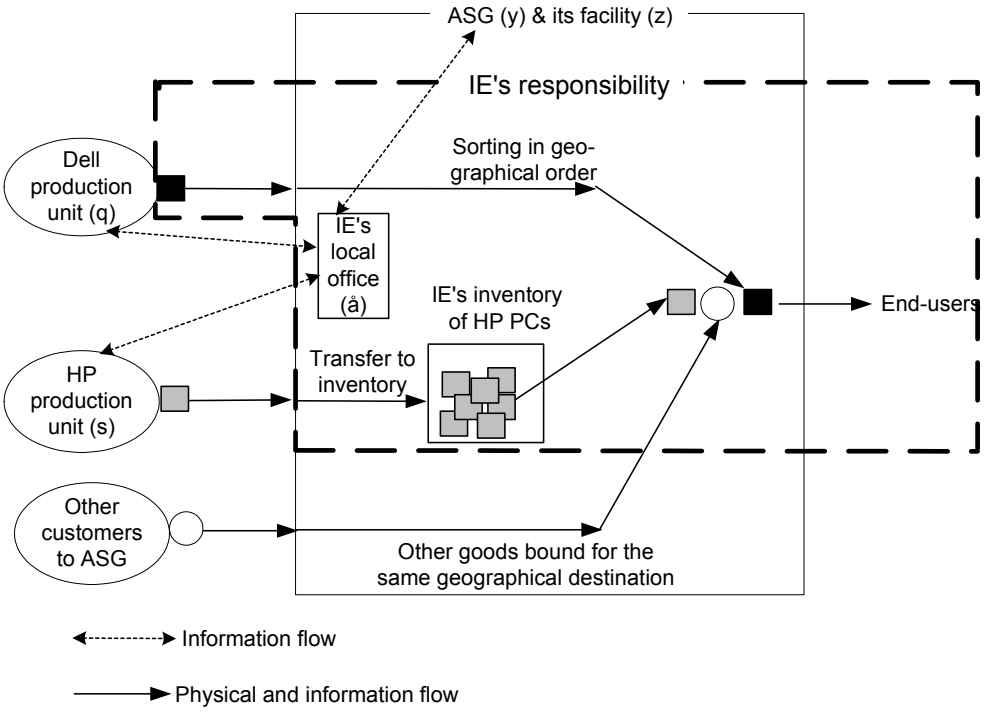


Figure 5.24 Irish Express and ASG jointly handle the PCs from Dell and Hewlett Packard

[58] Referred to as IE in Figure 5.24.

5.12 ASG – a partner of Irish Express, Dell, and Hewlett Packard

ASG is part of the Danzas-group, which is one of the largest logistics providers worldwide. ASG is an umbrella organisation for a number of shipping agents and has full coverage in the Nordic countries. ASG is involved in the delivery of PCs for three suppliers, Dell, Hewlett Packard, and Gateway. Of these, Dell accounts for 98%, and will therefore be focused on in the following section.

ASG's relationship with Dell was initiated in 1997.[59] Dell was working with Irish Express in Ireland and asked them if they could take care of the Nordic countries as well. However, Irish Express did not have any established business in the Nordic countries, and so they needed a partner with an established network and coverage in these countries. ASG was chosen as partner, and its terminal in Gothenburg was considered strategically located for Dell.

The interface between Dell, Irish Express and ASG

For ASG, the new business meant some challenges. Dell required reports to be sent by e-mail, which meant that ASG had to establish such a system sooner then they had planned for. Likewise, Dell required a 'track and trace' system that also had to be established. ASG also had to adapt in other areas when starting to be involved in the delivery of PCs. The fleet of trailers had to be adapted for security reasons. Trailers with soft covers could not be used, but only trailers with steel covers that could be sealed during transport. Hence, new trailers had to be acquired. Furthermore, railway transport could not be used, as Dell demanded the shipment to be constantly moving, for security reasons. The terminal also had to be adapted to the new relationship with Dell. A large fence now surrounds the area in the terminal where the PCs are handled, and 50 video cameras monitor the area.

Many of the adaptations made for Dell have been utilised in relation to other customers, especially the adaptations of the business system. ASG also believe that they would not have been able to close contracts with Hewlett Packard and Gateway if they had not already been working with Dell.

The agreement is a three-party agreement in which ASG operates at the request of Irish Express, which, in turn, operates at the request of Dell. Most of the information needed is received from the Irish Express business system, although ASG is connected to some limited parts of the Dell system as well.

[59] Since autumn 2001 Dell has been working with Schenker instead.

There are daily personal contacts between staff at ASG and Dell, especially with the person hired by Dell to work at the Irish Express local office in Gothenburg. All questions related to transportation within the Nordic countries are handled by ASG.

ASG handles about 20,000 orders every month for Dell, each order involving an average of 4.2 boxes. This means that a total of 90,000 boxes for Dell are handled at the ASG terminal every month. The number of trailers that arrives each day varies but a normal week will span from zero to twelve trailers per day, with an average of eight per day.

In Sweden, ASG gets information concerning the delivery one day in advance from Dell via the Irish Express business system. This information tells when the delivery is to be expected, how many trailers will arrive, how many 'boxes' they contain, as well as where they are bound for. This fact shows why it is of great importance for ASG to get this information in time, so that they can plan how to combine these deliveries with others bound for the same destination. It is also important to be prepared for unloading at the dock so the deliveries can be managed in a structured way. When the trailers arrive at the dock for unloading a conveyor is used. In conjunction with this operation, the bar codes on each box are scanned and the information transferred to the ASG business system, and it is transferred from there to the Irish Express business system 10-15 times a day.

When the boxes have been unloaded in the terminal and scanned for information they are counted to confirm that all boxes in a certain order have been delivered. Due to the fact that Dell wants to load the trailers as 'efficiently' as possible, it sometimes happens that an order is split among many trailers. These orders need to be gathered together again in order to be shipped to the end-users in one batch. Of all the PCs delivered from Dell to the goods terminal, 20% are merged with monitors before they are sent forward. For example, some of the monitors used by Dell are manufactured in Finland and Hungary. These are not sent to Limerick to be merged with the PC but instead they are delivered directly to the terminal in Gothenburg where ASG has a buffer stock of monitors. ASG gets information from the Irish Express business system one day before the PCs arrive concerning which PCs in a certain delivered batch that are to be merged with monitors. The monitors are picked from the buffer stock and marked with order information in advance so that they are ready to be merged when the PCs arrive at the terminal.

The boxes are then sorted in accordance with their final geographical destination and placed in specific areas where all goods handled by ASG bound for the same destination are gathered. Consequently, at this point the PCs from Dell are usually sorted together with PCs from Hewlett Packard as well as other kinds of goods. In the afternoon the goods are loaded onto a trailer. The trailers are then transferred to one of ASG's 30 Nordic hubs, where they are reloaded and transferred to local carriers who work with ASG. In relation to every loading and reloading the boxes are scanned for information, enabling the customers to trace the delivery. This information is transferred from the ASG to the Irish Express business system 10-15 times every day. As the Dell and the Irish Express systems are interconnected in real time the end-user can follow the delivery through Dell's Internet site. The time between when the PC leaves the assembly facility in Limerick until it is delivered to the end-user is three days. In Figure 5.25 and Figure 5.26 the physical flow and the exchange of information are illustrated.

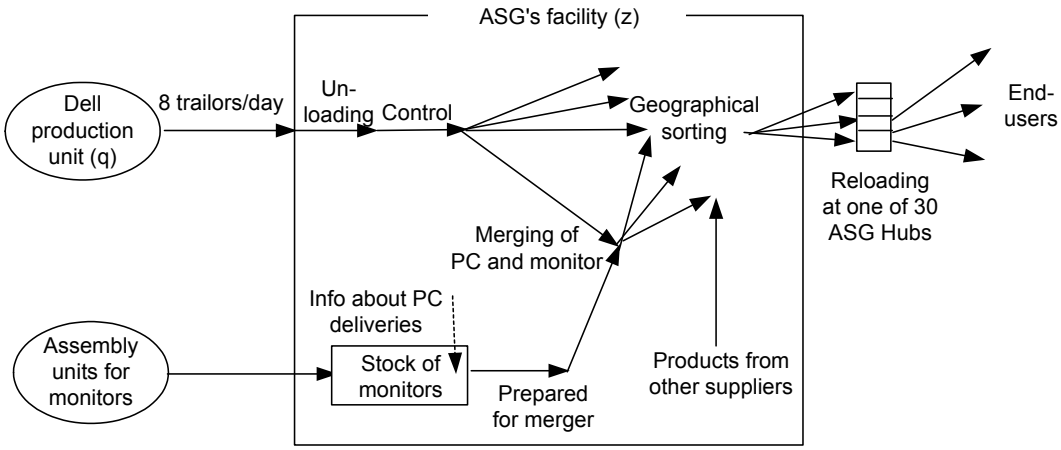


Figure 5.25 An illustration of the physical handling of Dell PCs

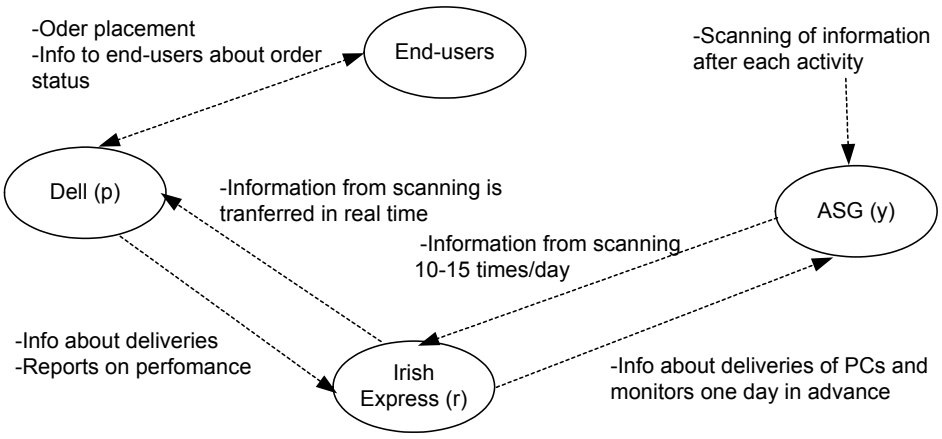


Figure 5.26 Information exchange among the involved actors

ASG, ICL, Unisys and IBM – partners for service parts delivery to Dell

Dell has chosen not to perform service and support themselves. Instead they work with three service providers: ICL (*ä*), Unisys, and IBM (*o*), all of whom act in the name of Dell in support and service matters. In 1998, Dell wanted to reorganise the way service parts were handled. The reason was that it was recognised that there were lots of components at the facilities of the different service providers, and Dell felt they did not have full insight. ASG was hired to host a hub in Gothenburg and to deliver components to the Nordic countries. Consequently, when a technical problem occurs with a PC during the guarantee period ASG delivers the components. Beyond the hub in Gothenburg, there are hubs in England, serving Great Britain, and in Belgium, serving the rest of Europe.

Dell owns all components and is fully responsible for service to end-users. Dell is therefore required to ensure that there is a sufficient level of inventory in different buffer stocks so that all end-users can be served in accordance with agreements. ASG provides administration and transportation services and has a rental agreement with Dell concerning space in the terminal for inventory.

The components are delivered from Limerick to the three hubs. The set inventory levels for each component determines the supply of components. In the terminal in Gothenburg, about 3000 different items are stored in 800 square meters, which is surrounded by a fence. Components are delivered each day from Limerick by DFDS (see section 5.11) or by air freight with DHL. All incoming components are registered in the Irish Express business system. Besides the components from Limerick, about 500 reclaims from end-users or service providers arrive at the terminal every day. These reclaims, which account for 12-15 pallets per day, are sent back to Limerick for investigation and/or rejection. ASG gets information about orders via a server where all service orders are stored in a list. Service orders are taken from this list and printed out as pick tickets, resulting in the picking and packing of about 700 components every day to be sent to end-users or service providers. Each service order contains an average of 1.5 components, so about 500 such orders are handled by ASG daily. (see Figure 5.27)

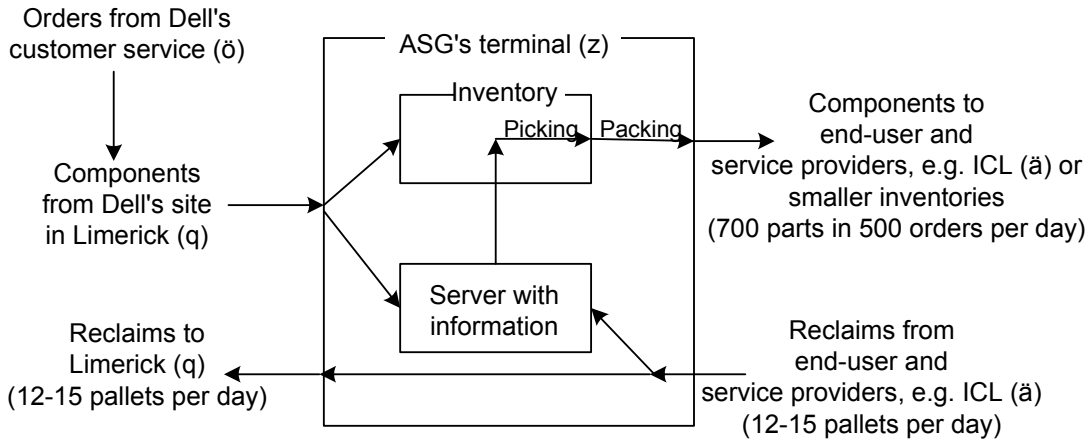


Figure 5.27 Physical- and information flow of service parts at the ASG terminal

When an end-user detects a problem he contacts Dell customer support *(ö)* in Stockholm, where it is decided how the problem should be handled. Three main alternatives are available:

- The end-user sends the component to a service partner.
- A technician from a service partner is sent to the end-user.
- The end-user sends the component to the terminal in Gothenburg.

As a result, 600-700 calls per day are received from technicians in need of components, and the information about each service matter is placed on a server that lists the orders. Two persons at ASG work with the administration of these orders. ASG collects the orders from this server, and order information and labels can be printed. The orders are then picked and packed as illustrated in Figure 5.27 above.

In addition to the hub at the terminal in Gothenburg, there are about 30 PUDO (Pick Up Drop Off) locations around the Nordic countries. The PUDOs are primarily for technicians. The components bound for the PUDOs are marked with information about end-user identity and which technician will pick up the component. Only this specific technician can collect it. ASG has '4-hour inventories' at 17 PUDOs. These are often located close to customers with specific requirements of fast delivery. From these inventories, Dell guarantees customers that a technician will provide service on site within four hours between 8a.m. and 4p.m. At the PUDOs Dell keeps a limited assortment of 100-1300 parts, often adapted to the needs of the nearby customers. The inventories are administrated from Gothenburg and are replenished from the hub there. For Dell, the challenge lies in keeping track of the customers in the area and their needs so that the inventory can be designed accordingly. At 11 of

these places with 4-hour inventories, Dell provides 24hour-service. This service means that a technician always can be reached by cell phone and that he will use all available means to solve a customer's problem.

Owing to the fact that Dell has integrated its business system with its partners and requires that all work operations are registered with bar code scanning, Dell is well-equipped to follow up all deliveries. ASG then receives daily information from Dell concerning the previous day's performance.

The picture of the empirical 'network' is updated below in Figure 5.28.

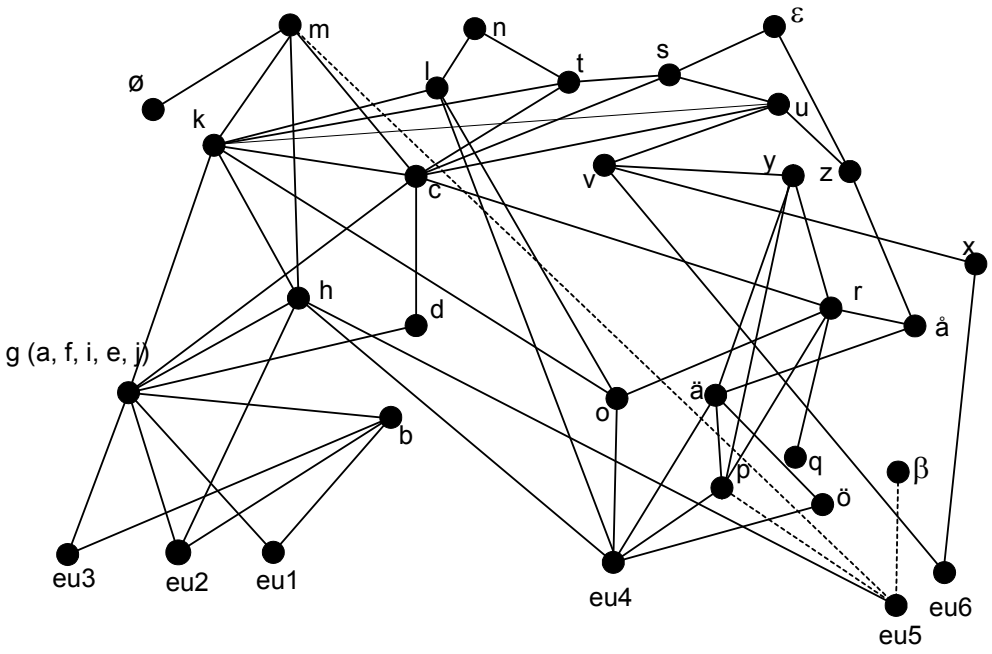


Figure 5.28 The updated empirical 'network'

Chalmers (*eu5*) has been identified as an end-user of both Dustin (*m*) and Dell (*p*) products. We now turn to yet another supplier of Chalmers, Programmäklaren (*β*), a small, local assembler. After this we turn to Chalmers itself.

5.13 Programmäklaren - a local supplier to Chalmers

Programmäklaren (*β*) was established in 1984 and is a small local supplier of PCs and accessories in Gothenburg, situated near Chalmers. The firm has always had approximately three employees. Over the years, they have established customer relationships with about 1000-1500 customers, almost all being business customers. No advertising has been used. The customers have been recruited through other customers.

Programmäklaren only offers PCs assembled in-house. Hence, they do not sell any of the 'large PC brands' such as Compaq, Hewlett Packard or IBM. All assembly is done to customer specification except during summer time when a limited number of PCs are assembled in advance so that the technician who does the assembly can have his vacation. In order to be able to deliver the PCs, Programmäklaren is dependent on not running out of components. Therefore, the company keeps a relatively large inventory of components compared with 'industry standards'. They believe it is more important to be able to deliver than to offer the lowest prices. The Programmäklaren view is that a crucial issue for the industry is the ability to foresee component shortage and act accordingly. Early information from suppliers is therefore important. Their strategy has been to buy large volumes of components if a shortage is foreseen, even if this results in relatively high prices. However, by buying large volumes, Programmäklaren has been able to get lower prices than would have been the case if they had only ordered a small number. In order to reduce the risk of component shortages, which, may lead to delivery problems to customers, Programmäklaren uses three different suppliers for each type of component, and they are all connected online. When a customer calls to place an order, it is therefore possible to immediately see what is available from the different suppliers and thus what is possible to deliver to the customer and when it can be delivered.

The customers are mainly small and medium sized companies. Programmäklaren's main competence lies in designing PCs and PC networks according to customer needs and translating these needs into a technical solution that fits the customer's organisation. Programmäklaren wants to be a problem solver rather than a product supplier and does not direct its attention to customers who already know exactly what they want. One main advantage is their flexibility, enabling them to provide services adapted to different customer needs. Service is also becoming more and more the essence of Programmäklaren's business. However, product sales are necessary in order to provide these services. One service offered is that a customer waiting for a new product, i.e. a PC or a printer, to be delivered can borrow equipment until it arrives. This means that the customer's daily operations can continue quite smoothly while he is waiting for a delivery.

A major challenge for a firm such as Programmäklaren, being a PC assembler, is the fact that not all components interact well with each other. According to the manager of the firm: '*Not all brands fit with each other, i.e. the standardisation is not perfect. This is something you have to learn and this is*

where we have the competence – which motherboards suit different graphic cards.'

We now turn to Chalmers *(eu5)*, a customer of Programmäklaren, as well as of Dell and Dustin.

5.14 Chalmers – a customer of Dustin, Dell, and Programmäklaren

Chalmers (*eu5*) is a university of technology, divided into a number of different schools, which, in turn, are divided into departments. Chalmers has twelve different general agreements with suppliers of PCs. These provide different specific price lists for buyers in the organisation. The purchasing of PCs is decentralised and managed by one contact person at each department. He interacts with the end-users and they decide together what to buy. This contact person can consult with the school's IT department. Decentralisation means that knowledge and preferences of different buyers in the organisation vary. The organisation is also traditionally highly decentralised and characterised by a high degree of integrity and freedom of action. In the discussion below we focus on one school: The School of Technology Management and Economics.

In order to cope with the diverse needs, the twelve selected suppliers display a wide variety of products and delivery options so that different requirements can be met. Three of these suppliers are discussed in greater detail, Dell, see also section 5.8, 5.11, and 5.12, Dustin, see also section 5.7, and Programmäklaren, see also section 5.13.

At present, the IT department at the School recommends one supplier of desktop PCs, Dell, and two of their variants, one 'normal' and one high performance. The recommended PCs belong to the Dell 'Optiplex-family' and are adapted to a network environment. These kinds of PCs are certified in accordance with 'Microsoft PC99', a standard that promises stability in a network environment, i.e. that the components match the software in a specific way. This points out the importance of the combination of components. If one component to what at a first glance appears to be an interchangeable component, this can affect the performance of the entire PC and how it interacts in the network environment. PCs bought from Programmäklaren cannot be guaranteed to have the same stability in this sense. What seems as a good combination of components 'on paper' can turn out to be problematic in a certain network setting. Chalmers only buys PCs from suppliers who can guarantee that the PCs are 'Microsoft PC99' certified. Consequently, they no

longer buy PCs from Programmäklaren. Instead they use Programmäklaren when fast deliveries of accessories are needed as well as for printers. Only printers from Hewlett Packard are guaranteed support by the IT department of the School, as the mix of different kinds of printers can result in problems in the network. Programmäklaren provides temporary printers until the order is delivered, which limits disturbance for the users. Dustin, who have an extensive assortment of accessories and components, is also used for fast deliveries of components and accessories.

From the School's perspective there are some important issues to be taken into consideration when choosing which supplier to use.

Order placement: It is considered important to be able to place orders on the Internet, as this enables evening order placement and reduces the time that has to be spent on a telephone queue during the daytime. Both Dell and Dustin offer this kind of interface for order placement. When an end-user logs in to the Dell website as a Chalmers user, the available and recommended options are displayed. One important difference between these is however that when placing orders at Dustin's website you get information directly about what is available for immediate delivery as the order system is connected to the inventory system in real time. This also means that an order confirmation is received directly. In the case of Dell, as described in section 5.8, the fact that the order is handled manually means that no confirmation of the order is received directly. It is not received until the PC has entered the production phase. This, in turn, means that if the order confirmation turns out to be incorrect it will be too late to correct it. Instead, the whole procedure will have to start over again. Programmäklaren does not offer any possibility of placing orders electronically. Instead, orders are placed over the counter or by telephone, and only during office hours.

Delivery: For end-users who need a PC upgrade, fast delivery is not usually a critical aspect. Instead, it is important to have information about when delivery is expected so that installation can be planned for, and also to get information about changes in estimated delivery time. However, sometimes, fast delivery is a critical factor, and in these cases Dustin is often used, for their broad and deep assortment and the fact that they can often deliver the day after order placement. One important issue related to delivery is the desire to have the products delivered to the end-user office. The suppliers use couriers who deliver to the office and they call before they leave to make sure that the ordering party is there to receive the goods. With Dell, the routines are different, as described below.

The interface between Chalmers and Dell

As indicated above, the main supplier of desktop PCs to Chalmers is Dell, with two models. The contact person for IT at each department places orders. The departments vary in size, and some departments have expertise in IT issues while other do not.

Orders are placed by phone or on the website, often after a discussion with the IT manager of the School. The IT department at the School is used as an advisor to the person at the department responsible for purchasing of PCs. The PCs are then delivered to Chalmers after about eight days. As was described in section 5.12, Dell has outsourced physical delivery to ASG. ASG had a policy of delivering to Chalmers daily some time between 11a.m. and 1p.m. However, many people have their lunch break at this time. This, together with the fact that ASG did not call before a delivery, led to delays of as much as a week. Because ASG brought the goods back to the terminal when nobody was there to receive them. This has been solved, so now Chalmers internal postal services collect all goods bound for Chalmers from ASG's terminal daily and deliver them to the addressees. This has also meant that the goods are delivered to the office of the receiver of the goods and not to a shared place of delivery, as was the case when ASG delivered.

When the PC is delivered to the end-user the person at the department responsible for IT unpacks and installs the PC with software. The School provides a 'ghost', a standard package of software, which is preconfigured and locked so the end-user cannot make changes. According to the IT department at the School, this enables economies of scale since the 'ghosts' take a short time to install and makes support issues easier since the software is standardised. However, due to the varying levels of knowledge among the IT contact persons at the departments, it is not so that everyone thinks the 'ghosts' are easy to install.

One main issue is that it often takes time to get in contact with 'the right kind of person' at the supplier. At Dell for example, all customers are channelled through the same procedure regardless of who is calling. This often means that a number of different salespeople are involved before the customer reaches the right person. This person then decides if the customer should send a certain component to Dell or if Dell is to send out a technician. In the first case Dell sends a form to the customer, which is to be packed with the component. A new component is then sent out to the customer who installs it. In the second case a technician brings a new component and installs it. However, the

delivered component often proves not to have been the right one, which means that the technician will have to come back with a different one. Customers have expressed a desire to be able to return the whole PC to the Dell support partner for repairs, instead of trying to pinpoint the problem on the telephone and have a technician arrive with what turns out to be a wrong part.

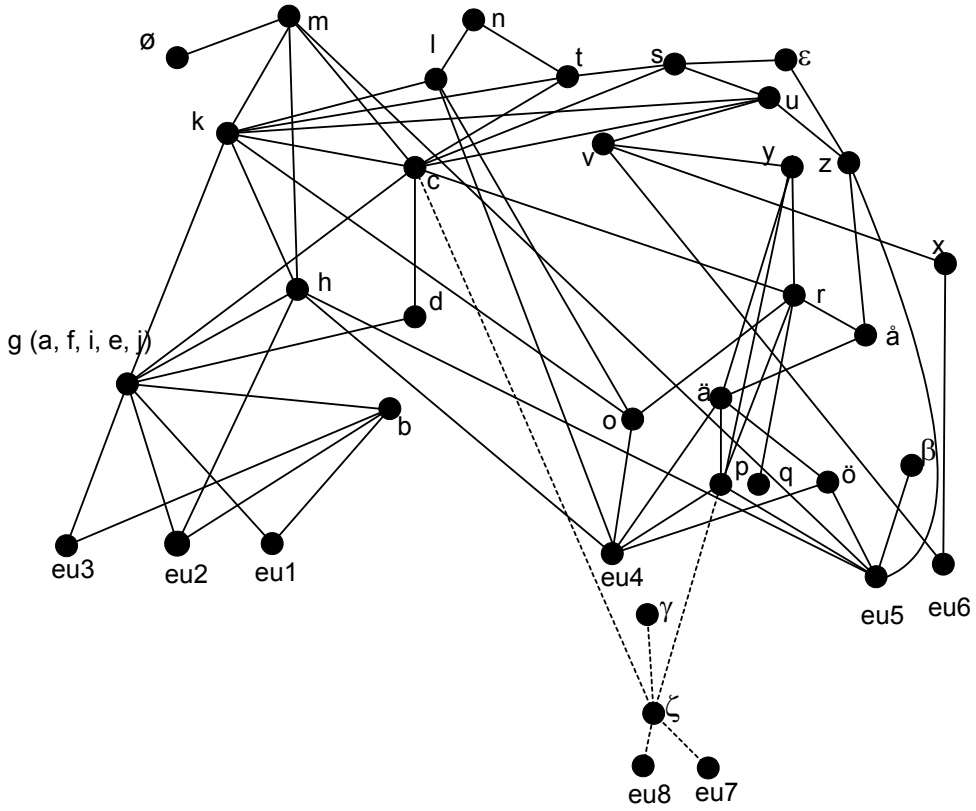


Figure 5.29 The updated empirical 'network'

We now turn to another customer of Hewlett Packard and Dell, Volvo IT (ζ), and two kinds of end-users related to Volvo IT, belonging to Volvo Car Corporation, VCC[60], (*eu7*) as well as to the Volvo Group (*eu8*). After this we continue with Volvlo IT's supplier, Atea (*γ*). (see Figure 5.29 above).

5.15 Volvo IT - a customer of Dell, Hewlett Packard, and IBM

Volvo IT was established in 1998 as a result of a need to centralise the IT function at Volvo. Volvo IT is a common centralised support function for Volvo Car Corporation (VCC) and Volvo Group, and handles all purchasing of PCs. In the summer of 2000, Volvo IT decided to work with one single interface for the physical handling of PCs. The choice was Atea[61]. When the

[60] This part of Volvo is owned by Ford

[61] Formerly a part of WM-data.

relationship with Atea was established Volvo IT only had one supplier of PCs, Dell. Dell was at first rather reluctant to act through this firm, because its strategy was direct contact with customers. However, they agreed to the arrangement. In the summer of 2001 Volvo decided to revise its single sourcing strategy from Dell for quality and delivery reasons. It was not that they were dissatisfied with Dell but it was more a matter of security related to delivery. The new strategy involved a change from one to three suppliers. The suppliers chosen were Dell, Hewlett Packard, and IBM, coordinated through a common interface, Atea. It was considered important to make sure that if one of the three suppliers had quality or delivery problems, the others could deliver instead.

From each of these suppliers, three types of PCs are bought; two laptops (one light and one high performance) and one desktop. This means that a total of nine models of PCs, of which three are desktops, are available to the end-users at Volvo. The PCs from the three suppliers are configured to be as identical as possible so that there should be no difference in performance irrespective of which brand the end-user chooses. The requirements for the desktop are that it should have good enough performance to be used for three years before needing to be replaced. The different 'companies' within Volvo have different preferences concerning choice of supplier. For example, VCC only uses Dell. This is an effect of the ownership of VCC by Ford, as Ford uses Dell as its sole supplier. Others let the end-user choose freely among the predefined PCs from the different suppliers.

From a 'technical network point of view' it is important that the PCs from the different suppliers work together in the network without any problems. To assure this, each PC is carefully tried out and tested in Volvo IT's network before being approved as a certified PC. Both hardware and software have to fit the network and that small changes in these respects can have large effects for the performance of the PC as well as the network. This means that the suppliers have to inform Volvo IT about new models at least ten months in advance. The time for adapting programs and network software is long, and the testing in the network takes at least 2.5 months. In order to monitor this, all PCs are delivered to Volvo with pre-installed software, specially designed by Volvo IT to fit the organisation as well as the network. The installed software is also locked so that the end-user cannot make any changes.

All PCs are bought directly from the three suppliers and come with a three-year service agreement. Each IBM PC has a unique serial number for Volvo and is specified by Volvo in terms of specific DVDs instead of CD drives, and a

certain amount of memory. Dell PCs are also configured exactly to Volvo's specifications. PCs from Hewlett Packard however, are not specifically designed for Volvo in terms of hardware.

Volvo IT has an internal helpdesk that handles issues related to all PCs independent of supplier. ICL handles the service parts for both Dell and Hewlett Packard. This has been described earlier in section 5.12. IBM has its own organisation for delivery of service parts.

We now turn to Atea, and to Volvo IT's interface with them.

5.16 Atea - a supplier to Volvo IT

Atea *(γ)* is a supplier of IT-products with a focus on making the handling of IT-related products more efficient for the customer throughout the entire product life cycle. This means more than just selling products. For example, Atea make changes to 50% of the products before they are sent to customers, for example configuration of hardware and software and making products theftproof.

Atea focuses on the 300 largest organisations in Sweden, of which Volvo IT is one. These customers have very different requirements, and Atea strive to meet this diversity by providing a number of different services that can be combined to meet different customer needs. Many of the customers do business worldwide, which means that Atea has to be represented in these geographical areas. One of their customers, for instance, is active in 60 countries. Each customer has one main contact man at Atea. However, there is an effort to extend the interface to let the customers interact with more people at Atea in order to better understand the customers' various needs and thereby better able to approach them. One main issue for Atea in its interaction with customers is the translation of needs into solutions. First a person with technical competence designs a solution and the order is then handed over to a seller.

Atea works with about 50-60 suppliers of whom 4-6 account for 80% of the purchased value. Each of these suppliers delivers about one trailer per day to Atea's warehouse. Atea mainly buys directly from producers but sometimes distributors, e.g. Ingram Micro, are used in order to be able to deliver a complete order to a certain customer in a short period of time. As was indicated in section 5.9, Hewlett Packard is a major supplier to Atea. Atea supplies Hewlett Packard's products directly to large end-users without any intermediary resellers, see Figure 5.19 on page 106. Atea hence works as the only interface between the PC producers and the end-users as illustrated in

Figure 5.30 below. This interface can be organised in different ways depending on the end-users' requirements. For example, in the case of Volvo IT, Atea does not take possession of the products but acts as a pure service supplier. This interface is further described later in this section.

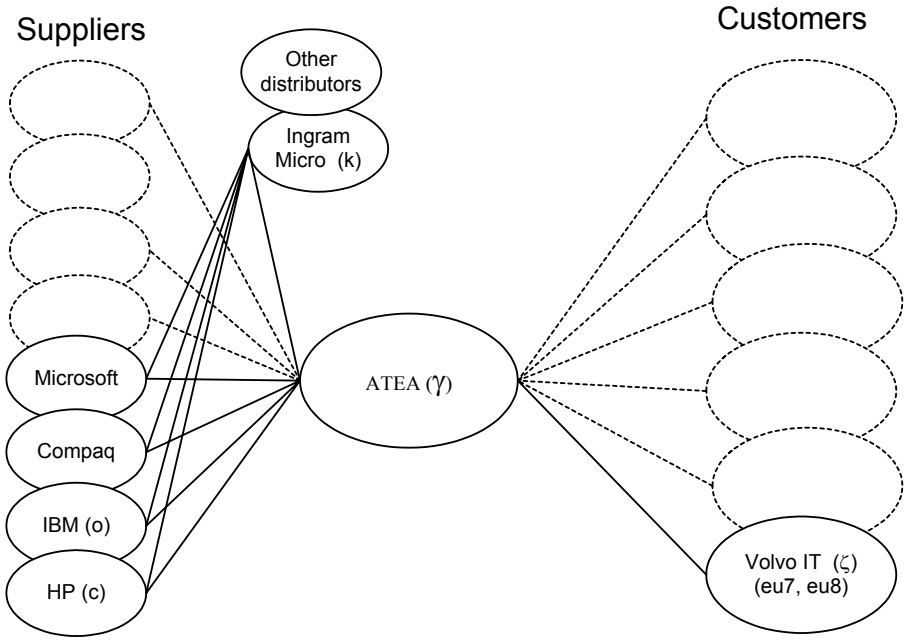


Figure 5.30 Atea as an interface between PC producers and large customers

Atea has about 13,000 items in their range. Of these, about 170 are part of a 'Focus assortment'. These are guaranteed to be 100% available and can be delivered the same day as ordered. The focus assortment is updated about once a month. The rest of the product range is divided into an A and an S assortment where the A assortment has higher availability than the S assortment. If a customer has a certain standard assortment, Atea can act as a stockkeeper for the customer, and the customers can make suborders when needed. This stock can be kept either in Atea's own warehouse or at the customer's facility.

Order administration

Orders can be placed by telephone to one of Atea's 20 sellers, by fax or by the use of WebDirect, a web-based interface for e-commerce. 60% of the orders are placed via the web interface. By adapting the system Atea is able to offer customer specific interfaces. For example, WebDirect can be used for handling requisitions on behalf of a customer to reduce the lead time for an end-user. It is also possible to limit the access to the assortment so that the end-users of a certain customer can only 'see' and order a certain part of the assortment. Through WebDirect it is also possible for customers to investigate which

products match and which do not, for example which accessories fit a certain PC.

Through WebDirect, the customer can access information about what has been bought, how much, and what serial numbers have been supplied. These reports are delivered in Excel files for further analysis. This gives customers a means of keeping track of their inventories. In relation to configuration services and marking of products as described above it also is possible to register this information and get the relevant reports.

When an order is placed it is automatically printed out as a pick ticket in Atea's warehouse. The order is picked and packed and attached with order information that is scanned with an automatic reading device. If nothing more needs to be done with the products they are delivered to the logistics partners' area in the warehouse. In many cases however, products are to be changed in some respect. If so, they are placed on a trolley and transferred to a configuration centre where they are printed out as a 'configuration order'.

Configuration

In the configuration centre Atea makes customer specific installations of hardware and software. When standard PCs arrive at the centre they are unpacked and modified according to customer specifications. Hardware can be added or software installed. In the case of software two alternatives are available. The customer has either provided Atea with a CD containing the software to be installed or Atea is connected on line to the customer's server and can download the software from there. Other activities include marking of PCs with customer specific information. This can involve making the products theftproof or marking products in accordance with the customers' demands in relation to inventory tracking, e.g. specific serial numbers. Since many of Atea's customers work on a wordwide basis, Atea also makes country specific adaptations. Another activity is to pack the products in specific wrappings.

Shipping

By integrating WebDirect with Posten Logistik's business system it is possible for the end-user to 'track and trace' a certain order to observe its position in the delivery process. This is possible since the packages are scanned after each work operation. Atea uses Posten Logistik for small packages and as couriers and ASG for larger deliveries. These logistics partners rent space in Atea's warehouse and when a package is delivered to these areas these firms take over the responsibility for them.

Installation services

Atea offers different kinds of installation services, including unpacking and installation at the end-user facility, the return of wrappings, etc. The installation services vary from rather simple installations of single PCs to entire systems, including start-up. Before each installation assignment, a technical and functional check concerning the match between hardware and software is performed in order to reduce the risk for problems to occur during installation. Atea also has contact with the end-user at the customer about how to prepare for the arrival of the installation engineer and when he will arrive. Atea also offers this service for products outside its own assortment. This is illustrated below in the section dealing with Volvo IT and its interface to Atea, and how Atea is responsible for the handling of Dell PCs not included in their assortment.

Invoicing and after sales

Atea provides an invoicing service with EDI-invoicing adapted to the customers' own business systems in order to reduce the customers' costs for administration. Concerning after sale activities the customer can choose to let Atea take care of the more or less of the daily IT support for end-users on site.

Reconditioning

When a customer buys a new PC there is often a need to deal with existing equipment. Atea has specialised in reconditioning such equipment. The handling of these existing PCs is often a process with high level requirements on security since the data on hard discs is often confidential. It is therefore important for Atea to be able to guarantee that the new user cannot recover data. This also implies requirements regarding the physical handling of the PCs. Atea therefore offers transportation solutions in sealed containers and storage on specific premises, only used for the products of a certain customer. The activities involved in reconditioning can be illustrated with the following activities. The goods are:

1. collected from the end-user facility and packed in specific sealed containers.
2. transported to Atea's facility in Växjö where they are kept in a locked area, isolated from other customers' goods.
3. taken into stock and registered. The customer is informed each month of what products have been delivered to Atea's reconditioning facility by serial number.

4. decoded and hard discs erased from information. All products are cleared from different kinds of markings, such as theftprotection and end-user specific identification.
5. tested and reconditioned to distinguish the products that can be rented or sold second hand. The rest of the products are sent to a recycling centre called Stena Technoworld to be disposed of in an environmentally sound way.

For an illustration of the activities of Atea in relation to their customers, see Figure 5.31 for an overview.

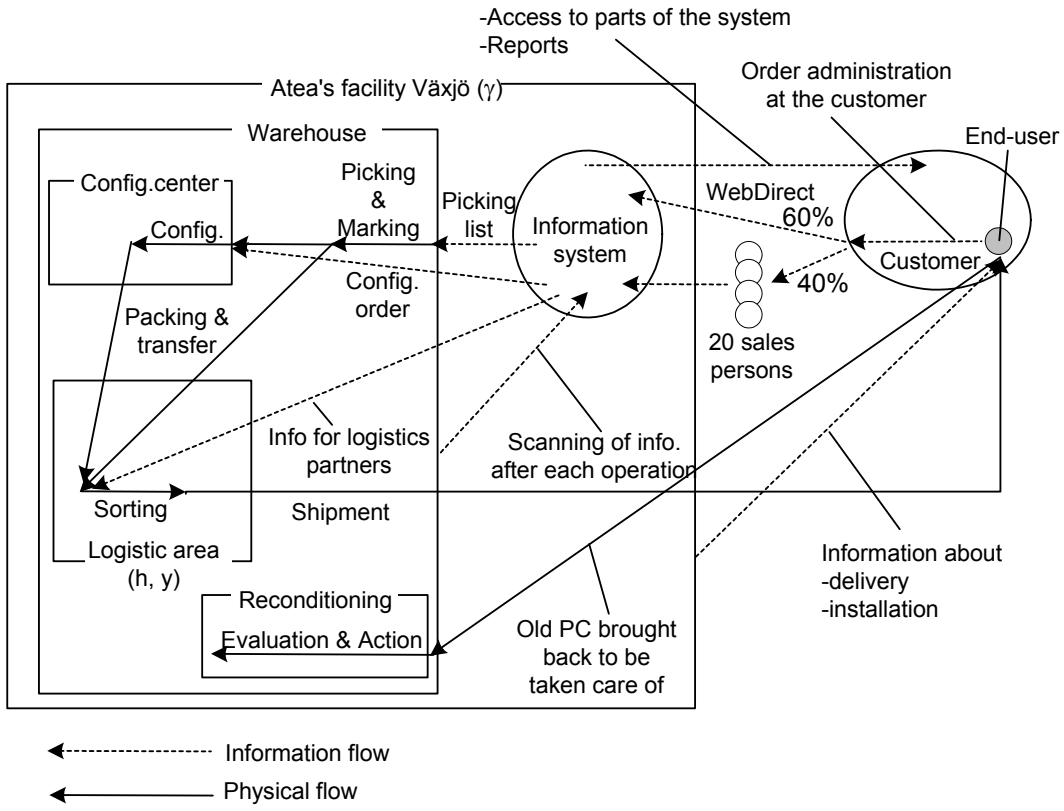


Figure 5.31 The interface between customers and Atea

We now turn to the specific interface between Volvo IT and Atea.

The interface between Atea and Volvo IT

As described in section 5.15, Volvo IT today uses three suppliers of PC's, Dell, IBM, and Hewlett Packard. Atea is also used as an interface for delivery and for other issues related to the physical handling of PCs. Hence, Volvo IT buys the products for the producing companies but Atea, which also provides other kind of services to Volvo IT, delivers the products to Volvo.

When an end-user at Volvo needs a new PC, the following activities are performed. The end-user uses an internal web-based order tool that shows which different PCs are available. The customer places an order and the order is transferred to her certifying manager. The manager requisitions the order and the order is then sent to the supplier, i.e. Dell, IBM, or Hewlett Packard, and a copy of the order is sent to the end-user as well as to Atea. This means that Atea can start planning for the arrival of the PC and for other services, e.g. installations related to the specific PC. Depending on the brand chosen by the end-user the activities are somewhat different before the PCs arrive at the Atea warehouse in Växjö. Each order placed by an end-user is treated as one order. However, when the orders arrive at the producing firms they are accumulated and an accumulated production order is placed.

If PCs from Hewlett Packard are ordered the PCs are delivered from an inventory held by the distributor C2000 (*ø*). For the preceding activities, see section 5.9. IBM delivers accumulated orders directly to Atea from the assembly site in Greenock, Scotland. Irish Express (*r*) operates these deliveries. As stated above, each supplier delivers about one trailer per day to Atea's warehouse. The deliveries from Dell, see section 5.8, 5.11, and 5.12, are transferred directly to the warehouse in Växjö when they arrive at the ASG terminal in Gothenburg. Sometimes VCC places large orders to Dell[62]. In these cases Atea acts as a stockkeeper until the PCs are called for by suborders. Atea also handles all PCs (Dell) directed to Ford in Sweden and is responsible for installation of these at end-users.

All PCs that have been ordered by Volvo (and Ford) are consequently delivered to Atea's warehouse in Växjö. When the PCs have arrived, Atea informs Volvo IT about a more precise estimated time of delivery and the installing engineer at Atea contacts the end-user at Volvo to plan for the installation. When the PCs arrive at the Atea warehouse they are transferred to the configuration centre where they are unpacked and stripped of their original wrapping. Manuals are sorted out, leaving only the most important ones, since an investigation at Volvo highlighted that a lot of time is spent reading unnecessary manuals. Since it is impossible to buy PCs without pre-installed operating systems, the PCs need to be re-loaded with software in accordance with Volvo IT's requirements. Hence, Atea has access to the 'masters', which have been tested for each of the nine models available for Volvo IT. These masters are different for each model owing to the differences in hardware, but the results are the same, so the nine models are totally compatible. Each PC is

[62] They can only use Dell since the ownership by Ford.

thereafter tested and marked with Volvo unique identification, a serial number. Modifications of hardware can also be performed in this phase, e.g. exchanging a CD drive for a DVD drive. The PCs are then packed in specially designed plywood boxes together with other items to be included as well as order information including Volvo serial number and where at Volvo the PC is to be installed. It is then transported to this specific site. Most often the monitors are delivered directly to Volvo who keep a small inventory at its facility. An installation engineer comes to the site and installs the PC and gets it started. The time from when the end-user places the order until the PC is installed is about 30 days.

At the same time, the installation engineer disconnects the end-user's existing PC and takes it, and the plywood box, back to the warehouse in Växjö. The PCs are tested at the reconditioning facility and if possible they are sent back to Volvo to be used by another end-user or sold to the second hand market after being reconditioned. When this is not possible they are sent to Stena Technoworld to be disposed of. The profit from selling the PCs is split between Atea and Volvo. Since Ford bought VCC, the demands for the handling of 'old' PCs have increased. Some of these demands are; (1) Certain PCs with classified data need to be transported non-stop in trailers. In order to monitor this, a GPS is attached to the trailer, which means that the transport can be traced in real time. (2) The data is to be erased with a certain device for demagnetisation since the usual means of reformatting hard discs is not considered safe enough.

For an overview of the interface between Atea and Volvo IT and related firms see Figure 5.32.

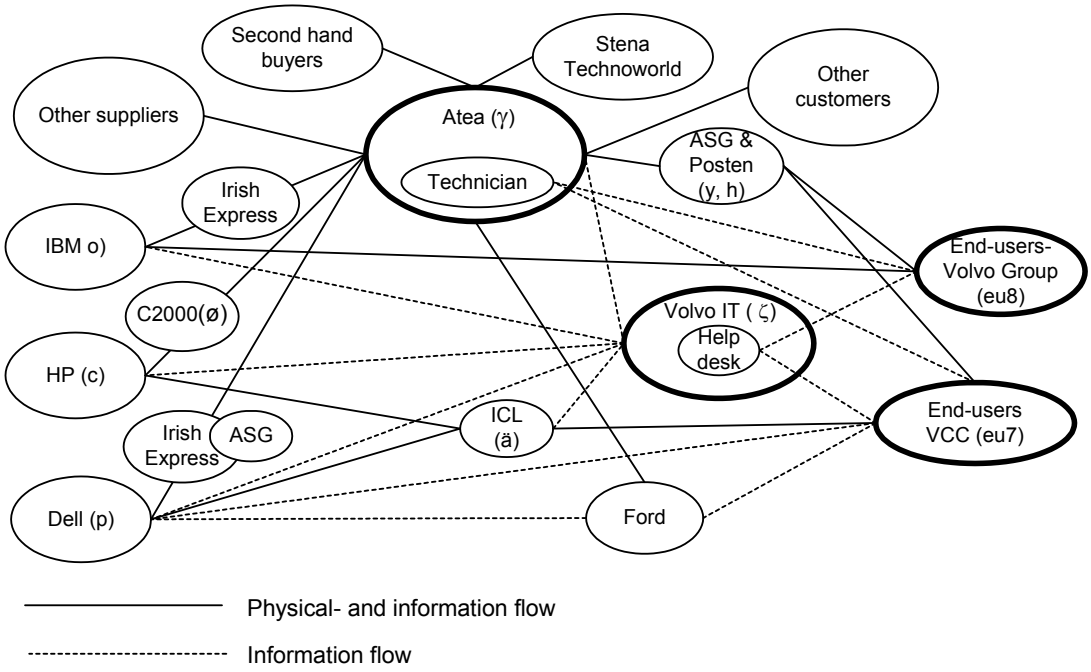


Figure 5.32 The interface between Atea, Volvo IT and the suppliers of PCs

Finally we turn to another of Ingram Micro's customers, Westium Data (δ), a local reseller, as well as describing another of its suppliers, CapTech (α), a local PC assembler. First, though, we update our empirical network in Figure 5.33.

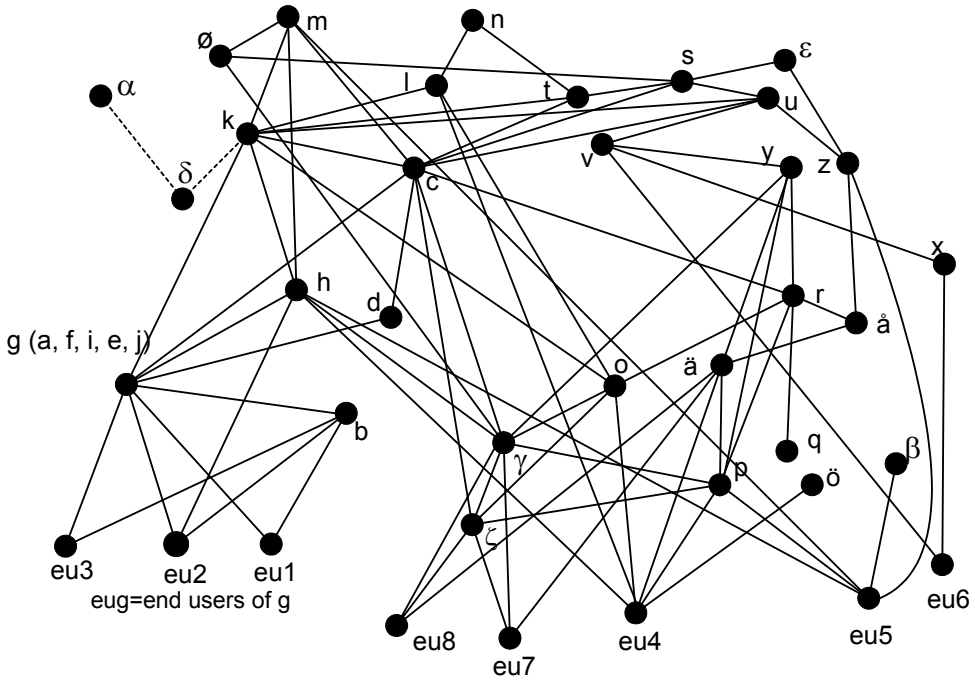


Figure 5.33 The updated empirical 'network'

5.17 Westium Data - a customer of Ingram Micro

Westium Data was established in 1983 with an initial focus on selling minicomputers such as the Commodore Vic 20 and Vic 64 to private consumers. The first IBM PC was introduced in Sweden this same year, and it was included in the assortment. PCs were far more expensive than minicomputers and therefore attracted business customers rather than consumers. In 1994, the Commodores were taken out of production. Since Commodores were Westium Data's main products they were confronted with a choice of either selling PCs assembled by other producers, e.g. IBM, or starting their own production. They decided to start their own assembly of PCs and this was made possible since the trend toward components with more standardised technical interfaces had accelerated during 1994. A new company, CapTech, was established to focus on assembly of PCs. This is described below in section 5.18. Westium Data planned to sell these and PCs from other suppliers. In 1996, business customers accounted for between 60 and 70% of the sales and a decision was taken to redirect the business focus from private consumers to business customers. The reason for this decision was that the internal resources were considered more appropriate for selling to business customers. Also, there were companies, with other sets of resources in terms of for example range, facilities and organisations, which were regarded as more fitting for private consumer sales.

In 2001, Westium Data had one 'business store' and one 'private consumer store', which means that two main types of end-users can be identified, the business store end-user (*eu9*) and the private consumer store end-user (*eu10*). The private consumer store is, however, directed to 'advanced consumers' who know almost as much about the products as a business customer. The range in this store includes PCs, PC components, PC games, software, and network components for home use. The focus in the consumer store is on components, but a limited number of PCs are sold. Only a very limited inventory of items is kept and PCs are not kept in stock in the store at all.

The inventory is joint for the two stores and is kept in the business store's facilities. Four different brands of desktop PCs are offered: Hewlett Packard[63], Acer, LC, and IBM but the LCs account for 90% of the PCs sold. The LCs are designed and assembled by the local PC assembler in Gothenburg, CapTech, with whom Westium Data has a common history, and also some joint ownership[64]. The only PCs that are kept in stock are a limited number of two

[63] See section 5.9 for a further discussion of Hewlett Packard (Hewlett Packard).

[64] This is further discussed in section 5.18.

standard models of LCs. PCs from Acer, Hewlett Packard or IBM are ordered from distributors when needed. The inventory is refilled partly on the basis of a gut feeling from the person responsible for the inventory but also on information from the salesmen about yesterday's sales figures of the different components. A courier delivers from the storage room to the private consumer store once or twice daily in accordance with consumer orders. Consumers often arrive with certain specifications for a PC for which they want a price quotation. If Westium Data cannot offer exactly this configuration it can often offer a similar PC.

The business store is focused on small and medium sized customers in the Gothenburg area with up to 50 employees that do not have an IT department to design the solutions they needed. To this kind of customer Westium Data offers total solutions where the PC is only one component in a larger system. The 'average' customer in this category has ten employees. The secondary customer group is large firms buying components. Westium Data has eleven employees, of whom two are technicians working with support, light assembly, and network installations at customers' facilities. The salesmen have a relatively high level of technical knowledge and have to be able to translate the specifications of the needs of a customer with no knowledge of PCs to a solution that suits the customer. The salesmen should also be able to advise the customer against some combination of products that might 'look good on paper' but that will not be stable in a network setting when combined. The PCs included in the solutions can be any of the standard brands provided by Westium Data but in special cases Westium Data also designs and assembles PCs themselves. From a learning perspective this is important since this keeps the technicians up to date with technology needed for support and service reasons. Westium Data handles minor support issues such as memory expansion. Advanced issues are forwarded to the suppliers, e.g. CapTech.

The PCs sold to consumers and business customers vary in that PCs sold to businesses are often slower in terms of performance but are more stable in a network setting than those sold to consumers. The most powerful PCs are often sold to consumers who use the PC to play PC games.

The variety of customers in terms of their knowledge about PCs and what they require is great. Some customers demand that some specific components from a certain supplier are used. Others are not at all familiar with what kinds of components that are included in a PC or which firms that supply them. A common way of doing business can be illustrated with the following example that deals with a painting firm that was in need for an IT solution. First, the

person responsible at the painting firm contacted a salesman at Westium Data and they discussed the firm's need in terms of what functions the firm wanted to be able to perform with the solution. When this was clear to the salesman, he took the specifications to a technician who visited the painting firm to study the facility and its conditions to be able to design an appropriate solution for this specific firm. The technician and the salesman then together designed a solution and made an offer to the firm. In this way, Westium Data tries to take the individual customer and its needs as a point of departure and adapt solutions to these needs. Many of their customer relationships have lasted for many years. Westium Data tries to have a long term view of their relationships to customers which means that they do not necessarily always propose solutions to customers that are best for Westium Data in a short term view. For the customers this personal relationship is important, as well as well functioning service agreements, so that they get support and service fast.

The salesman includes in the offer, a service agreement that involves on site service within 24 or 48 hours. Customers with these service agreements are prioritised before the other customers who pay for their service per hour. The agreements also help Westium Data coordinate and plan its service activities.

When the customer accepts a solution that involves a PC from CapTech the salesman fills in an order form with a table like the one illustrated in Table 5.3 below. The order is then sent by fax to CapTech each day before noon. A description of the subsequent activities performed at CapTech can be found in section 5.18.

Component	*Alternative 1*	*Alternative 2*	*Alternative…n*
Hard disc	X		X
Processor		X	
Motherboard	X		
'Component…n'		X	X

Table 5.3 Specification of order from Westium Data to CapTech

Westium Data can also place orders in a similar way via CapTech's web interface. As the system for placing orders is connected to the system for inventory handling, showing what components are available in stock, it is possible to get an immediate response regarding what can be ordered. A salesman at CapTech verifies the electronic order manually. The components are then directly blocked in the system and cannot be ordered by another

customer. Either way, it takes about five working days before the PC is delivered from CapTech.

Westium Data works with about 30 suppliers, Ingram Micro[65] being one, 10 of which are more actively used and from whom purchases are made about once a week. The reason for using so many suppliers is that Westium Data does not want to become too dependent on a few suppliers, primarily for reasons of price, delivery, and assortment. This is, however, a balance between the cost for administrating many supplier relationships and the possible advantage of using many suppliers. Most of the suppliers are distributors with quite similar assortments. The fact that some customers have very specific requirements regarding brands of components means that a large assortment needs to be covered.

The main supplier of PCs is CapTech, from whom Westium Data buy PCs directly, without any intermediary distributor. Westium Data also buys components from CapTech. The interface between Westium Data and CapTech is further discussed in section 5.18. In Figure 5.34 below Westium Data is outlined in its network of relationships.

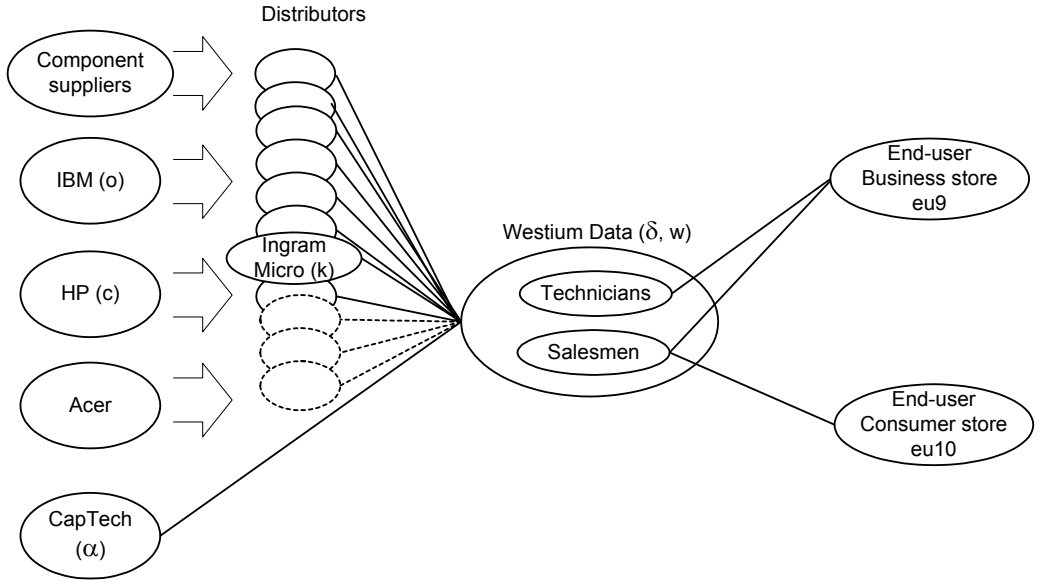


Figure 5.34 Westium Data in its network

The other PCs, e.g. from Hewlett Packard, are bought from the other suppliers who act as distributors. For example, the PCs from Hewlett Packard are bought from a distributor, e.g. Ingram Micro, who in turn buy them from Hewlett Packard. These distributors are, however, mostly used for purchasing of

[65] See section 5.4 for further discussion of Ingram Micro.

components. As discussed above, Westium Data uses many suppliers but in order to reduce the administrative costs there is an effort to accumulate purchases from different suppliers as much as possible. In order to be able to do this it is important that the suppliers keep an extensive assortment. The way suppliers handle returned goods is also very important, as this impacts on Westium Data's own customers and their relationships to them. The most important factor in this respect is that Westium Data is informed about when the returned goods are delivered. The time for handling returned goods is also important, but not as important as the information about when the goods are delivered. Delivery time, too is important; most of the suppliers deliver the next day with Posten Logistik. Almost all deliveries (95%) are transferred through Westium Data. At the Westium Data facility, the products are marked with barcodes that facilitates shipping to end-users. Only 5% are delivered directly to the end-user. The ways orders can be placed is also an aspect considered when choosing suppliers. Web interfaces make the order placement uncomplicated. Finally, price is important, although other aspects can compensate for small price differences.

We now turn to CapTech, Westium Data's main supplier of PCs.

5.18 CapTech - a supplier to Westium Data

CapTech is a local assembler and distributor of PCs and a distributor of components, which began in conjunction with Westium Data, as described in section 5.17. CapTech works with two major product groups, their internally designed and assembled series of PCs, the 'LC' PC, and components. Fifty percent of the components are sold to CapTech's customers and the remaining 50% are used in the assembly of the PCs. The assembly facility has a capacity corresponding to the assembly of 120 PCs per day.

CapTech has three main customer groups. First, other local assemblers that design and assemble PCs in a similar way as CapTech use CapTech as a component supplier. Second, local stores like Westium Data purchase PCs and components and, in turn, sell them to end-users as solutions or as individual items. Third, consultancy firms working with installations use CapTech as a supplier of components and PCs.

CapTech has a warehouse and assembly facility in Gothenburg. Components are ordered from suppliers several times a week and the components are delivered and placed in the warehouse where they remain for between 3 and 60 days. The ways components are bought and delivered differ. All components

delivered to CapTech are stored in the warehouse in close proximity to the assembly area. Each morning, a number of chassis are pre-assembled with disc drives and motherboards. Two types of motherboards, one advanced and one 'simple' are used, resulting in two different kinds of pre-assembled modules. These activities take about 15 minutes per PC.

Orders from resellers, e.g. Westium, arrive at lunchtime and are translated manually to an assembly order. The required components are then picked from the warehouse together with a pre-assembled module. All hardware components are put in a plastic case together with the assembly order and form a queue on a conveyor belt. The technicians then assemble the PC, which takes about 5-10 minutes. It is then transferred to another area where software is installed. This takes about 30-45 minutes. In some cases installations of customer specific software is performed in relation to this. The PC is then placed in a special room designed for testing. This room reaches a temperature of 42°C and the PC is tested overnight with a test program that runs about 30,000 times during a 12-14 hour period. These conditions are supposed to correspond to one week of work at the height of the summer. The next morning, the results of the tests are evaluated and an additional manual and visual control of the PC are performed. When the PC has passed these tests it is packed in a special box and shipped. When a PC arrives at the customer, e.g. Westium Data, five working days have passed.

5.19 Looking back and forth

To sum up, this chapter has in a step-by-step manner developed the 'picture' of a great number of interconnected firms involved in production and distribution of PCs. A number of end-users have also been identified and described in relation to this production and distribution 'network'. The descriptions resulted in Figure 5.35 as outlined below.

The chapter has illustrated great variety in terms of how PCs end-up with end-users, both in the ways that they are 'produced' and 'distributed'. It has also been showed that these various 'ways' of producing and distributing PCs are interconnected by the use of the same facilities, embodied as 'black points' in the figure below. Furthermore, the chapter has also showed that end-user contexts in which PCs are used vary to a great extent.

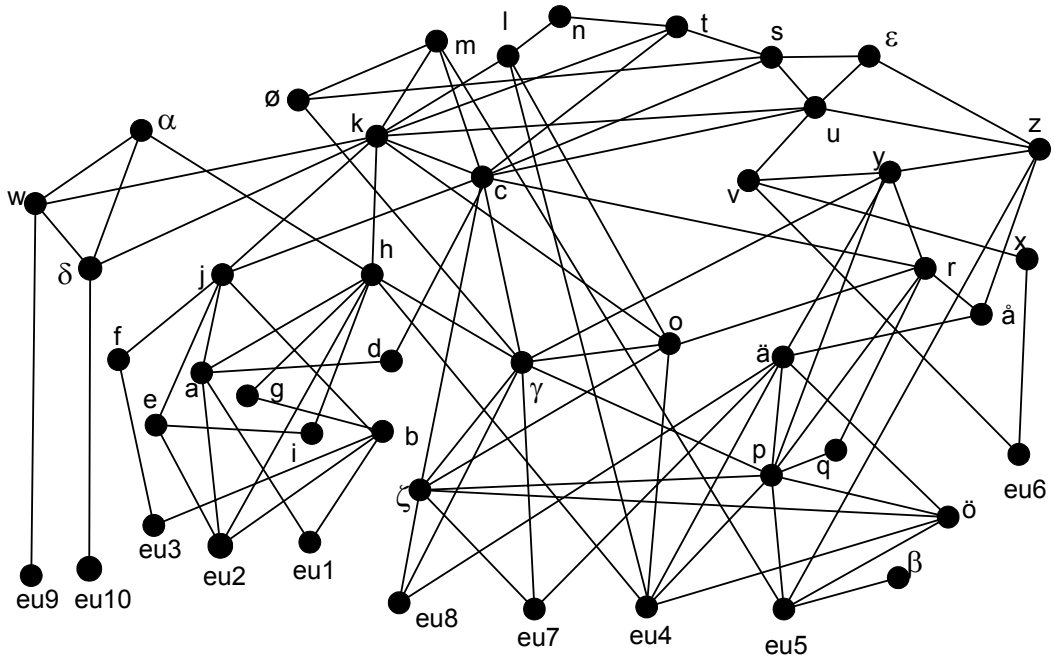


Figure 5.35 The ‘empirical network’ dealt with in chapter 5.

Recapitulating the aim of this dissertation, an overarching issue is to explore the variety in such production and distribution networks. In chapters 6 and 7 we turn to an analysis of this ‘picture’ by applying the framework developed in chapter 2. The analysis is performed on two levels. In chapter 6, a number of transvections are identified and analysed with regard to each individual transvection and its nature. Then, in chapter 7, different crossing points are identified and analysed, focusing on how transvections are interconnected.

6 Transvection Analysis

In this section transvections that can be identified from the empirical material in chapter 5 are analysed. These transvections are discussed in terms of how transformations and sortings are organised and coordinated as well as how resources are divided among the firms and accessed in the transvections.

In the analysis, ten end-users and 15 transvections are analysed. The fact that a larger number of transvections than end-users has been identified implies that more than one transvection can be identified in relation to any specific end-user. For example, an end-user at the Volvo Group can be involved in three different kinds of transvections (8a, b, and c). What is important to note, however, is that each end-user can only be related to one kind of transvection at a time. Furthermore, each single transvection is unique, as it is associated with the delivery of a certain end-product to a specific end-user.

End-user	**End-user code**	**Transvections (Trv) to be analysed**
Local Siba store user	eu1	Trv1
Siba.se user	eu2	Trv2
ComputerCity user	eu3	Trv3
Pharmacia	eu4	Trv4a, Trv4b
Chalmers	eu5	Trv5a, Trv5b, Trv5c
Hewlett Packard Internet Store	eu6	Trv6
Volvo Car Corp	eu7	Trv7
Volvo Group	eu8	Trv8a, Trv8b, Trv8c
Westium Data business user	eu9	Trv9
Westium Data consumer	eu10	Trv10

Table 6.1 Outline of the analysis of single transvections

The transvections are described and analysed below in line with the theoretical framework developed in chapter 2. The following symbols are used in the graphics and the related text (see Table 6.2).

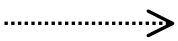
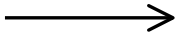
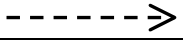
Explanation	Text symbol	Graphic symbol
Sorting (assigning or selecting)	S	
Transformation	T	
Information exchange		
Sorting resource	SR	
Transformation resource	TR	
Conglomerate resource	Objects	
End-product		
Transformation output		

Table 6.2 The symbols used in the analysis

In accordance with the definition of a transvection (see quotation on p. 33) 'all actions'[66] related to the process of landing a PC in the hands of an end-user are mapped and analysed. Furthermore, the transvection both begins and ends with the end-user.

In the subsequent sections each transvection is described and discussed analytically. The discussion is related to the research issues presented in chapter 2. This means that the discussion focuses on how the transvections vary with regard to activity organisation and coordination and resource access and utilisation. The aim of the discussions is to highlight the characteristics of the different transvections and thereby to illustrate the variety among them.

The 'empirical network' developed in chapter 5 is used to highlight the activated parts of the network, illustrating the involved actors and facilities in each transvection (see e.g. Figure 6.1). Furthermore, in the appendix, foldouts are provided that further can help the reader through the analyses in chapters 6 and 7.

6.1 Transvection1

This transvection takes its starting point in the end-user (eu1) who turns to the local Siba store (a). The actors and facilities involved in the transvection are Ingram Micro and its warehouse (*k*), Siba (*g*) with its purchasing organisation (*j*), the local Siba store (*a*), the call center used by Siba (*b*), Hewlett Packard (*c*) with its production site (*s*) and order administration unit (*t*), Schenker (*u*) with its hub (*ε*), and Posten Logistik (*h*).

[66] By 'all actions' we mean all activities of relevance to a certain aggregation level since mapping *all* activities would not contribute to the understanding of the problem approached in this thesis. This issue is further discussed in chapter 3, under methodological issues.

In the figure below, the 'total empirical network' as outlined in chapter 5 is illustrated. Furthermore, the part of the network activated by transvection 1 is marked black.

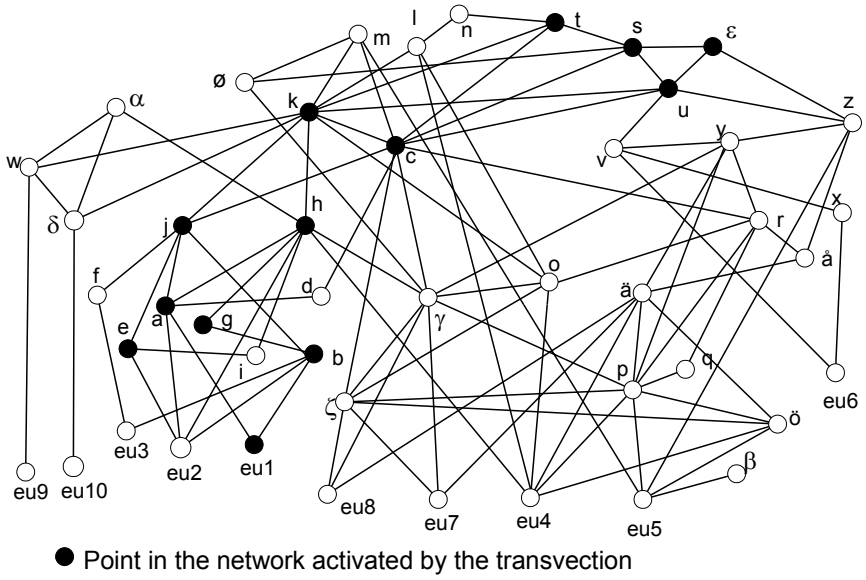


Figure 6.1 The part of the 'network' activated by Transvection 1

Analytical description of transvection 1

In relation to the discussion below, see Figure 6.2 for an illustration of the transvection in terms of transformations and sortings and how it is activated in relation to different actors.

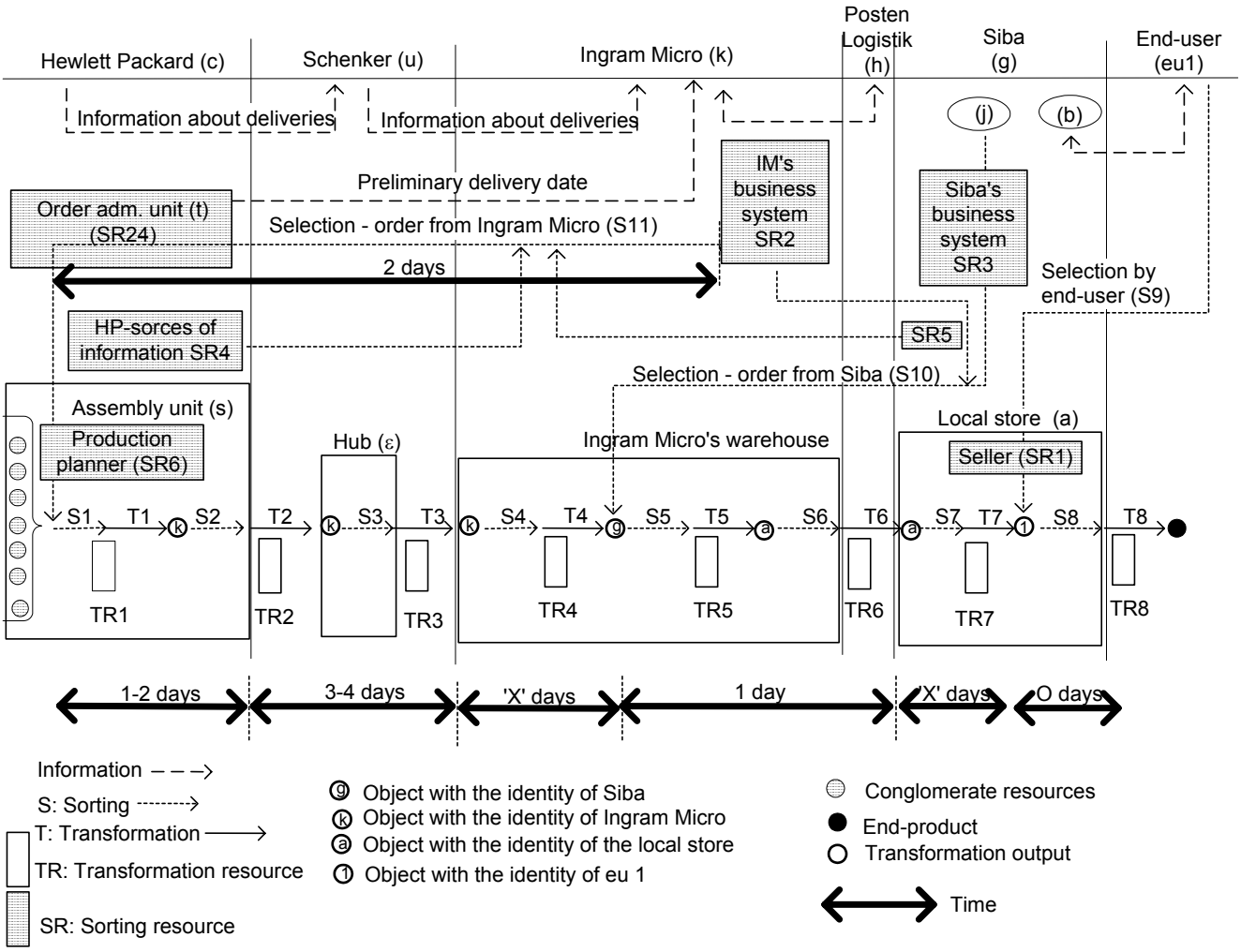


Figure 6.2 An illustration of transvection 1

The starting point, the end-user, needs to complement its existing 'collection of end-products' and approaches its local Siba store (*a*). In the store, the end-user is helped to select an object. Hence, the seller functions as a sorting resource (SR1) that can be accessed by the end-user. The final selection (S9) is a result of the interaction between the two parties where the main challenge for the seller is to try to understand and translate the needs of the end-user into an offer that matches these needs. The main activity in this phase is selection where different objects are compared, and one is ultimately selected. The chosen object (PC) is then assigned (S8) to the end-user and is assigned the identity of the end-user. The end-user then takes the PC home and installs it (T8), sometimes in interaction with the call centre (*b*). In the discussion below, the transvection is traced back in order to understand how the object ended up at the local Siba store.

The PC in focus, selected by eu1, was once ordered by the purchasing organisation at Siba (*j*) from Ingram Micro (*k*) as one part of a larger batch of products. Hence, the PC was ordered without the involvement of the end-user. As the purchasing department at Siba has access to parts of Ingram Micro's business system, they can immediately see what can be delivered and a selection (S10) is made on this basis. The order from Siba is based on information from Ingram Micro's business system (SR2) as well as from information from its own business system (SR3) in terms of, for example, sales statistics. When the order is placed the PC is locked in Ingram Micro's business system with the rest of the order and it is assigned the identity of Siba (*g*). This means that no other customer can order the PC. A pick ticket is printed at the warehouse and the PC is picked from its shelf (TR4) where it has been stored (T4) and it is assigned the identity of the local store (*a*) to which is its destination. It is then assigned (S5) and transferred (T5) to the area in the warehouse (TR5) controlled by Posten Logistik (*h*). Posten Logistik then assigns (S6) the PC to a trailer (TR6) in accordance with the geographical destination of the local store (*a*). The PC is then sent to the local store (*a*) by Posten Logistik, arriving the day after the order was placed by Siba (*j*). When the PC arrives at the local store it is assigned (S7) to a certain place and shelf (TR7) where the PC is stored (T7) until the end-user selects and purchases it.

The decision of what and how much to order and store are critical issues for Ingram Micro. This selection is based on information accessed through interaction with customers such as Siba as well as from suppliers such as Hewlett Packard. The suppliers and customers are therefore important sources of information and are sorting resources (SR4 and SR5) for Ingram Micro. The ordering of the PC later bought by the end-user is therefore a result of such a selection (S11) and the PC is part of a larger batch. The order for this batch is sent by EDI[67] to Hewlett Packard's order administration facility (*t*) (SR24) in Germany where it is put with other incoming orders from Sweden. The order from Ingram Micro then becomes part of the assembly order that is sent daily to the production facility (*s*) in Grenoble. When the order arrives at the assembly facility it is again put with other assembly orders from other countries, and becomes part of an assembly plan. This is done by a production planner (SR6). The orders are combined so that PCs of the same models are assembled together, because from Hewlett Packard's perspective, economies of scale can be gained when many transvections that use the same resources are

[67] Electronic Data Interchange

activated at the same time[68]. When the PC has been included in an assembly plan information about a preliminary date for assembly, a shipping date, and a delivery date is sent to Ingram Micro.

The printing of a pick ticket initiates the assembly, and the conglomerate resources are picked and assigned (S1) to certain assembly equipment (TR1). During the assembly (T1) the PC gets a serial number and thereby an identity related to Ingram Micro. After the PC is tested and packed it is assigned (S2) to a specific trailer bound for the geographical area in which Sweden is included. The PC is then transferred (T2) to the hub (ε) in Copenhagen operated by Schenker. The main activity in this facility is sorting in order to assign (S3) the PC to a new trailer (TR3) destined for the Ingram Micro warehouse. Schenker informs Ingram Micro 24 hours before delivery so that the handling of the delivery can be planned for. When the PC arrives at the warehouse after the transportation (T3) it is registered and assigned (S4) to a specific place and shelf in the warehouse (TR4). The PC is stored there (T4) until the order arrives from Siba and it is then handled in accordance with the description above.

Discussion

The activities involved in the transvection are triggered in accordance with the principles of both speculation and postponement, but in different parts of the transvection. No assembly is activated without orders from a customer, e.g. Ingram Micro, which means that all form transformations are postponed until the arrival of orders from customers. The selection (S11) made by Ingram Micro is limited to quantitative aspects in terms of how many PCs to order as well as to a certain limited assortment of models of PCs with predefined combinations of conglomerate resources. Hence, although form transformation is postponed until the arrival of orders this type of transvection does not provide any opportunity for the customers to influence the choice of conglomerate resources or how they are combined beyond the predefined combinations. From Hewlett Packard's perspective, the main effect of postponing the form transformation is the elimination of the stock of 'finished goods' and hence the risk of ending up with a stock of unsold PCs that decrease in value. Instead the stock of finished goods and the accompanying risk is shifted to Ingram Micro. From the perspective of the total transvection, the postponement of assembly activities means that the number of inventories of finished goods is reduced from three to two (Ingram Micro and Siba). Furthermore, the standardisation of objects in the form dimension to a limited

[68] This is further discussed in section 7.1, dealing with Hewlett Packard's assembly unit as a transvection crossing point.

number of predefined models provides possibilities to capture economies of scale in form transformation even though the form transformation is postponed until orders from customers arrive.

For Ingram Micro, it takes 6-8 days from when the order is placed until delivery. Of this total time, order administration and coordination with other orders take two days, assembly takes 1-2 days, and transportation from the assembly facility to the warehouse takes about 3-4 days. Hence, speculation in form transformation resulting in a stock of finished products at the assembly site could have reduced the time of delivery by about 3-4 days from Ingram Micro's perspective on the condition that the 'right' products and the 'right' quantities were available in stock. The postponement of form transformation thus results in 3-4 days' extra delivery time from Ingram Micro's.

The order from Ingram Micro is a result of speculation, both in terms of quality, i.e. what models to buy, as well as quantity, i.e. the volume of the order. With this in mind as well as the considerable price reductions of PCs, the selection concerning what to order is a crucial issue for Ingram Micro. To make reliable forecasts, information from suppliers and customers and other sources of information is of great importance. For example, if Siba plans a certain campaign involving a specific PC model this is important information for Ingram Micro in its order planning. Getting access to such information improves Ingram Micro's chances to make reliable forecasts. These sources of information consequently constitute important sorting resources. Siba's orders result from the same kind of speculation, both in qualitative and quantitative terms. In order to influence demand, Siba can direct end-users somewhat in their buying behaviour. This can be done by campaigns or in interaction between the seller and the end-user. It is interesting to note that there is a conflict of interest among different actors involved in the transvection, attributable to the use of the principle of speculation. From Hewlett Packard's and Siba's perspective it is of great importance that Ingram Micro keeps a sufficient level of stock in order to ensure that PCs from Hewlett Packard are available at the Siba store shelves when the end-users require them. For Ingram Micro, in turn, it is of great importance of balancing the level of stock so that deliveries can be secured and at the same time not holding too high level of stock for reasons of risks and high costs. Naturally, if Ingram Micro kept an unnecessarily high level of stock this would affect also Siba and Hewlett Packard negatively.

Consequently, the transvection is successively coordinated in different 'steps' when the objects change identity from Hewlett Packard, to Ingram Micro, to

Siba, and finally to the end-user. The changes in identity appear when the transvection is successively re-activated. The first activation is the order from Ingram Micro, and then the transvection is reactivated (see e.g. 'X days' in Figure 6.2) when the order from Siba arrives. The same thing happens in the next step, where the end-user selects the specific object and thereby re-activates the transvection. The interruptions in the transvection in 'time' are thus a result of the logic of speculation.

The many changes in identity of the objects provide opportunities for the objects to be sorted with objects in other transvections in different ways than would have been the case if the identity had remained the same throughout the transvection. This highlights the importance of the points in the transvection at which an object is assigned an identity. The matter of identity and how it relates to the potential of creating likeness among objects through sorting is discussed further in chapter 7.

Owing to the interruptions in time in the transvection and the many changes in identity of the objects, the parts of the transvection between these interruptions are more or less decoupled from each other. This results in the main coordination of sorting and transformation activities being firm-internal, where each firm focuses on improving economies of scale in its internal operations. Consequently, by accessing information from different sorting resources, each firm tries to coordinate the internal sorting and transformation activities as efficiently as possible with regard to their operations.

For example, Hewlett Packard is interested in coordinating its internal activities so that economies of scale can be obtained in the sorting of orders and in the form transformation by utilising the resources efficiently according to their logic. This logic is hence based on the creation of similarities among activities and standardisation of objects in the form dimension. Hence, the postponement of the activation of these activities reduces stock but still enables economies of scale to be gained. In Richardson's (1972) terms this means that the transformations and sorts performed at the Hewlett Packard assembly unit (*s*) are closely complementary with regard to Ingram Micro. This part of the transvection is hence characterised by sequential dependencies. The fact that one firm operates this part of the transvection however, enables the capturing of similarities even though the activities are closely complementary, as the activities can be coordinated with regard to the internal logic of the firm.

Ingram Micro, in turn, tries to access sorting resources to be able to improve sorting both in qualitative and quantitative aspects. This involves information

about both suppliers' and customers' planned activities. By gaining access to this information they can plan their internal operations efficiently according to their logic. This logic rests upon the handling of large numbers of objects and sorting them in new ways that enable the creation of likeness among them in accordance with their customers' needs[69]. From Ingram Micro's perspective therefore, information concerning deliveries from suppliers is crucial so that the handling of incoming objects can be planned for and performed efficiently. This is also the main type of coordination of activities among these points in the transvection. A third party, Schenker, who can be said to be the coordination link between Hewlett Packard and Ingram Micro, supplies this information.

Siba, in a similar way, tries to access sorting resources to improve its sorting skills by being sensitive to end-user preferences and to new product releases and to the availability of a certain model. Early information from Hewlett Packard about problems in a specific assembly facility can, for example, mean that Siba re-schedules a certain campaign. Hence, by accessing the sorting resources of other actors, the coordination of internal activities can be improved.

From the end-user's perspective the selected object is one among many to choose from at the local store. This is a result of the fact that many transvections cross this point, i.e. the store. This is made possible because the objects in the transvections are not directed towards single end-users. The standardisation of form allows for a collection of objects to be displayed and compared in the store. Further, the stock of objects held by the local store means fast deliveries to end-users. Hence from the end-user's point of view the object's features in the time dimension can be important as they enable him to bring the PC home directly. The object's features in the place dimension allow the PC to be physically tried out and compared with others.

However, the high degree of standardisation towards end-users also creates limitations from the end-user's point of view. The end-user has no possibility to get differentiated solutions in any dimension. The selection of objects is limited to the assortment that is kept in stock at present. Depending on how flexible the end-user is in his preferences he will be more or less open to alternative choices in his selection of PCs. For Siba this creates a challenge: to select the collection of objects in a way that matches the preferences of the end-users. This is related

[69] This is further dealt with in section 7.3, dealing with Ingram Micro as a crossing point for transvections.

to the fact that the object does not get an identity of the end-user until the very last point in the transvection. This also means that Siba has to speculate about the demand from end-users, both in terms of quality and quantity. For Hewlett Packard, in turn, it is important to be represented with products at the local store when the end-user enters, to prevent the end-user from selecting another, comparable, PC. The exchange of information among Hewlett Packard, Ingram Micro and Siba is consequently important, especially in relation to releases of new products. Furthermore, concerning delivery, the information exchange among Hewlett Packard, Schenker, and Ingram Micro is important so that the internal activities of Ingram Micro can be coordinated with the incoming deliveries.

In conclusion, this transvection is characterised by standardisation and permits no adaptations of form, place, time, or identity from an end-user point of view. This characteristic, in turn, provides opportunities for the capturing of economies of scale thanks to the 'high degree of' similarities among activities belonging to 'equivalent'[70] transvections, both regarding form, place, and time transformation. Further, it is characterised by recurrent interruptions in time as it is re-activated and changes identity owing to its lack of close complementarity. These interruptions provide a necessary flexibility since the transvection is not locked to only one identity. This example also shows how similarities can be obtained even though close complementarity prevails. Thereby both parallel and sequential dependencies are handled 'within the boundaries of the firm'.

6.2 Transvections 2 & 3

Transvections 2 and 3 take their points of departure in end-users, eu3 and eu2, who are buying a PC from ComputerCity (*f*) and Siba's Internet store (*e*), respectively. These transvections partly activate the same parts of the network as transvection 1 (see Figure 6.3 and Figure 6.4). The only parts that are not commonly activated are the ComputerCity store (*f*) and the Internet store (*e*).

[70] Equivalent transvections are transvections related to mass production and distribution of standard goods. The only difference between them is that they end up with different end-users. Hence they make use of the same resources until the very last selection is made by a certain end-user. For example, the assembly of a batch of 100 PCs of the same model involves 100 equivalent transvections, making use of exactly the same resources, and they are sorted in accordance with the same logic.

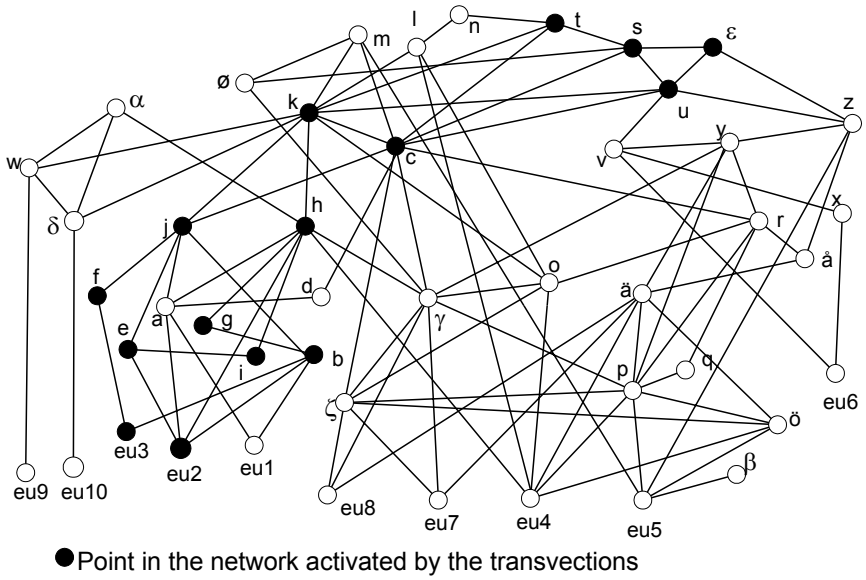


Figure 6.3 The part of the 'network' activated by transvections 2 and 3

Analytical description and discussion of transvection 2 & 3

In comparison with transvection 1, illustrated in Figure 6.2, transvections 2 and 3 activate the same transformation and sorting resources as transvection 1 until an order arrives from Siba's purchasing organisation and thereby gives the objects different identities, i.e. until S10 in Figure 6.2. It is interesting to note that the transformation output from T5 in Figure 6.2 can be assigned the identity of the Internet warehouse (*i*), the local Siba store (*a*), or the local ComputerCity store (*f*).[71] This is because the same model of PC is offered by all of these suppliers. The transvections related to eu1, eu2, and eu3 can hence be directed to either of these facilities after transformation T5. Before this point the features of the transformation outputs of the three transvections are identical in form, time, place, and identity. This, in turn, creates flexibility in the way they can be further assigned (S6).

[71] A discussion concerning Siba's purchasing unit as a crossing point for transvections is found in section 7.5.

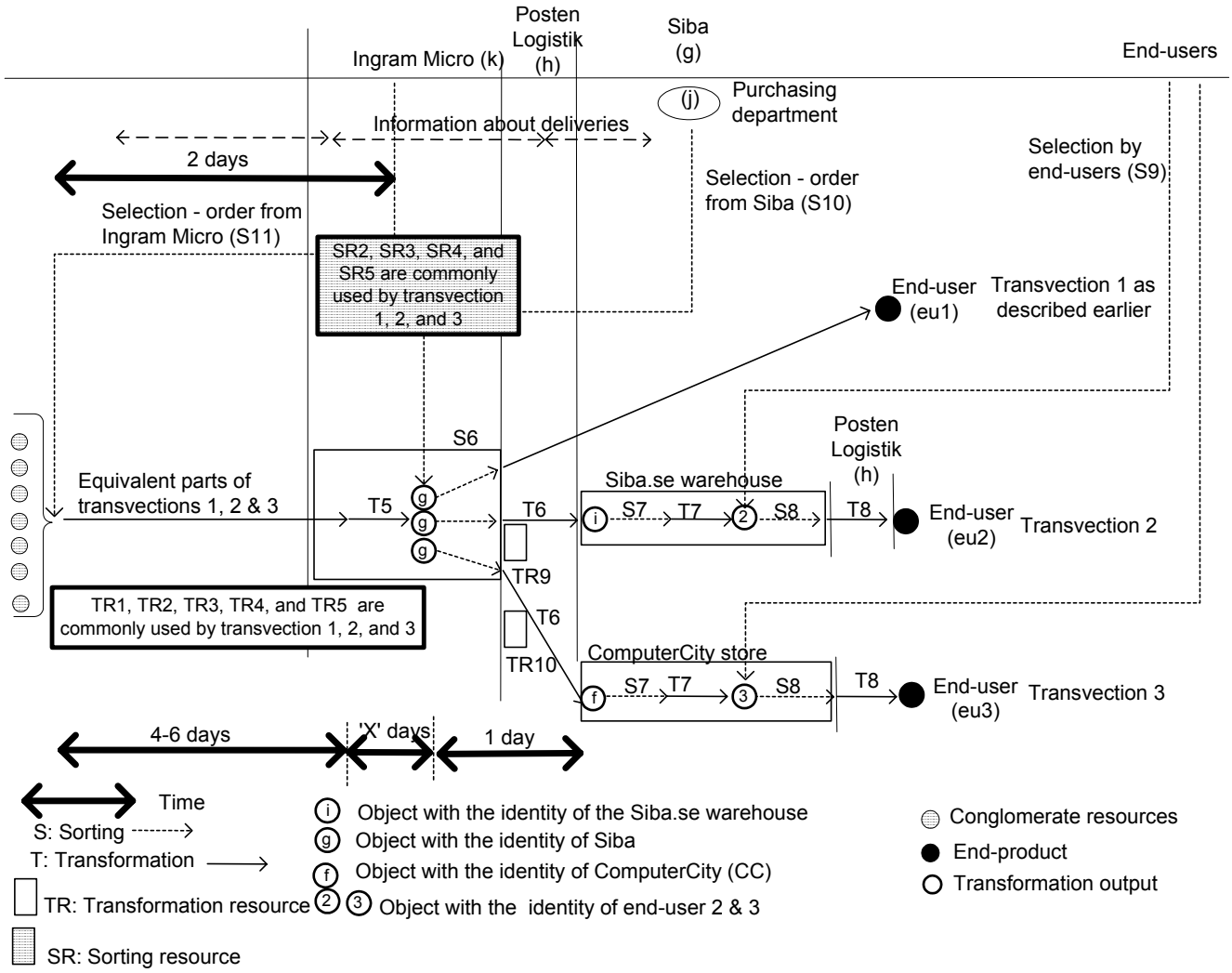


Figure 6.4 Illustration of transvection 2 & 3

As illustrated in Figure 6.4, transvections 1, 2, and 3 are identical until the order arrives from Siba and the objects are assigned identities related to the facility within Siba to which they are directed. This means that the three transvections make use of the same transformation and sorting resources to some extent. Marking the resources with bold lines indicates the fact that the resources have been activated in a transvection described above.

In transvection 2, the object is assigned (S6) to a trailer that transports (T6) the object to the Siba.se warehouse where it is assigned (S7) to a specific place and stored (T7). When an order arrives from the end-user (eu2) the PC is picked, packed, and assigned (S8) to another trailer that transports (T8) the PC to the end-user's address or local post office. Hence, there is a choice for the end-user concerning the place dimension in this transvection. This postponement in the place dimension eliminates the cost for local inventories in stores close to end-

users. Further, the end-user can choose among different delivery options concerning time as well. The delivery time can be from one up to five working days. However, there are no options available in the form dimension beyond the predefined assortment on the website.

Transvection 3 displays a strong resemblance to transvection 1, with the only difference being that the PC is assigned (S6) to a different store, ComputerCity instead of the local Siba store. This assignment can result in the transformation resources, TR8, TR10, in the two transvections being either two different resources or the same resource, depending on the geographical location of the stores. If the stores are located in the same geographical area the two PCs are assigned to the same transformation resource. Transvections 1 and 3 include more or less the same activities with the exception that the seller at ComputerCity is adapted to the end-users' higher level of knowledge of PCs, compared to the end-users turning to the local Siba store. Similarly to transvection 1, this transvection means that the time, form, and place dimensions are locked from the end-user's point of view, permitting no flexibility in theses respects. However, as pointed out above, there is flexibility in how the objects can be sorted with other objects throughout the transvection. The transvection provides fast delivery of the present assortment of products as well as personal guidance by a seller. It is important to note that although transvections 1 and 3 can be regarded as 'similar' in many respects, the transformation outputs resulting from T7 in Figure 6.2 and Figure 6.4 respectively display different features concerning the collections of objects into which they are sorted (S8).[72]

The activation of transvections 2 and 3 is identical to that of transvection 1 regarding the parts of the transvections that are activated by the order from Ingram Micro, triggering the sorting of the conglomerate resources, and the order from Siba's purchasing organisation to Ingram Micro. Furthermore, transvection 3 is re-activated by the end-user selecting the PC from the shelf in the ComputerCity store in a similar way as in transvection 1. Hence the analysis of the nature of transvection 1 depicted in section 6.1 can also illustrate the nature of transvection 3. Transvection 2, however, is somewhat different. In contrast to transvections 1 and 3, which are based on speculation in form, time and place with regard to the end-user's perspective, transvection 2 illustrates the situation characterised by postponement in time and place from

[72] The relation between the features of objects and how they are sorted with other objects into collections of objects is further discussed in chapter 7.

the end-user's perspective. The postponement in time and place provides a possibility for the end-user to influence the PC's features in these dimensions.

The fact that transvections 1, 2, and 3 are activated by the same actor (j) means that economies of scale can be gained in administration related to purchasing for this actor[73]. This is made possible owing to similarities among purchasing activities.

6.3 Transvection 4a

The end-user (eu4) at Pharmacia (PU) can choose to activate a total of 4 transvections for desktop PCs, one high and one low performance PC from Dell and IBM respectively. This gives two main kinds of transvections, one that involves a PC from Dell (4a) and one that involves a PC from IBM (4b). We start with transvection 4a in the next section.

The facilities and actors that are activated in the transvection are illustrated in the network below. (see Figure 6.5). The actors involved are Dell (*p*), ASG (*y*), Irish Express (*r*), referred to as IE in the figures, and IBM[74] (*o*) that runs the helpdesk at Pharmacia. The facilities involved are Dell's production site (*q*), ASG's goods terminal (*z*), Irish Express' local office in Gothenburg (*å*).

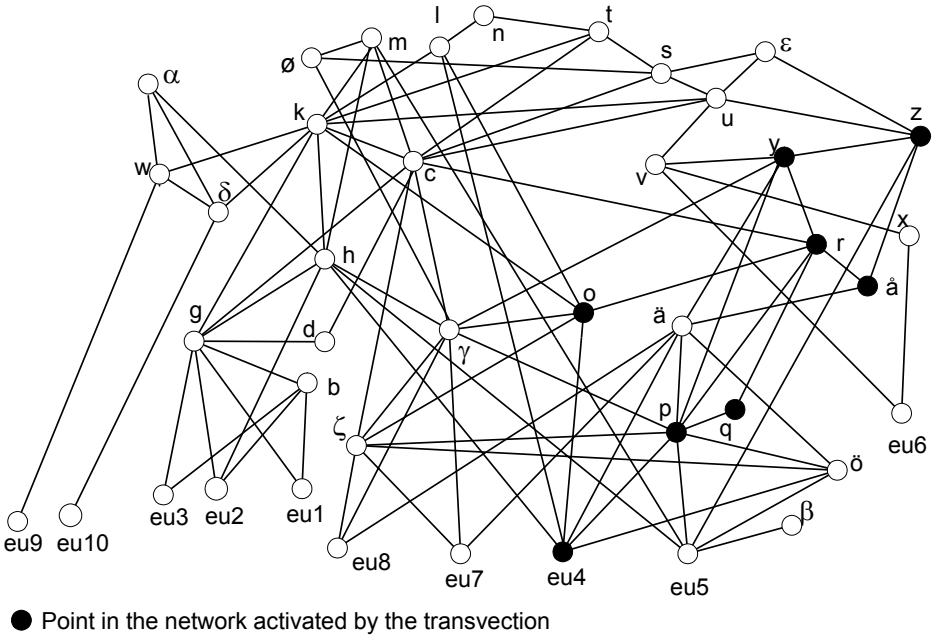


Figure 6.5 Activated part of the 'network' by Transvection 4a

[73] This is further discussed in section 7.5 dealing with Siba's purchasing organisation as a crossing point.

[74] In this case point (*o*) relates to IBM as the larger organisation and not only to the actual helpdesk operated by IBM at Pharmacia.

Analytical description of transvection 4a

This transvection takes its starting point in the end-user (eu4) at Pharmacia that has ordered a PC from Dell (*p*). Figure 6.6 illustrates the transvection in terms of transformations and sortings and how it is activated in relation to different actors and facilities.

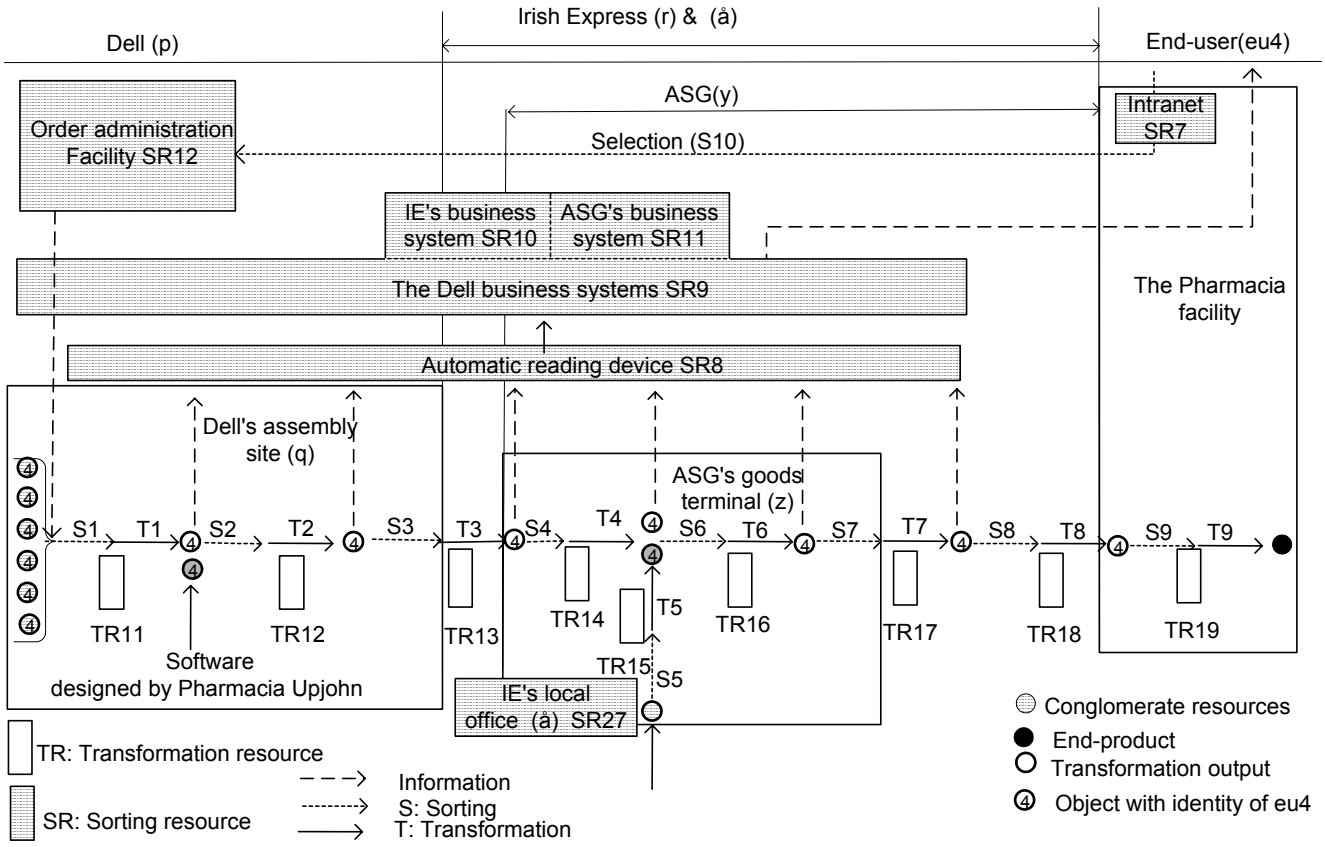


Figure 6.6 Illustration of transvection 4a

The end-user (eu4) can choose between two predefined models from Dell, displayed with technical information and price on the Intranet at Pharmacia (SR7). The end-user thus has no possibility to influence the form dimension. However, the department at Pharmacia responsible for purchasing of PCs together with Dell configures the two PCs in accordance with the firm's overall requirements. Each PC ordered is therefore adapted to fit the organisation of Pharmacia but not the specific needs of the end-user. Pharmacia also designs the software to be included in the PC in a way that fits the hardware configuration of the PC. When the end-user selects a certain PC (S10) and places an order it is first processed internally and then sent electronically to the order administration unit (SR12) at Dell where it is further processed and sorted in relation to other incoming orders. The order number generated links the identity of the specific end-user to the order. This means that when

assembly is initiated at the Dell assembly facility, the conglomerate resources to be included are picked and assigned (S1) to the end-user. Further, based on the incoming orders, the conglomerate resources are delivered from suppliers based on a 'just-in time' principle. Consequently, each conglomerate resource is assigned an identity of the end-user as soon as it is picked from the shelf and assigned to the assembly equipment (TR11). During the form transformation (T1) the conglomerate resources are combined in accordance with the configuration specified in the order. After this, the PC is assigned (S2) to a specific area (SR12) for customised installations, and the firm specific software is installed and the PC made theftproof (T2). After each transformation the order number is scanned with an automatic reading device (SR8) and the information is stored in the Dell business system (SR9). Other actors involved in the transvection, for example the helpdesk and the end-user at Pharmacia, can then access this information, as illustrated in Figure 6.6. Consequently, information is constantly being exchanged and shared among the business systems of Dell (SR9), Irish Express (SR10), and ASG (SR11).

When the PC has been assembled it is sorted (S3) by geographical destination, i.e. in terms of its features in the place dimension and assigned to a trailer (TR13) that transports the PC to ASG's goods terminal (*z*). At the goods terminal the PC is unloaded and assigned (S4, T4, TR14) to an area used for combining incoming goods into complete orders. The day before the delivery of the PC, a monitor, which is an additional conglomerate resource, has been picked up from a certain buffer stock, marked with the same order information as the PC, and assigned (S5, T5 TR15) to the same area. These activities are coordinated by Irish Express' local office in Gothenburg (SR27) and performed by ASG. By marking the monitor with order information it is assigned the same identity as the PC, i.e. the end-user's. The two objects, the PC and the monitor, are then assigned to each other (S6) and combined into a complete order (T6) by personnel at ASG (TR16) after which it is assigned (S7) to a trailer (TR17), according to the geographical destination of the object. It is then transported (T7) to a re-loading hub in which it is assigned (S8) to a new trailer (TR18) and transported (T8) to the Pharmacia facility. In accordance with Figure 6.6, Irish Express (*r*) is responsible for the part of the transvection that begins with T3 and ends with T8. Of this part of the transvection ASG operates some of the transformations and sortings, S4-T8. The PC is then taken care of by the helpdesk at Pharmacia, run by IBM, where a technician (TR19) unpacks and installs (S9, T9) the PC in the end-user's office.

Discussion

The activation of the transvection is characterised by postponement in form, place, and time with regard to end-users as no transformations or sortings are activated without orders from end-users. Once the transvection is activated the object does not change identity along the way. This means that this transvection is only activated once - by the placing of an end-user order. By relying on postponement the risk associated with stockkeeping is eliminated for all actors except for the suppliers of the conglomerate resources. The main challenge in this transvection is instead related to the coordination of the activities involved.

The fact that the transvection is not interrupted in terms of changes in identity creates the challenge of 'keeping the transvection together' along its way to the end-user - from the time when the order is placed all the way to the end-user. Another challenge lies in delivering the 'right' end-product in terms of its features to the end-user. These features include form, i.e. the 'right' combination of conglomerate resources, time, i.e. the delivery time should be as expected, and place, the end-product should end up at the 'right' place. In order to accomplish this, the coordination among the actors involved in the transvection is crucial.

In Richardson's (1972) terms all transformations involved in this transvection are closely complementary, i.e. directed to a certain end-user. This, in turn, creates sequential dependencies along the transvection that need to be handled by the actors involved. Because many firms are involved in the transvection, the coordination among these firms and their internal operations related to the transvection becomes critical for the output of the transvection. In order to accomplish this coordination, information has to be exchanged among the actors. This is mainly done by integrating the firms' business systems in terms of giving each other access to parts of each actor's business system. One input to the business systems is the information gathered about the transvection through the scanning of information after each transformation. This provides information about the object and its present features in terms of form, time, place, and identity along the transvection. By sharing this information the transvection can be coordinated in a way that is in line with the end-user's requirements. The information gained from the business system is used for the actors to coordinate its activities in relation to the transvection as a whole. This information provides a means for the planning and coordination of the internal activities of the end-user and the firms involved both with a focus on how the activities can be fitted into each firm's internal activity structure and

concerning the coordination with other firms and their internal activity structures.

For example, for Irish Express that coordinates and is responsible for the performance of the transvection from T3-T8 it is vital to get information from Dell concerning the assembly activities T1 as well as the sorting activities S2 in order to plan for the transportation T3. Further, Irish Express has to exchange information with ASG concerning the delivery to the goods terminal in order for ASG to plan for the handling of the delivery (S4 and T4) and for the preparation of the monitors to be combined with the incoming object (S5 and T5). This means that the two objects, the PC and the monitor, needs to be coordinated so they can become alike in the time and place in accordance with end-user requirements.

For the companies involved, information concerning each single transvection and its features is crucial in order to coordinate this transvection in relation to other transvections of which they are a part[75].

This transvection does not allow the end-user to be involved in the design of the PC in terms of which components and how these conglomerate resources are combined. Instead, Pharmacia does this in interaction with Dell on an aggregate level to suit Pharmacia as a whole. From Pharmacia's perspective it is utterly essential that the end-user not be allowed to change the configuration of conglomerate resources. This is because the PC delivered to the end-user is not to be regarded as a single unit but as part of a larger interconnected system of PCs. A change in the configuration can disrupt the performance both of the single PC and of the system as a whole. This points out the importance of seeing an object from multiple perspectives. For Pharmacia, the important features of the PC are primarily related to the form dimension on a 'conglomerate resource level' and how the PC relates to other PCs used by other end-users. The object is a completely different thing for the end-user, who sees it as quite an isolated facility that needs to have certain features related to the use of the PC. The end-user also sees it in relation to other objects in his or her work environment. For the end-user the form dimension is important on an aggregate 'performance level', and so are features in the place and time dimensions, i.e. that it is delivered to the right place at the right time.

For ASG and Irish Express, the features of the object that are of interest are the time, place, and identity dimension since these features determine how the

[75] These issues are discussed further in chapter 7.

object can be sorted in relation to other objects from their point of view. From Dell's perspective, in turn, it is important that the object's features enable it to be assigned to the same transformation resources as others in order to gain economies of scale in the internal sortings and transformations.[76]

To conclude, this transvection is characterised by closely complementary activities along the whole transvection.

6.4 Transvection 4b

The other transvection that can be activated by the end-user (eu4) at Pharmacia activates a totally different set of actors and facilities in the network than in the previous case (see Figure 6.5). The actors and facilities involved in the transvection are IBM (*o*) with its assembly facility in Scotland, Irish Express (*r*), Ingram Micro (*k*) and its warehouse, and IMS (*l*).

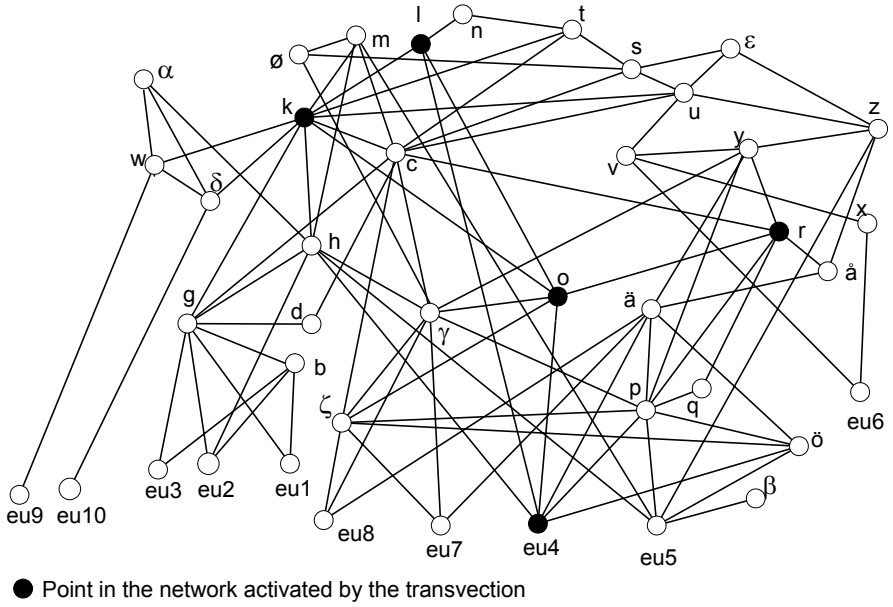


Figure 6.7 Activated actors and facilities by transvection 4b

Analytical description of transvection 4b

This transvection takes the starting point in an end-user (eu4) at Pharmacia that has ordered a PC from IBM (*o*). Figure 6.8 illustrates the transvection in terms

[76] This issue is discussed further in section 7.2, dealing with Dell's assembly unit as a crossing point.

of transformations and sortings and how it is activated in relation to different actors and facilities.

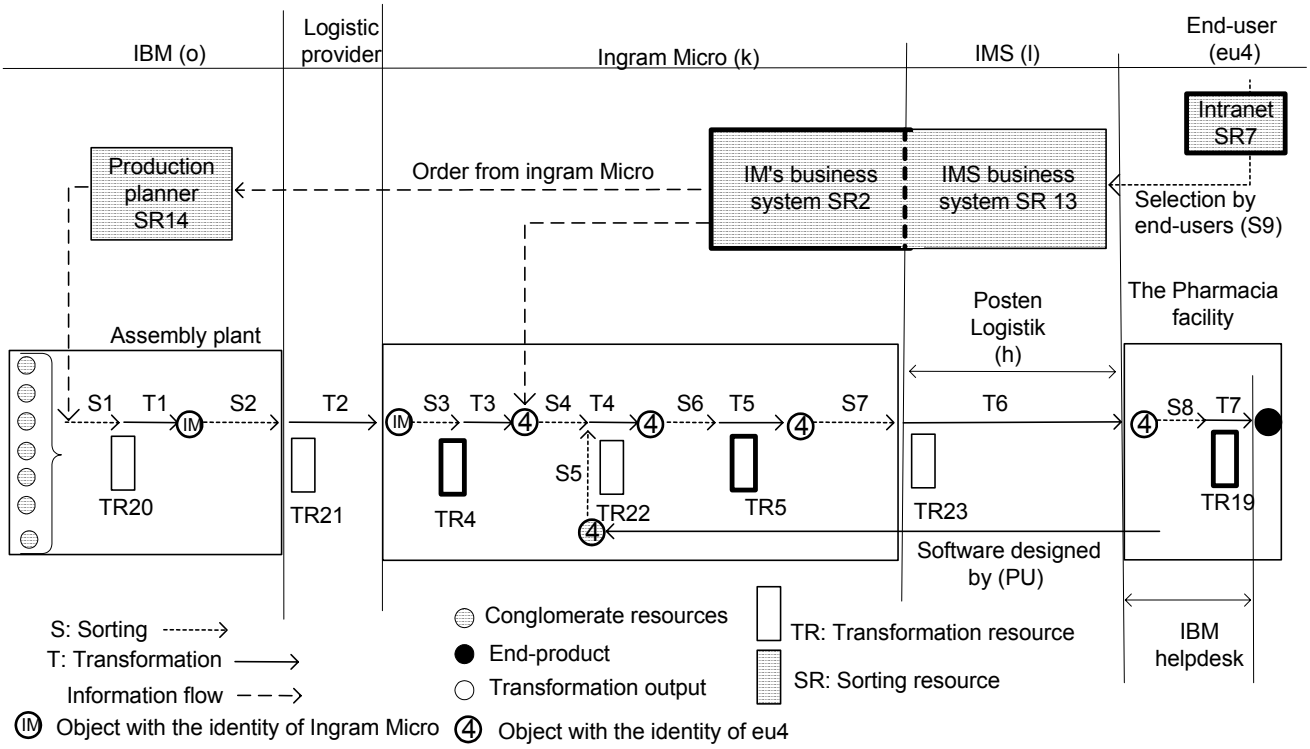


Figure 6.8 An illustration of transvection 4b

In a similar way as in transvection 4a, the end-user can choose between two predefined models (S9). The order placement also involves the same activities, i.e. S9 in Figure 6.8 is the same as S10 in Figure 6.6, and they activate the same sorting resource, the Intranet SR7, marked in bold in the figure. The order is then sent to IMS. Since the business systems of IMS (SR 13) and Ingram Micro (SR 2) are integrated, the order is automatically transferred to Ingram Micro, where it is processed.

For Pharmacia it is of major importance that the exact configuration as has been tested and specified at the Intranet (SR7) is delivered. This is due to that substituted components can have severe effects on the performance of the PC network. This means that it is important to Pharmacia that IBM does not change any components in the configuration of the ordered PCs without informing Pharmacia in advance so that new configurations can be tested with the Pharmacia software. The two PC models that can be chosen by eu4 are hence two of the predefined standard models in the IBM product range but they

have been carefully tested in Pharmacia's PC environment together with the Pharmacia software.

Ingram Micro places aggregate orders to IBM in a similar way as in transvection 1. The orders are processed by a production planner (SR14). The conglomerate resources are assigned (S1) to the assembly equipment (TR20), and assembled, and packed. The conglomerate resources are assigned the identity of Ingram Micro as soon as they are picked from the shelf. The PC is then assigned (S2) to a certain trailer (TR21) and shipped (T2) to the Ingram Micro warehouse in Stockholm. When it arrives it is handled (S3, T3, TR4) in the same way as in transvection 1 (S4, T4, TR4 in Figure 6.2).

Upon activation by the order from Pharmacia, the PC is removed from the shelf, assigned (S4) to a specific configuration area (TR22) in the warehouse. The object now changes identity from Ingram Micro (IM) to the end-user (eu4) in accordance with Figure 6.8. The conglomerate resource in terms of the predefined software by Pharmacia has also been assigned (S5) to this area. The PC is then unpacked, installed with the software, and packed again (T4). After this, the PC is assigned (S6) to the same area in the warehouse (TR5) as in transvection 1 and then further assigned (S7) to a trailer (TR23) that transports (T6) the PC to the Pharmacia facility. When it arrives at the Pharmacia facility it is handled (S8, T7, TR19) in the same way as in transvection 4a (S9, T9, TR19 in Figure 6.6).

Discussion

From the end-user's perspective, transvection 4b involves the same activities as transvection 4a. The selection and order placement as well as the final handling of the PC by the helpdesk are identical. (S8 and T7 in transvection 4b are equal to S9 and T9 in transvection 4) Hence, some parts of the transvections are the same in transvections 4a and 4b. Although the activation of the transvection is identical from the end-user's perspective it is completely different from other actors' perspectives. The aggregated orders placed by Ingram Micro are a result of speculation from their perspective. However, the assembly initiated by the order from Ingram Micro is activated by the principle of postponement in a similar way as in transvections 1, 2, and 3. Furthermore, the final assembly in terms of installation of software is postponed until orders arrive from Pharmacia. This means that the identity is kept 'non-end-user-specific' until this point. From Ingram Micro's perspective, this means that the PC can be directed to other customers until this point, which reduces the risk of speculation. This is made possible since the two available models that the end-

user (eu4) can choose between are standard models from IBM's assortment, with no specific hardware configuration directed to Pharmacia. However, from Pharmacia's perspective it is important that these specific configurations are not changed since they adapt their internal 'collection of objects' to this configuration. Hence, the conglomerate resources are not adapted to Pharmacia in the way they are combined. Instead, Pharmacia has adapted to how IBM has combined the conglomerate resources. The object's features in terms of form therefore become highly important from Pharmacia's perspective, as a small change in the configuration of a single PC can affect the performance of the whole system. This issue is the same with regard to the features of the PCs from Dell and IBM.

With regard to activity coordination, the part of the transvection that begins with S9 and ends with the delivery of the object to Ingram Micro (T2) is closely complementary with regard to Ingram Micro. The transvection is re-activated by the order from the end-user and the object is then assigned the identity of the end-user. The transvection then again becomes closely complementary, now in relation to the end-user, until it ends as an end-product installed at the end-user's site. The postponement of the last change in identity opens up for flexibility from Ingram Micro's perspective in the way the object can be sorted before it is assigned the identity of the end-user. Hence, this point in the transvection links two parts of the transvection, each being closely complementary, directed to Ingram Micro and the end-user respectively.

Transvection 4b makes use of some of the resources activated in the previously described transvections. It activates the sorting resource (SR2) and transformation resources TR4 and TR5, which are jointly used with transvections 1, 2, and 3. Furthermore, it activates the same sorting resources (SR7) and transformation resource (TR19) as in transvection 4a. This kind of crossing of transvections is discussed further in chapter 7.

6.5 Transvection 5a

The end-user (eu5) at Chalmers can choose to activate a total of three different transvections.[77], 5a, 5b, and 5c. We begin with 5a, which involves the actors and facilities Dell (*p*) and its assembly unit (*q*), and customer service (*ö*), Irish Express (*r*) and its local office in Gothenburg (*å*), and ASG (*y*) and its goods terminal (*z)*. (see Figure 6.9)

[77] Since Chalmers works with 12 suppliers of PCs the number of possible transvections the end-user can activate is immense. However, in the empirical material only three of these were highlighted.

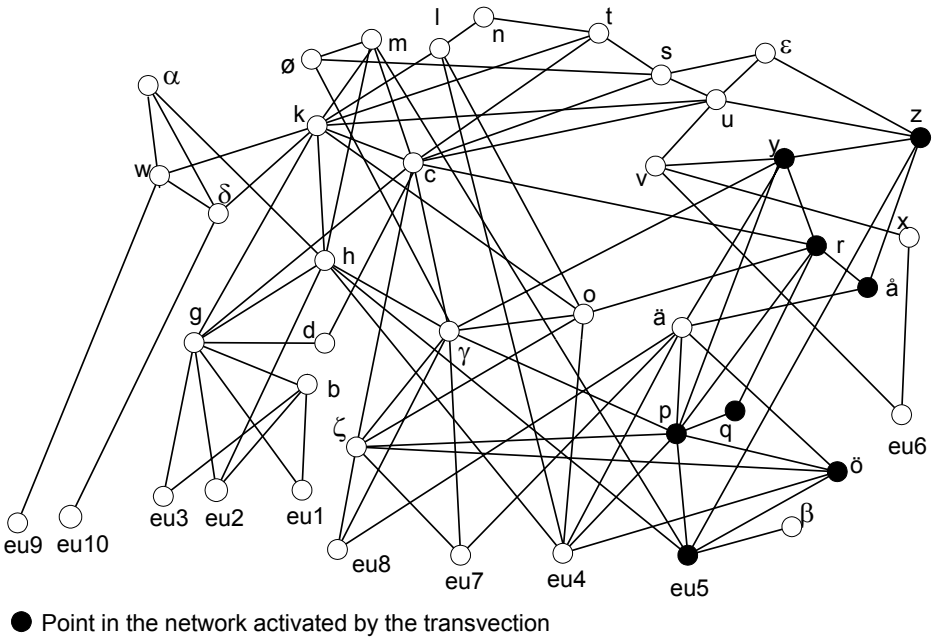


Figure 6.9 The part of the network activated by transvection 5a

Analytical description of transvection 5a

This transvection takes its starting point in the end-user (eu5) at Chalmers University of Technology who orders a PC from Dell. In Figure 6.10 the transvection is illustrated in terms of sortings and transformations and how these activate different resources.

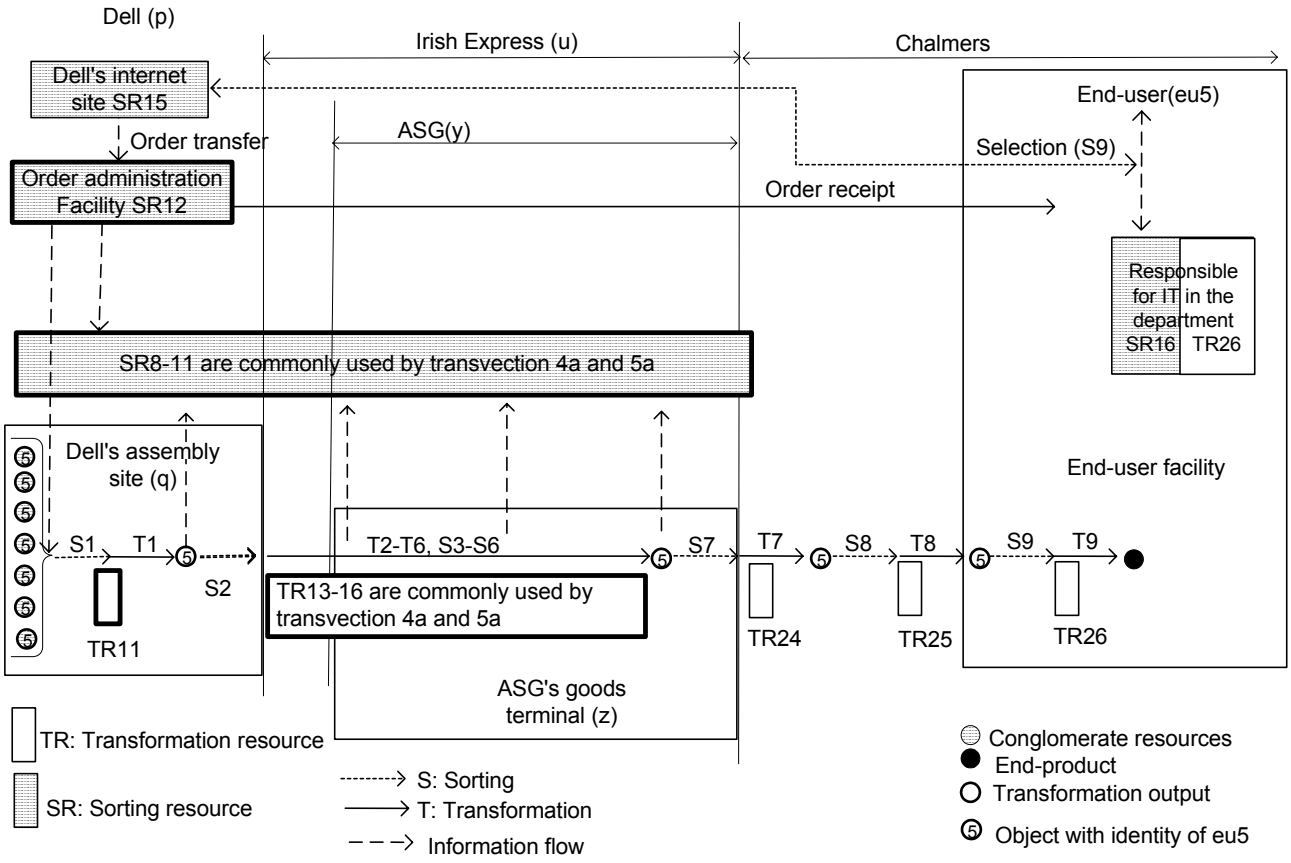


Figure 6.10 Illustration of transvection 5a

The end-user (eu5) makes a selection by interacting with two different sorting resources, the person responsible for IT at the department (SR16) as well as Dell's Internet site (SR15), which displays the PC configurations available to end-users at Chalmers. The end-user can choose from about three different basic configurations. Hence, Chalmers limits the available choices in relation to the end-user by only permitting the kind of PCs that are designed to be 'network-safe' 'company PCs'. The end-user can select any of these predefined configurations or take them as a starting point when changing the configuration in accordance with what the configuration tool allows for. In contrast to transvection 4a where the end-user could not make any changes in the configuration decided upon by Pharmacia, the end-user at Chalmers can make such changes. The end-user can design the PC in terms of its combination of conglomerate resources within the limit provided by the configuration tool.

The order is placed (S9) on the Dell Internet site, and then sent electronically to Dell's order administration unit (SR12). From this point, the transvection is identical to transvection 4a, described in section 6.3, in terms of activities performed until the transformation output of TR16 with one exception.

Transvection 5a does not make use of TR12 since no additional customisation is performed as is the case in transvection 4a where specific software is installed and the PC is made theftproof. Consequently the transformation outputs of TR11 in the two transvections are assigned (S2) to different transformation resources, TR12 (Trv4a), and TR13 (Trv5a), respectively. Hence, TR11, and TR13-16 are used in both transvections 4a and 5a. Furthermore, the sorting resources SR8-SR11 and SR12 are also commonly used by the two transvections. Bold lines in Figure 6.10 illustrate this.

The transformation output from T6 is then assigned (S7) to a truck (TR24) operated by Chalmers internal post service that collects all goods bound for end-users at Chalmers. The PC is then further assigned (S8) to the specific end-user and delivered (T8). It is then unpacked and installed (S9/T9) by the person (TR26) responsible for IT at the department. Hence, this person is both a sorting resource (SR16) when helping the end-user to choose, and a transformation resource (TR26) helping the end-user to install the PC and get started.

Discussion

As is the case in transvection 4a, this transvection is characterised by postponement of transformations in form, time, and, place. This means that the activities involved are closely complementary from start to end. A discussion on the effects of this may be found in section 6.3. In this transvection the end-user can influence how the conglomerate resources are actually combined, within the limits set up by Dell, as materialised in the configuration tool. This means that certain flexibility in the form dimension is available from an end-user perspective. However, this flexibility is 'controlled' by Dell. This is important from this actor's perspective since unlimited flexibility would cause problems in many respects. First, not all conglomerate resources work together in a satisfactory way. This has implications on the performance of the single end-product, i.e. the PC in itself, and on how the PC works together with other objects. Second, from a supply perspective, Dell wants to limit the number of variants of conglomerate resources, because of its just-in-time based supply structure. Third, there is a desire to be able to use the same resources for many transvections in order to gain economies of scale in operations, no matter what combination of conglomerate resources is used.[78] Consequently, the objects' features in the form dimension have implications on many 'levels'.

[78] This issue is further discussed in section 7.2 dealing with Dell's assembly facility as a crossing point for transvections.

In this transvection some adaptations have been made affecting the time and place features of the objects. The adaptations were made since some of the activities in the 'standard way' Dell organises its part of the transvection did not fit into Chalmers internal activity structure. The solution with Chalmers picking the goods up using its own postal service means that the end-users can get the goods delivered at the time and place suitable for the succeeding activities in the transvection, S8 and T8.

6.6 Transvection 5b

This section deals with another transvection that can be activated by end-users at Chalmers. The actors involved in this transvection are illustrated in Figure 6.11, and are Dustin (*m),* Hewlett Packard (*c)* with its production site (*s*) and order administration unit (*t*), Ingram Micro (*k*), Posten Logistik (*h),* Schenker (*u*), and its hub (*ε*).

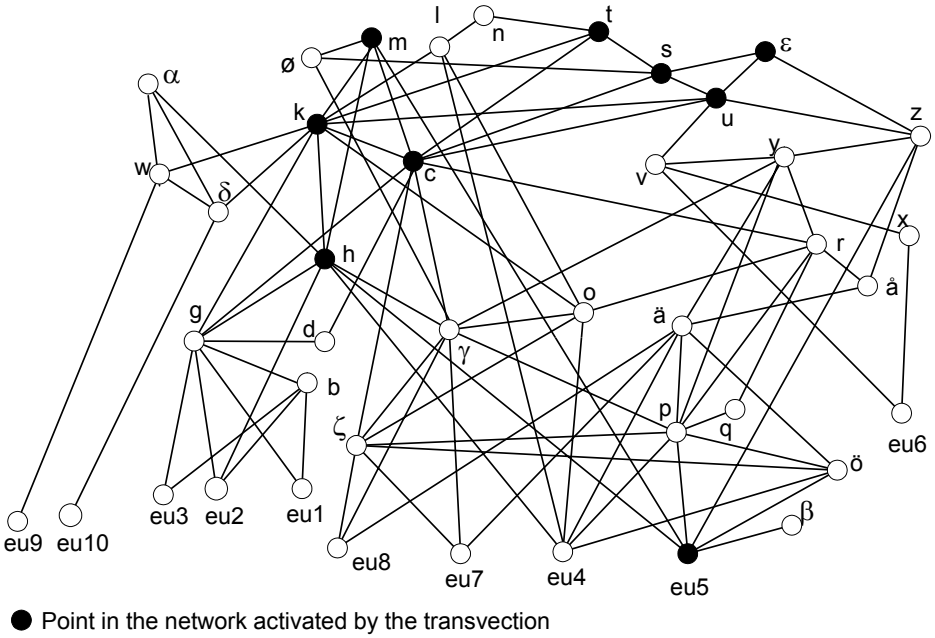


Figure 6.11 The part of the network activated by transvection 5b

Analytical description of transvection 5b

This transvection takes its starting point in an end-user (eu5) turning to Dustin to buy a Hewlett Packard PC. The transvection is illustrated graphically in Figure 6.12 below.

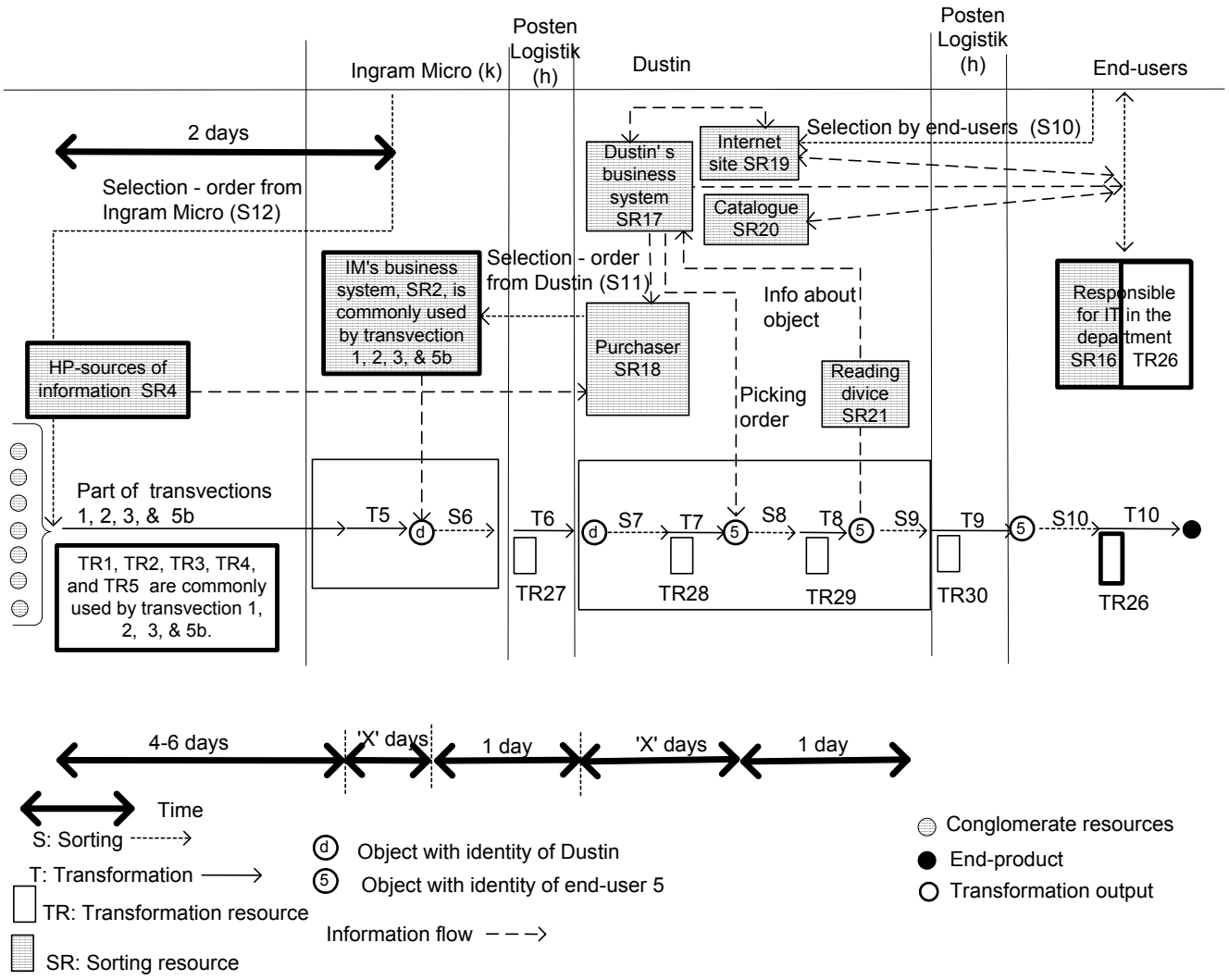


Figure 6.12 An illustration of transvection 5b

The end-user makes a selection (S10) from the Dustin product range in interaction with the person (SR16) responsible for IT at the end-user's department and with the help of the extensive catalogue (SR20) and the Internet site (SR19). The business system is constructed so that the end-user can access information about the different products, their technological features and prices. Further, information connected to each product concerning its availability, e.g. '1-2 days', 'in stock', and 'not in stock' is available. This information helps the end-user to select. When the selection is made the order is placed on Dustin's Internet site[79], which is connected directly to the Dustin business system (SR17). When the order is placed, the end-user receives an instant order receipt with information about delivery status. If the PC cannot be

[79] 50% of the total number of orders is placed on the Internet and the rest by phone or fax. This transvection only involves order placement on the Internet.

delivered immediately, automatic e-mails are sent to the end-user every time the delivery status is changed.

The purchaser at Dustin responsible for PC products (SR18) interacts with a number of other sorting resources (SR4, SR17, SR2) in order to obtain information that can improve the sorting decisions that result in the selection (S11) in term of an order to Ingram Micro. The part of the transvection that is initiated with an order from Ingram Micro until the storing (T5) of the PC in the Ingram Micro warehouse is identical with transvections 1, 2, and 3. S10, and T10 are also identical to S8 and T8 in transvection 5a. Consequently, much of the analysis concerning transvections 1, 2, and 3 is also valid for transvection 5b. (see sections 6.1 and 6.2 for an analysis of this part of the transvection) The order to Ingram Micro results in an assignment of the PC (S6) to a certain trailer assigned to Dustin (TR27) that transports it (T6) to the Dustin facility where it is assigned (S7) a certain place (TR28) in the warehouse.

When the end-user places an order and the PC is in stock, a picking order is printed in the warehouse assigning the PC the identity of the end-user. The PC is then packed (T8) and order information and a barcode that is scanned by an automatic reading device (SR21) is attached. This information is then transferred to the business system (SR17) and then further automatically by e-mail to the end-user. The PC is then assigned (S9) to a trailer (TR30) and transported (T9) to the geographical area in which the end-user is situated. Posten Logistik informs the end-user before arrival so that the end-user can plan for the delivery. The PC is delivered to the office of the end-user and not to some common postal service area. The PC is then installed in accordance with transvection 5a. It takes about one day from when the order is placed until delivery if the product is in stock.

Discussion

From an end-user perspective this transvection does not provide any possibilities to influence the combination of conglomerate resources. Instead, the end-user chooses from a predefined collection of objects selected by Dustin. To help in the selection process, the end-user is provided by information about the objects' features in the form dimension, i.e. what different conglomerate resources that are included. This information is accessed through the catalogue or on the Internet site. The catalogue is interesting as a sorting resource as it is used both by the end-user and by other suppliers, as a base for their own sortings.

For the end-user, information concerning when the PC will be delivered can be crucial. By automatically providing information about delivery dates and changes in delivery dates the end-user can plan internal activities (e.g. T10). This information is also needed in order for the person responsible (TR26) at the IT department to plan his involvement in different activities. This information acts as a coordination link between the internal activity structure of the end-user and the part of the transvection organised by Dustin. Hence, information concerning the object's features in the time dimension is crucial in this transvection.

Furthermore, from the perspective of the person responsible at the IT department it is important that the PC is delivered to the office of the end-user, i.e. to the place of installation. Consequently, the PC's features in the place dimension are also important. In order to accomplish this, information from carriers to end-users concerning delivery is required. By calling before leaving, the carriers can ensure that someone at the end-user's facility is able to receive the goods.

6.7 Transvection 5c

The third transvection involving Chalmers only involves one actor beyond the end-user, the supplier Programmäklaren (β).

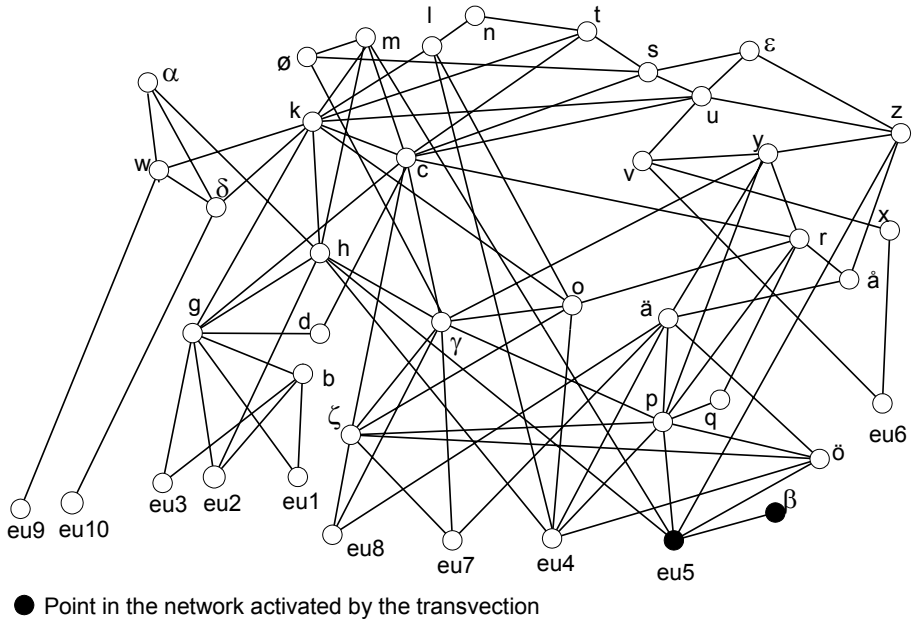


Figure 6.13 Transvection 5c

Analytical description of transvection 5c

This transvection starts with the end-user, eu5, turning to Programmäklaren (β) to buy a PC. (see Figure 6.14 for a description):

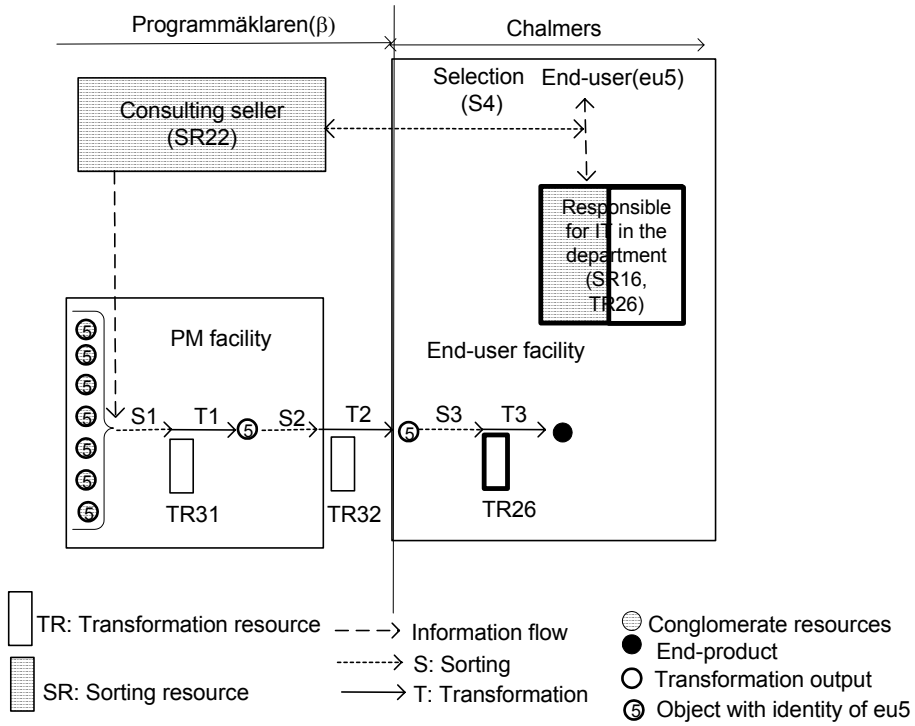


Figure 6.14 An illustration of transvection 5c

The selection (S4) concerning what to buy is made in interaction with the person responsible for IT at the department (SR16) and the consulting salesperson at Programmäklaren (β) (SR22). The design of the PC, i.e. the configuration in terms of the combination of conglomerate resources, is done in interaction among Programmäklaren, the end-user and the person responsible for IT at the department. From the perspective of the latter, it can be important that some specific component is included, for reasons of compatibility, as the PC has to fit into the larger network of the department, the school, and the university as a whole. Programmäklaren, in turn, can contribute knowledge concerning how different components interact technically within the PC itself.

The order placed as a result of this selection (S4) activates the sortings and transformations performed by Programmäklaren. One person performs all transformations, from the picking of components and assembly (T1) to delivery (T2) with the use of different kinds of equipment (TR31 and TR32).

Discussion

By interacting in the design the actors try to ensure that the PC as an object functions well, in relation to both internal and external aspects. From the end-

user's perspective, it is important that the PC fulfils the needs set by the end-user in terms, for example, of performance for operating certain applications. This transvection hence provides the end-users with an opportunity to be an active part of the design of the PC in a way the other transvections do not provide. Compared to transvections 4a and 5a involving Dell, this transvection enables more interactive participation in the configuration, only permitting the combinations that are predefined by the configuration tool.

With regard to the objects and their features, the transformation output in the form dimension from (T1) is a result of the interaction among the three parties as argued above. This interaction, in turn, is facilitated by the geographical closeness between the end-user and Programmäklaren. From the end-user's point of view, this closeness also means that the object is 'close' in terms of its features in time and place. This creates short delivery times as well as an opportunity to physically turn to Programmäklaren to discuss different matters in person. This transvection enables the end-user to be part of the design of the transvection by providing flexibility in the time, form, and place dimension in relation to end-user requirements.

All activities performed are directed to the specific end-user. Hence, the whole transvection is characterised by the principle of postponement and activities being closely complementary in relation to the identity of the end-user. This is also a prerequisite for taking advantage of the interaction among the parties and the effects on the features of objects.

6.8 Transvection 6

This transvection involves a large number of different actors and facilities as illustrated in Figure 6.15 below. The following actors and facilities are involved in transvection 6. Hewlett Packard (*c*) and its production unit (*s*), order administration unit (*t*), Internet shop (*v*), and sales office operated by a local firm (*x*). Schenker (*u*), and its hub (*ε*) is involved as well as Irish Express (*r*), with its local office (*å*). ASG (*y*) and its facility in Gothenburg (*z*) are also involved in the transvection.

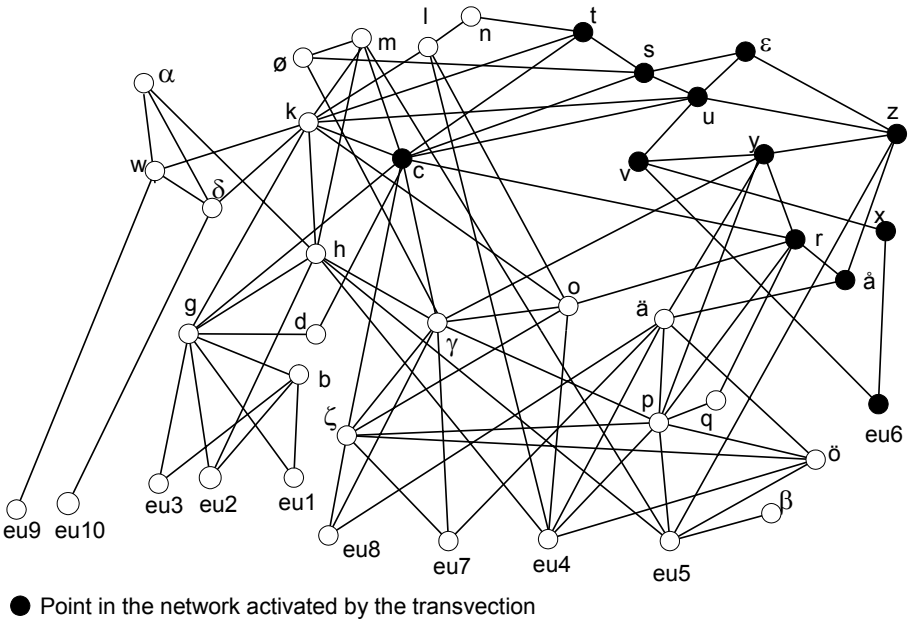


Figure 6.15 Part of the network activated by transvection 6

Description and analysis of transvection 6

This transvection begins with a private end-user turning to Hewlett Packard's Internet site (SR23) (see Figure 6.16).

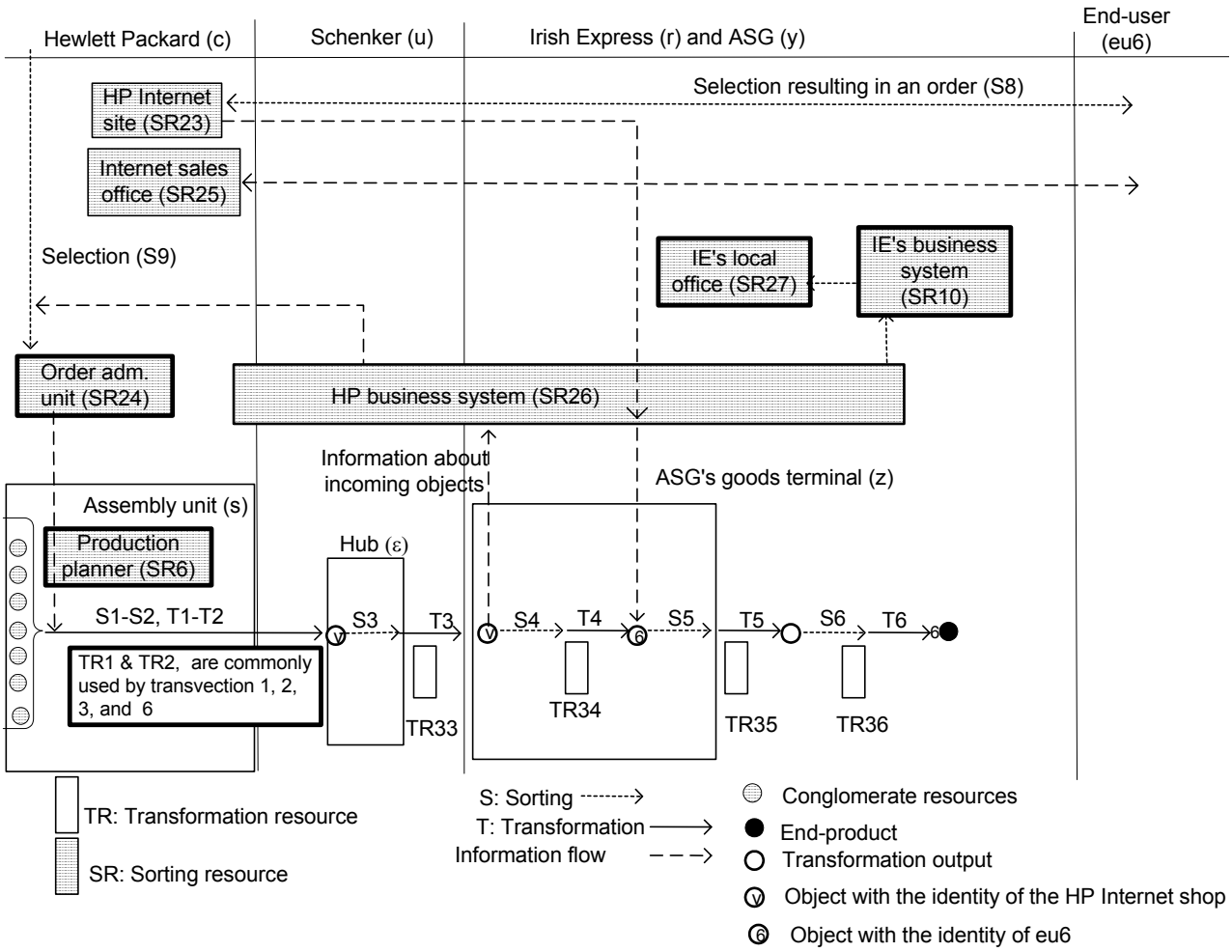


Figure 6.16 Graphical illustration of transvection 6

The Internet site displays a limited part of the Hewlett Packard product range that is directed to consumers. With the information provided by this resource and, in some cases, with the help of the Hewlett Packard Internet sales office (SR25), the end-user makes a selection (S8), which results in the placement of an order on the Internet site. An order can only be placed if the specific object is available in stock at the ASG facility in Gothenburg. The order information is transferred directly to the Hewlett Packard business system (SR26) and further to the Irish Express business system (SR10).

The production order to the assembly unit is a result of a selection (S9) made internally at Hewlett Packard, based on speculation regarding demand. The production order is handled in the same way as the orders from Ingram Micro in transvections 1-3, making use of the same sorting resource (SR24). Furthermore, the order activates the same transformation resources (TR1, TR2) as in transvections 1, 2, and 3. The objects are assigned the identity of the

Internet store as soon as the conglomerate resources are assigned (S1) to T1. At the reloading hub they are sorted in accordance with this identity and assigned (S3) to a trailer (TR33) bound for ASG's goods terminal. When the object arrives at the terminal it is registered and information about it is transferred to the business system (SR26). It is then assigned (S4) to a certain area (TR34) reserved for objects having identities of the Hewlett Packard Internet store. The objects are kept in stock (T4) at this warehouse until an order arrives from an end-user as described above. Because information about which objects are available in stock is transferred to the Hewlett Packard business system and this information is coordinated with the order system at the Internet site orders cannot be placed for objects that are not available in stock.

When the order arrives the object is assigned the identity of the end-user (eu6) and is brought out from the inventory (TR34) and assigned (S5) to a trailer (TR35), bound for a certain re-loading facility at which it is re-loaded and assigned (S6) to a new trailer (TR36) and delivered (T6) to the end-user.

Discussion

The production order from Hewlett Packard is based on speculation regarding demand. From their perspective this means a balance of the level of stock kept at the ASG facility. On the one hand it is important to keep the level high enough so that orders can be placed, since orders cannot be placed if the PCs are not in stock. Depending on the end-user's preferences, it can be more or less easy turn to another supplier if it is not possible to place orders. On the other hand, the costs for keeping inventory of 'finished' PCs is substantial, which means that an unnecessarily high level will result in 'high' costs for stockkeeping.

The part of the transvection illustrated by S9, S1-S4, and T1-T4 is consequently characterised by speculation in time, form, and place from Hewlett Packard's perspective. However, time and place differentiation of the object is postponed in relation to the end-user by keeping an inventory at the ASG facility. In this way short delivery times can be obtained. When the order from the end-user arrives, the object is assigned the identity of the end-user, and its features in place and time are changed until it arrives at the end-user. The objects' features in the form dimension do not change after the form transformation (T1).

6.9 Transvections 7, 8a, 8b, and 8c

These transvections share a lot of common characteristics, and so they are discussed together in the same section. All four transvections involve Atea (γ) as well as Volvo IT (ζ). First, transvection 7 takes its starting point in an end-user (eu7) at the Volvo Car Corporation and involves Dell. Second, transvections 8a, b, c take an end-user (eu8) at the Volvo Group as their starting point and involve Dell, HP, and IBM respectively. Both end-users are directed to use Volvo IT as their purchase interface when buying a PC. Volvo IT in turn uses Atea as a partner for delivery.

Analytical description of Transvections 7, 8a, 8b, and 8c

The transvections are analysed below in relation to one another, highlighting the differences and similarities among them.

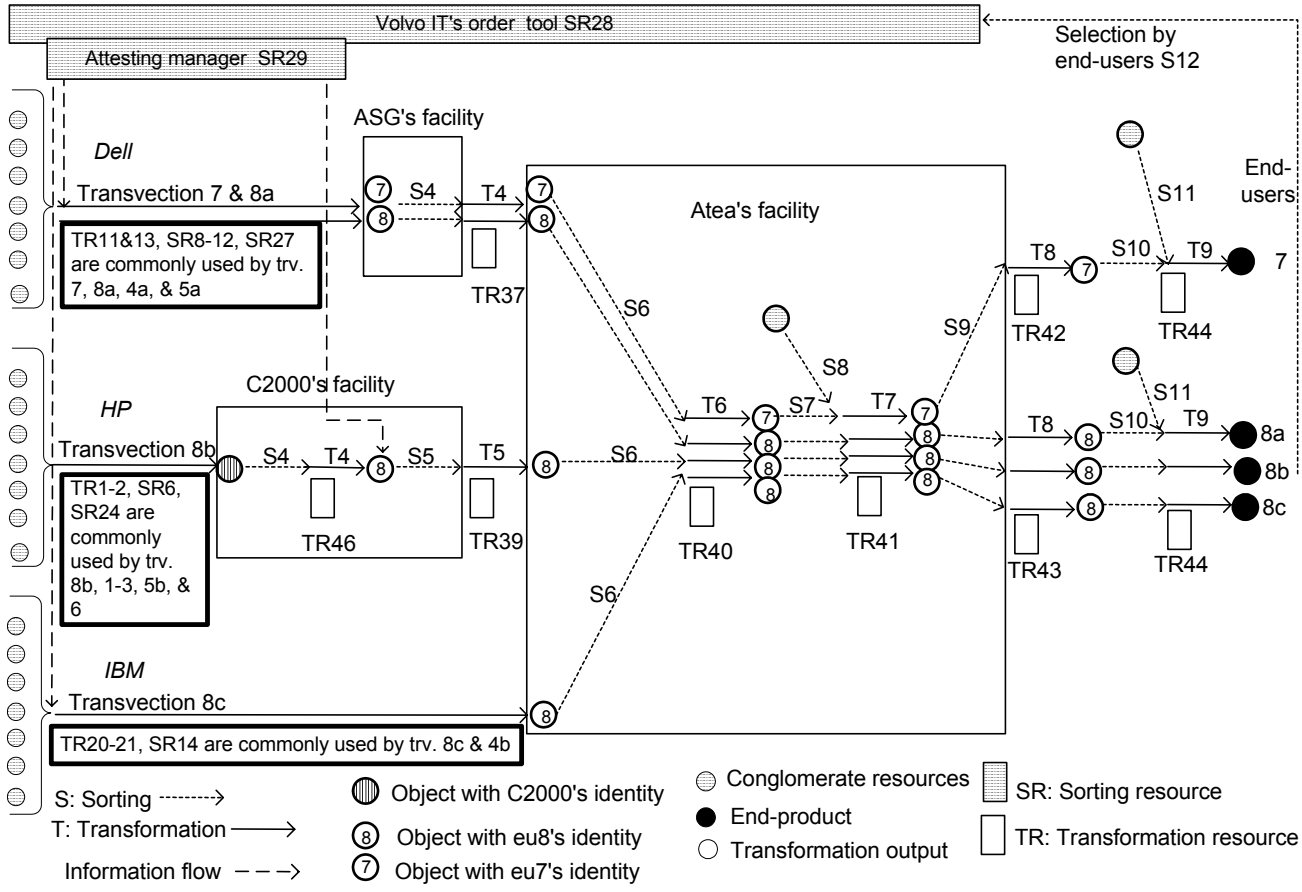


Figure 6.17 Similarities and differences among four transvections

The end-users begin by connecting to the Volvo Internal web based order tool (SR28) that shows which PCs are available for the users. As the two organisations at Volvo have different preferences eu7 will be directed to a PC

from Dell and eu8 can choose from three similar desktop PCs from Dell, Hewlett Packard, and IBM. All these PCs are pre-configured, which means that the end-user cannot influence how the conglomerate resources are assigned in relation to each other, i.e. the objects' features in the form dimension. From the eu7 perspective there is no choice but to select (S12) one single object – the pre-configured PC from Dell. However, eu8 can choose among three similar objects with the main difference related to the 'brand', i.e. a PC from Dell, IBM, or Hewlett Packard. In either case, when the selection (S12) is made, the order is transferred to the end-user's attesting manager (SR29) who either accepts or rejects it. If it is accepted, the order is submitted directly to Dell, Hewlett Packard, or IBM. A copy of the order is also sent to Atea.

With regard to transvections 7 and 8a the orders from eu7 and eu8 are transferred to Dell and are handled in accordance with transvections 4a and 5a until the PCs arrive at the ASG goods terminal in Gothenburg. The transvections hence make use of the resources TR11&TR13, SR8-12, SR27, (see Figure 6.6 for further information about this part of the transvection). When the PCs arrive at the ASG facility, they are unloaded, registered and assigned (S4) to another trailer (TR37) on which they are loaded. They are then transferred (T4) to the Atea facility in Växjö together with other Dell PCs with a Volvo identity (Volvo Group or Volvo Car Corporation).

Transvection 8b is partly handled in the same way as transvections 1-3, 5b, and 6. When the order arrives at Hewlett Packard it is directly transmitted to the distributor C2000 (*ø*) warehouse who keeps this kind of PC in stock. The PC has been delivered from the Hewlett Packard assembly unit to C2000 in line with the description of transvections 1-3, 5b, and 6 (see Figure 6.2 for further information about this part of the transvection) except that the PC is assigned (S3) to a trailer (TR38) that is bound for the C2000 warehouse instead of Ingram Micro. Consequently, transvection 8b make use of some of the same resources as the other transvections; the order administration unit (SR 24), the resources used for assembly and transportation, TR1 and TR2, as well as the same sorting resource SR6 in terms of a production planner. When the PC arrives at the C2000 warehouse it is assigned (S4) to a storage rack (TR46) where it is stored (T4) until the order from the end-user arrives. It is then assigned the identity of the end-user, and assigned (S5) to a trailer (TR39) together with other PCs bound for the Atea warehouse, and transported (T5) to the warehouse.

The last transvection, 8c, is partly identical to transvection 4b, except that the identity is VolvoIT instead of Ingram Micro. (For more information concerning

this part of the transvection see Figure 6.8). The transvections both make use of the following resources: SR14, TR20-21. When the order from eu8 arrives at IBM it is accumulated together with other orders from end-users related to Volvo. These orders then together make up a production order for Volvo. The accumulated volume each day is comparable with the delivery of one trailer. All PCs in the production order are loaded onto one trailer and shipped directly from the IBM assembly unit to the Atea warehouse.

From the point when the PCs arrive at the Atea warehouse until they leave the warehouse, the four transvections are identical. When the PCs arrive they are registered, and information about delivery time is sent to VolvoIT. The installation engineer (TR43) at Atea also contacts the end-user in order to plan for the installation. When the PCs arrive they are assigned (S6) to the configuration centre (TR40) where they are customised (T6) in line with Volvo IT's requirements. This customisation requires changes in the object's features in the form dimension. For example, Atea installs Volvo-specific software, removes unnecessary manuals and re-packs the PC. Each of the three available configurations of desktop PCs (from Dell, IBM, and Hewlett Packard respectively) has its own specified software, which has been tested to fit the specific object in the form dimension in each of these transvections. After this, the PCs are checked and marked with a unique Volvo id-number. The PCs are then assigned (S7) to the packing area (TR41) where they are packed (T7) in boxes designed especially for Volvo together with other objects that are assigned (S8) to the same end-users. Hence, other conglomerate resources are added at this point. The boxes are then assigned (S9) to trailers (TR42 for eu7 and TR43 for eu8) that transport (T8) the PCs to the end-users. At the end-user facilities the PCs are assigned (S10) to the installation engineer (TR44) who installs the PC (T9) together with the monitor that has been assigned (S11) and delivered directly to the end-user facilities from the suppliers.

Discussion

These four transvections illustrate situations where firms try to standardise both the starting point of the transvection, i.e. how the end-user selects and places an order, and the ending-point, in terms of the features of the end-product as well as the way it is delivered and installed.

At the same time the end-user (eu8) can choose among three different PCs, which has shown to be related to very different transvections. This means that from the end-users' perspective the end-product should have 'the same' features independent of which transvection is involved. Consequently, the

delivery time, the place of delivery and the function[80] of the object are the same in all four transvections. However, the transvections are very different in terms of how they are activated and how activities are organised and resources used.

For example, in transvections 7 and 8a the form transformation related to each PC is initiated by the end-user's order, in accordance with the principle of postponement. When the PC has been assembled it is gathered together with other PCs with identities of end-users related to Volvo. In transvection 8b, the form transformation is triggered by an order from C2000 ($\varnothing$), i.e. using the principle of postponement from Hewlett Packard's perspective. This order, in turn, is a result of speculation from the C2000 perspective. In transvection 8c, orders from end-users related to Volvo are collected and regarded as one production order from the IBM perspective. The form transformation is initiated by this aggregated production order and results in a collection of identical objects that are shipped directly to the Atea warehouse.

All in all, this means that objects with very different features arrive at Atea. Atea can be said to have two major functions. First, from the VolvoIT perspective, Atea changes the objects' features in a way that make them 'identical' from the perspective of VolvoIT in order to fit into their internal activity and resource structure. For example, by changing the packaging so that all PCs, no matter what supplier, are delivered in the same box, the same waste handling and transportation facilities can be used for all PCs. Further, by installing Volvo-specific software, all PCs will function in the same way in the computer network regardless of which supplier they originate from. Second, from the end-user's perspective Atea coordinates with the end-user so that the end-product has the 'right' features in the time and place dimensions, so the end-user can prepare and plan for the installation.

Atea and its involvement in transvections is further discussed in section 7.6, discussing Atea as a crossing point.

6.10 Transvections 9 & 10

These transvections deals with two end-users, eu9 and eu10, who are buying a PC from Westium Data's business store (w) and consumer store (δ) respectively. CapTech (α) assembles the PCs.

[80] Even if the form is not identical in the way that the conglomerate resources are assigned to each other, the performance of the object from the end-user's perspective is identical. Hence, the end-user perceives the object as a 'black-box'.

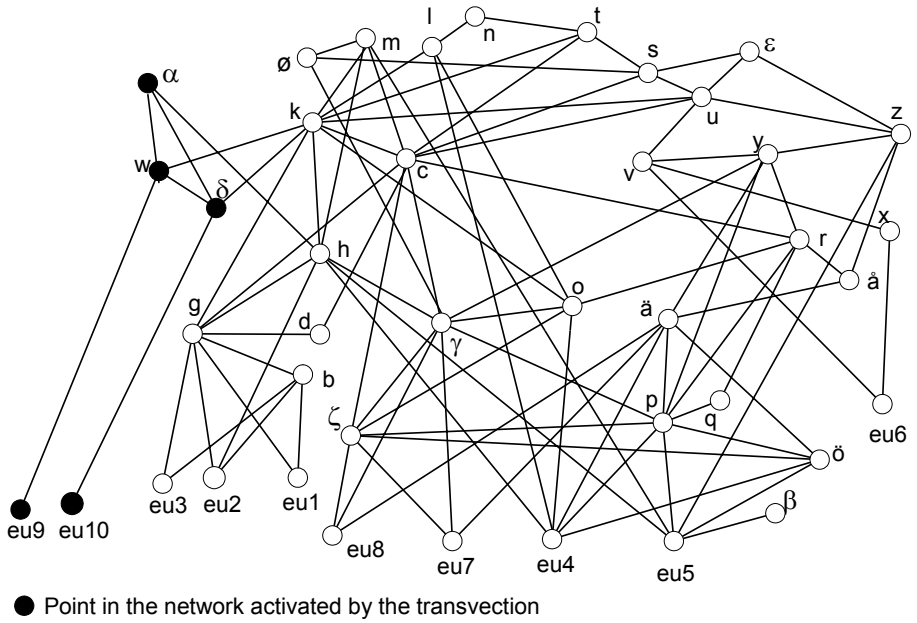


Figure 6.18 Part of the network activated by transvection 9 and 10

Analytical description of transvections 9 & 10

The analytical description of transvections 9 and 10 is below illustrated graphically in Figure 6.19 below.

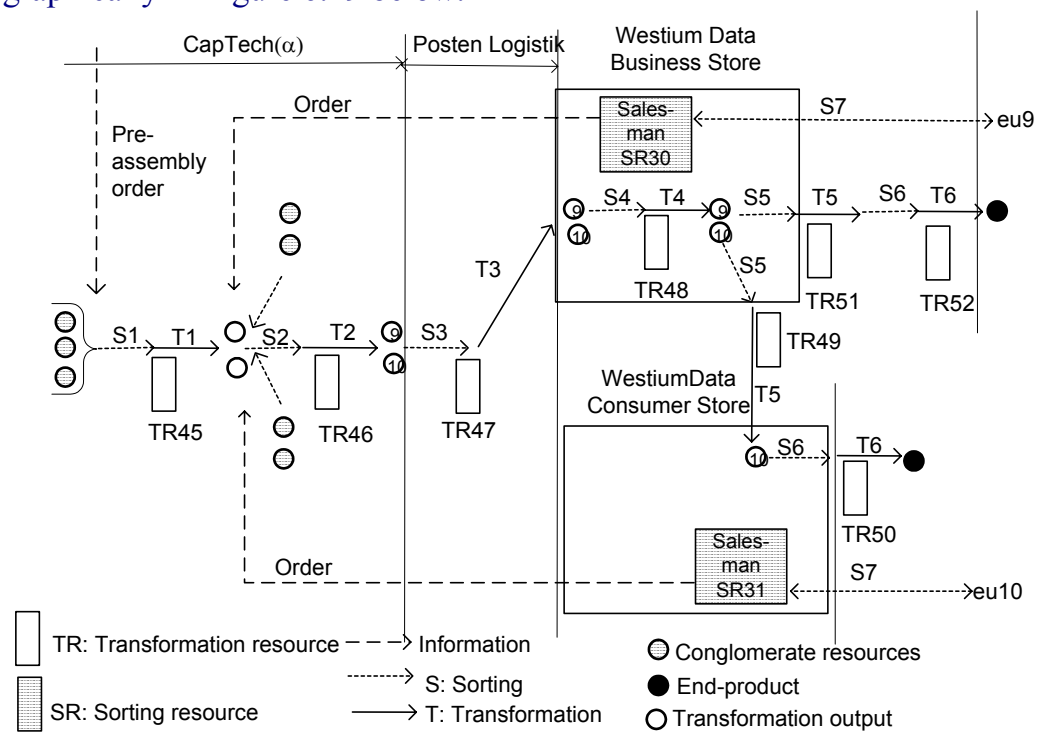


Figure 6.19 An illustration of Transvection 9 and 10

The selections (S7) made by eu9 and eu10 are somewhat different. In the case of transvection 9, the end-user is often a representative of a firm that is part of a

'total system' in which a PC from CapTech is only one component. For the salesman (SR30), this means that one of the main issues is to understand the needs of the buying firm in order to make a suitable offer. After this, an order is placed with CapTech, specifying the exact configuration of the PC in terms of components. In the case of transvection 10, the end-user is a private consumer who has certain ideas of what he needs. This means that the customer often brings along a specification of certain components. In this case the salesman has to convert this specification to an offer that is available to Westium. This means that the customer is often offered equivalent components if the ones required are not available. When the customer is satisfied, an order is placed in the same way as for the business customer.

When CapTech receives the orders from Westium Data, some pre-assembly (S1, T1, TR45) has already been done. This is made possible since CapTech has set some limitations concerning which disc drives, motherboards, and chassis can be chosen. Chassis and disc drives are assembled with two different motherboards, resulting in two basic configurations. Hence, no matter what configurations are ordered, one of the two pre-assembled 'barebones' can be used. When the order arrives, these pre-assembled objects are then customised in accordance with the configuration required and the additional conglomerate resources (e.g. processor, graphic card, hard disc, CD drive) are included, after which the PCs are tested and packed (S2, T2, TR46). The two different PCs also get unique end-user identities directed to eu9 and eu10 respectively. The PCs are then assigned (S3) to the same trailer (TR47) for shipment (T3) to the Westium Data Business store. Posten Logistik operates this shipment. When they arrive at Westium Data, the PCs are marked with information important to Westium Data (S4, T4, TR48). The PC for eu10 is then assigned (S5) to a vehicle (TR49) for transportation (T5) to the consumer store. This PC is then assigned (S6) to a place in the store to wait for the end-user (eu10) to pick it up and take it home (T6) by car (TR50). In the case of transvection 9, the PC is assigned (S5) to a trailer (TR51), transporting (T5) the PC to the end-user, often together with other objects included in a 'total solution'. In this case the technicians (TR52) will help to install the solution (S6, T6) at the end user facility if the customer does not have this knowledge in-house.

Discussion

These transvections are characterised by a mix of speculation and postponement. The pre-assembly of a number of conglomerate resources is done on speculation, resulting in two different basic objects. These objects only differ in one respect - form, more exactly the motherboard performance.

However, from these pre-assembled objects, a large variety of objects can be created as different conglomerate resources can be added in various combinations. The limited variation in pre-assembly enables economies of scale in sorting and transformations and it also limits the required level of inventory. Furthermore, the pre-assembly means that the lead time for end-users is reduced compared to if the transvection were based on pure postponement. However, pure speculation could reduce lead time even more but would result in large inventories and the associated costs. These transvections point out that by combining postponement and speculation strategies, a large variety in terms of form can be created at the same time as economies of scale are obtained by limiting some form dimensions and not others.

The end-products resulting from the two transvections are very different in terms of form, place, and identity, as well as how they are assigned to the end-user context. However, the transvections make use of common resources to a large extent. This is mainly related to the mix of postponement and speculation strategies as pointed out above. However, it is also related to the fact that the objects are not as different in form from a supplier perspective as from an 'end-user perspective'. From an end-user point of view the two objects are related to very different contexts. First, the two different interfaces in terms of a 'Business store' and a 'Consumer store' means that the objects are perceived differently as they are placed in different product ranges as well as locations, and salespersons. This also means that the two end-users will perceive the objects totally differently even if their features in the form dimension may very well be more or less identical from the perspective of another actor. From a supplier perspective, as argued above, the objects are very much alike, as many common transformation and sorting resources can be used for their handling. This highlights the importance to identify potential likeness among objects from different actors' perspectives and in various dimensions.

6.11 Summing up the transvection analysis

This chapter has focused on single transvections and their nature. The analysis has illustrated variety in the activity as well as in the resource dimensions. Below, we highlight some of the main aspects discussed.

The way that activities are organised in transvections has an extensive impact on how objects change along the transvection, and thereby on the features of the end-product. Two main principles of organising have been discussed: speculation and postponement. It has been shown that the extent to which

transvections are characterised by these different principles provides different conditions for sorting and transformation of objects.

First, how activities in transvections need to be coordinated varies owing to that different ways of organising entail various types of dependencies among activities. Some transvections are characterised mainly by firm internal coordination. In such cases a main challenge becomes to capture similarities among activities by efficient resource utilisation. Other transvections require tight coordination of activities along the whole transvection, across firm boundaries, owing to activities being closely complementary and thus sequentially interdependent.

Second, how and where in the transvection objects are assigned to different actors affects how the features of objects can change in time, place, and form. For example, in transvections based on pure postponement, the very first assignment of the conglomerate resources results in an end-user identity being assigned to the objects. This identity does not change along the transvection and this partly sets the conditions for how the objects can be sorted in the other dimensions. In a transvection characterised by speculation, in turn, the 'lack of' end-user identity in large parts of the transvection may provide a greater flexibility in how objects can be sorted. Where in the transvection objects are assigned certain identities also impacts on the extent to which end-users may be involved in the specification of the end-product, in term of its features in time, form, and place.

Third, the need to access 'external' resources also varies among the different transvections. In some transvections, sharing resources among firms, for example data bases and information systems, is crucial in order to coordinate activities across firm boundaries. This is often the case in transvections relying on postponement. In transvections of a more 'decoupled' nature, i.e. relying more on speculation, the sharing of this type of resource is not as important. Instead, getting access to sorting resources can lead to that 'speculation', in terms of which objects to select into a certain collection of objects, can be improved.

7 Crossing Point Analysis

Chapter 6 indicated a great variation concerning the nature of transvections. This relates firstly to how transvections are organised in terms of transformations and sortings, and secondly, as the chapter also illustrates, to diversity with regard to how transformation and sorting resources are accessed and used in transvections. The various ways in which objects are transformed in transvections were also highlighted.

In chapter 2, the crossing of transvections was discussed. The crossing points are defined as transformation resources, to which objects belonging to different transvections are assigned in line with the discussion in 2.3, page 33. This implies that crossing points are transformation resources in which potential likeness among objects and similarities among activities are taken advantage of. Crossing points are thus an abstraction of transformation resources. As was discussed in section 2.3, a number of more or less fixed transformation resources are available for actors involved in a distribution network. For example, certain warehouses and production units are available, each with specific equipment for assembly and materials handling. Furthermore, trailers and trains and other means of transportation connect these facilities. This means that the structure of transformation resources constitutes the foundation for how objects are assigned.

The fact that transvections cross was also indicated in chapter 6, analysing single transvections. In each transvection, a number of crossing points to other transvections can be identified. We now continue to elaborate on these 'Transvection Crossing Points', providing some examples of how objects are transformed at crossing points. The analysis is based on the empirical material in chapter 5 and the transvection analysis in chapter 6. The focus of this analysis is how objects change features at crossing points and how potential likeness among objects is taken advantage of at crossing points. The aim of the following sections is to illustrate variation in terms of how objects change features in different dimensions, i.e. time, place, form, and identity.

7.1 Crossing point 1: the Hewlett Packard facility

We begin by exemplifying how likeness in form is created in the Hewlett Packard assembly unit. Among the transvections identified in chapter 6, six (1, 2, 3, 5b, 6, and 8b) cross the transformation resource TR1. (see Figure 7.1)

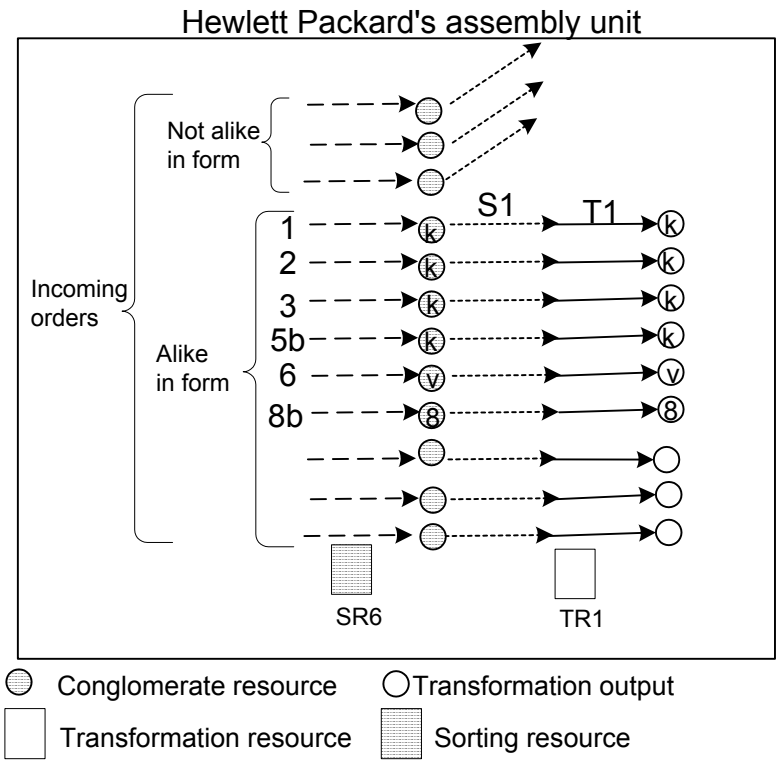


Figure 7.1 The Hewlett Packard assembly unit with its crossing point

The incoming orders in this example are always on an 'aggregate' level, meaning that a batch of 'identical' PC's are ordered together. It is not possible to order a single PC.

All orders from customers are sorted so that those involved in transformations resulting in transformation outputs that are alike in the form dimension, are gathered together. This means that the orders are sorted so that PCs of the same models, i.e. with identical collections of conglomerate resources, are assembled together, although they are assigned to different customers. In other words, they have different identities but are potentially alike in the form dimension. This implies that transvections related to very different actors cross at this crossing point owing to the potential of capturing economies of scale as the sorting and transformation activities undertaken in the different transvections are similar. They also make use of 'the same' conglomerate resources, i.e. conglomerate resources with the same features in terms of time, place and form. (see Figure 7.1)

All conglomerate resources are assigned to the assembly equipment (TR1) as a result of sorting performed by the production planner (SR6). In this sorting, all conglomerate resources are assigned an identity. The conglomerated resources related to transvections 1-3, and 5b, are assigned the identity of Ingram Micro

(k), the object of transvection 6 is assigned the identity of HP's Internet shop (v), and the object of transvection 8b is assigned the identity of the Volvo Group (8). After the form transformation (T1) the transformation outputs are alike in form.

In the case of 'our' six transvections, the transformation outputs resulting from the crossing point are alike in form[81] but not in identity. The fact that the identities are different implies that the objects are further sorted with regard to their respective identities, and a new crossing point occurs. This is discussed in section 7.7.

Each incoming order from a customer is thus organised so that the internal sorting and transformation resources can be utilised efficiently from Hewlett Packard's perspective. This is done by organising the orders so that objects are assigned to the same transformation resource (TR1). This, in turn, means that economies of scale can be obtained.

7.2 Crossing point 2: the Dell assembly facility

Another example related to the form dimension concerns Dell's assembly site. This is different from the previous example in that each order is related to a single PC and not to an aggregated 'batch of PCs', as was the case above. Nor is each PC is alike in form, in terms of its collection of conglomerate resources. Each transvection is also characterised by close complementarity with regard to the end-users. However, although the transformation outputs from transvections 4a, 5a, 7, and 8a in Figure 7.2 have different features in form in terms of the conglomerate resources involved, they are a result of the activation of the same transformation resources, the assembly equipment (TR11) and the trailer bound for Sweden (TR13). Further, they also make use of the same sorting resources in terms of the automatic reading device (SR8), Dell's business system (SR9), and Dell's order administration facility (SR12). This means that the transvections are similar with regard to both sortings and transformations at this crossing point and that economies of scale can be captured in spite of the fact that the transformation outputs are not alike in form in the same way as was the case at the Hewlett Packard assembly site.

[81] This will be dependent on which specific PC model that is involved in each transvection. In this discussion we will assume that all transvections involve the same model, hence they all have identical conglomerate resources. This is however not necessarily the case. If not, this will mean that the orders are sorted in accordance with the different models. The principle for this crossing point will nevertheless be the same.

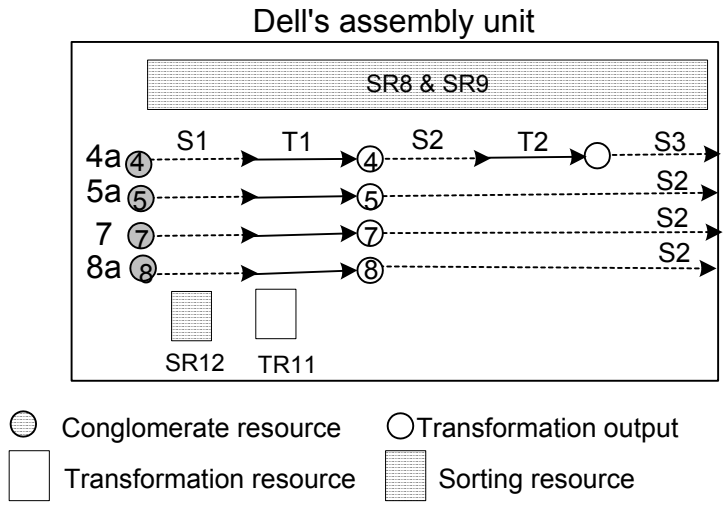


Figure 7.2 The Dell assembly unit with its crossing point

This example illustrates how objects can be perceived as alike with regard to form even when the transformation outputs are not alike in the form dimension from the customers' perspectives. Although the set of components included in each PC might differ from each customer's perspective, from Dell's perspective the same transformation resources, i.e. assembly equipment (TR11), can be used for the transformation for all these objects, i.e. potential likeness in form can be taken advantage of. The potential likeness in form makes it possible to use the same transformation resources for the form transformation of the various objects and thereby be able to obtain similarities and hence economies of scale in transformations and sortings.

This example has other aspects related to the nature of each transvection in terms of activity coordination. Since each transvection is characterised by close complementarity, this entails a need for both sequential and parallel coordination of the activities, within and across the transvections.

7.3 Crossing point 3: the Ingram Micro facility

Ingram Micro has 100 suppliers, which means that the objects arriving at the warehouse have very different origins and are involved in many different transvections. To coordinate all these transvections Ingram Micro needs information concerning how much and what is delivered. For example, Schenker informs them about deliveries 24 hours in advance. With this kind of information Ingram Micro is able to plan for and coordinate the handling of incoming objects. For example, there needs to be space to physically handle the delivered objects.

When objects arrive at the warehouse they are registered and assigned to a specific location and shelf in the warehouse together with other objects that are alike in form, i.e. PCs are assigned to the same area. The PCs are stored there until an order arrives from a customer, e.g. Siba or Dustin. It is interesting to note that the PCs that are identical in form, e.g. PCs from Hewlett Packard of the same model, at this point are alike in all dimensions. Nothing differentiates them from each other. This creates flexibility in how they can be sorted since they are not locked to any specific customer identity. However, as soon as orders from customers arrive, the PCs are assigned the identity of this customer, and are no longer totally alike. When the PCs are assigned identities to customers, they are at the same time assigned to a certain area in the warehouse, controlled by Posten Logistik where other objects directed to the same geographical area are gathered.

The objects, which can be assigned to Siba, Dustin or to some other customer, are then assigned to different transformation resources (trailers) on the basis of their potential likeness in the place dimension. In the case of transvections 1, 2, and 3 Siba's order is split here, because the PCs involved are directed to different facilities. Hence they are no longer alike in place. However, each of these objects now instead has the potential to become alike with regard to other objects.

This example shows how flexibility in the place and time dimensions can be created by keeping objects free from identity.

7.4 Crossing point 4: the ASG facility

This example deals with the ASG goods terminal (*z*) at which a large number of transvections cross. From the analysis in chapter 6, five transvections that cross ASG's goods terminal can be distinguished: 4a, 5a, 6, 7, and 8a. Beyond these, a large number of other transvections also cross the goods terminal, as illustrated in Figure 7.3 below. Four of the transvections described above are related to Dell (4a, 5a, 7, and 8a) and one to Hewlett Packard (6). These are coordinated at this crossing point and make use of some common resources. For example, transvections 4a and 5a share the transformation resources for merging monitors and PCs (TR14, TR15, and TR16).

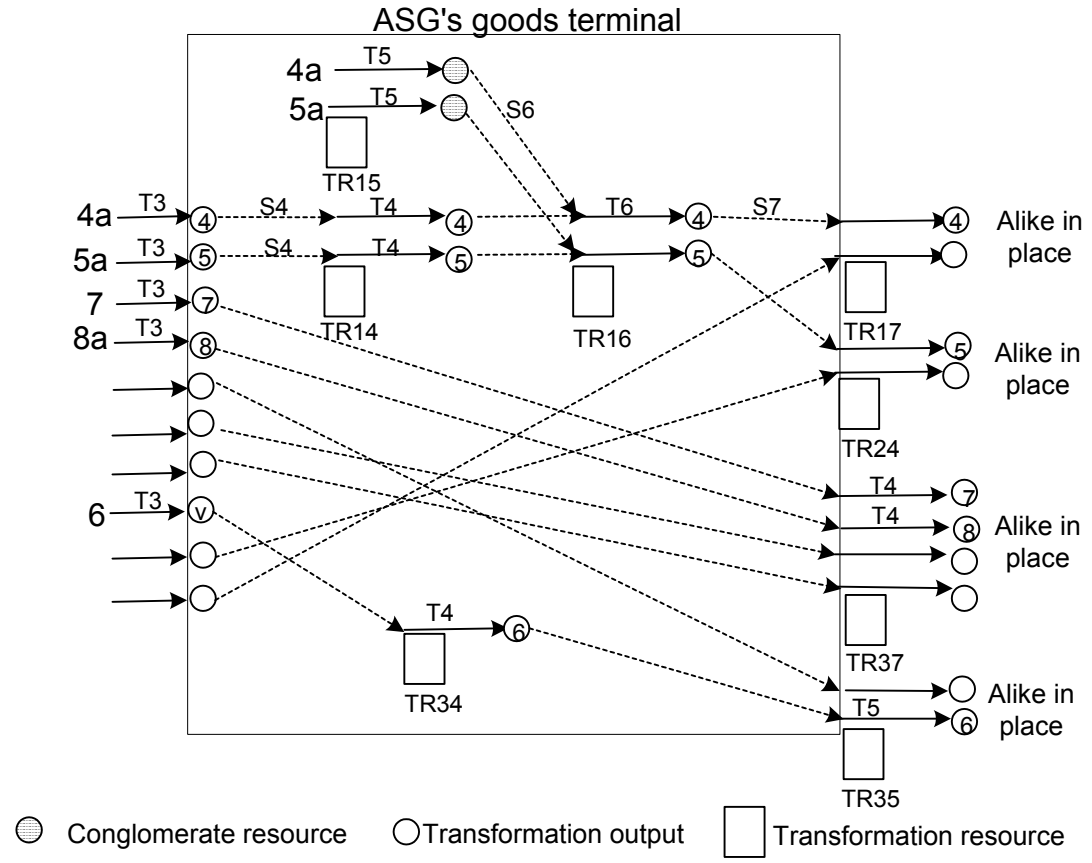


Figure 7.3 The ASG goods terminal as an aggregated crossing point

From the ASG perspective the objects belonging to all these transvections are 'merely boxes' to be handled. ASG is not concerned with what is 'inside', except if it might impact on how they are handled. The fact that they are perceived as potentially alike in form makes it possible to use the same equipment for handling. However, in some cases specific features in the form dimension will require adaptations in order to be able to perform transformations. For example, ASG had to invest in specific trailers in order to be allowed to ship Dell PCs.

In this example, the transvections involved are very different with regard to how activities are organised, both before and after the crossing point. However, the objects are potentially alike in place even though the transvections are very different in other respects. This means that the objects entering the crossing points are alike in place with regard to the ASG terminal. The objects are then assigned to different trailers (TR17, TR24, TR37, TR35 in Figure 7.3) with regard to their geographical destinations. This means that a PC from Dell can be co-loaded with a PC from Hewlett Packard as well as with other objects of very different kinds. The ASG goods terminal thus serves as an aggregate

crossing point, involving a number of crossing points related to the creation of likeness in place among objects.

This example illustrates how the features of objects can change in one dimension at a crossing point and thereby be sorted in new ways.

Furthermore, transvections 4a and 5a are characterised by close complementarity from 'beginning to end', and involve PCs assembled by Dell. In relation to these transvections, one of the main tasks for the logistics provider ASG (*y*) is to coordinate the monitors and PCs so that they have the same features in the time dimension (see Figure 7.4). This means assigning the 'right' PC to the 'right' monitor. In order to do this, the time aspect is crucial. Since the transvection is characterised by close complementarity, it is important that the right kind of monitor is available when a certain PC arrives. This coordination is facilitated by the fact that the monitors are delivered to the ASG facility (*z*) on 'speculation' and a small 'stock' of different monitors are kept at the ASG facility.

This example points out that branches of transvections need to be coordinated in both time and place in line with the discussion in sections 6.3 and 6.5. However, these transvections also have to be coordinated in relation to each other in time and place. The way this can be done depends on the identity of the objects and the features in place and time that this identity brings with it. In the example below (see Figure 7.4) the two transvections share transformation and sorting resources up to the point where the respective identities bring new features that require assignment (S7) of the objects to different trailers, TR17 and TR24 respectively. After this point they are no longer alike in place.

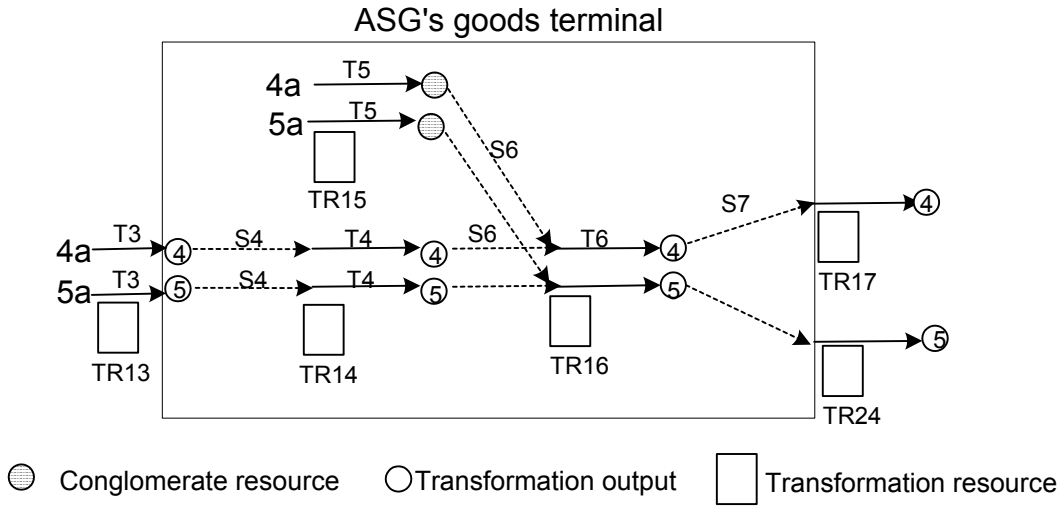


Figure 7.4 Transvection 4a and 5a in crossing points at the ASG goods terminal

This example points out the importance of not only place but also time. The objects are transformed from being alike in place to being alike in place and time.

7.5 Crossing point 5: the Siba purchasing unit

This example illustrates Siba (*g*). First, Siba selects what PCs to buy. (see sections 6.1 and 6.2 illustrating transvections 1, 2 and 3, ending up at end-users at the local Siba store, the Siba Internet store, and the Computer City store respectively) This selection is based on speculation, and is made at an aggregate level, and involves large volumes of objects that are alike in terms of form, time, place and identity. As all these objects are purchased from the same supplier, Ingram Micro, administrative costs for purchasing can be reduced by using the same sorting resource for all transvections. Hence, similarities can be utilised and economies of scale gained.

Siba then takes these 'identical' objects, them being alike in all dimensions, and differentiate them in time and place by assigning (see S6 in Figure 6.4, p. 154) them to different actors, hence giving them an identity related to different business units, (a local Siba store, the Internet store, or ComputerCity), and thereby to different transformation resources.

This example shows how the postponement of the assignment of an object to a specific actor can enable a more efficient use of transformation and sorting resources.

7.6 Crossing point 6: the Atea facility

This section deals with Atea (*γ)*, which was described in section 5.16. In section 6.9 four transvections (7, 8a, 8b, and 8c) were discussed, which cross the Atea facility. (For an illustration of this crossing point see Figure 6.17, p. 177).

When the PCs arrive at Atea they have different features in form in terms of conglomerate resources, as they originate from different assemblers, i.e. Dell, Hewlett Packard, and IBM. Nevertheless, from the customer's (VolvoIT (*ζ*)), perspective they are alike in form concerning the hardware, as the different configurations have been tried out and specified in order to be identical with regard to how they function in Volvo's PC network. However, as regards the software the PCs are not alike when they arrive at Atea.

In order for the objects to become alike in form the PCs have Volvo specific software installed. This means that all PCs are standardised from a customer and end-user perspective in order to function in the existing collection of objects of the customer, i.e. the Volvo PC network. When the various PCs arrive at Atea, they are packed in different kinds of boxes. All PCs are re-packed into standardised boxes adapted to Volvo's requirements. This standardisation of wrapping provides possibilities for standardising the handling of goods. In other words, Atea standardises the objects with regard to the form dimension in relation to Volvo IT in order to be able to create similarities in place transformation.

Further, when the PCs arrive at Atea they have different identities with regard to the end-users. This implies that the objects will be related to different requirements concerning the time and place of delivery. The PCs are to be delivered to different end-user facilities at different times. Atea hereby fills another function by adapting the objects in time and place in relation to end-user requirements. By coordinating with the end-users, Atea sees to that the PCs are delivered at the 'right' time and to the 'right' place from the end-users' perspectives.

Hence the objects assigned to this facility are 'standardised' in the form dimension concerning the features of the 'incoming' objects with regard to Volvo IT's requirements. This means that the objects are alike in the form dimension. The objects are also adapted in the time and place dimension with regard to the end-users' perspectives at this crossing point.

This example shows that how objects that are transformed in a crossing point can be perceived very differently from various counterparts' perspectives.

7.7 Crossing point 7: A trailer

This kind of crossing point will be illustrated by transformation outputs from Hewlett Packard's assembly facility (see Figure 7.1, p. 186). It was argued that the objects resulting from transformation T1 could be alike in terms of form and/or identity. After this transformation, the objects are assigned to new transformation resources with regard to their destinations together with transformation outputs from other transvections. The objects related to transvections 1, 2, 3, 5b, 6, and 8b are all related to identities with destinations in the Nordic countries (see Figure 7.5). They are therefore assigned (S2) to the same trailer (TR2) directed to the Schenker hub for further sorting. Other objects, with identities related to other regions, are assigned to other trailers.

This sorting with regard to place is done without consideration to form. However, as illustrated in the figure, some of the objects may very well also be alike in form, as exemplified with form (1) and form (2). Hence, the objects also become alike in place after this crossing point, from have being only alike in form. This example illustrates how potential likeness can be taken advantage of in one dimension at the same time as it is partly broken up in another dimension.

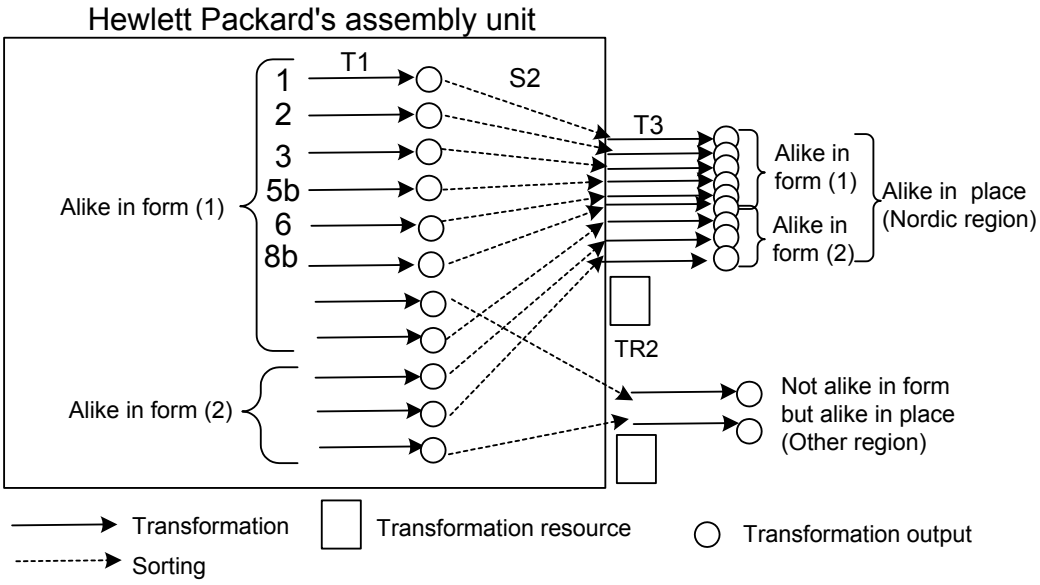


Figure 7.5 A crossing point for switching between likeness in form and place

7.8 Crossing point 8: the Schenker facility

If we take the objects discussed in the previous section as our point of departure, they are alike in place when they arrive at the Schenker logistics hub in a trailer, as they are all assigned to this facility (TR2 in Figure 7.5). Further, other objects, all alike in place, arrive from different assembly facilities to this logistics hub.

Schenker can make use of the potential likeness among objects in different transvections so that resources used for transformations can be shared. This is due to the fact that from Schenker's perspective the objects are also alike in form as they are merely perceived as 'identical boxes' and not as PCs or printers or other products. Hence, the fact that the products in the boxes are not alike in form from the customers' perspectives does not mean that they are not alike in form from Schenker's perspective.

When the objects arrive at the hub they are sorted (S3) with regard to their identities (see Figure 7.6). For example, the objects involved in transvections 1, 2, 3, and 5b are all assigned the identity of Ingram Micro and are hence assigned (S3) to the same transformation resource (TR3), the trailer bound for Ingram Micro's warehouse in Stockholm. In the same way, objects belonging to transvection 8b assigned the identity of C2000, and objects belonging to transvection 6 assigned the identity of the HP Internet Store, are assigned to TR38 and TR33, respectively.

When the objects are sorted with regard to their identities they also become alike in place. For example, all objects assigned the identity of Ingram Micro become also alike in place as they are bound for the same warehouse. As illustrated in Figure 7.6, this crossing point transforms objects from being alike in place to being alike in identity and place. It is important to note that they are not alike with regard to the *same* place before (the Nordic countries/the logistics hub) and after (for example Ingram Micro's warehouse in Stockholm) the transformation. In this example, each identity, e.g. Ingram Micro, is related to only one 'place', i.e. the Ingram Micro warehouse. However, it could very well have been the case that Ingram Micro could have had two warehouses. Then the objects would have been assigned to different trailers, depending on which of the warehouses they were bound for. Consequently, objects being alike in identity does not necessarily mean that the objects are alike in place, even if this is often the case. This further implies that identity and place are closely related but they are still separate dimensions.

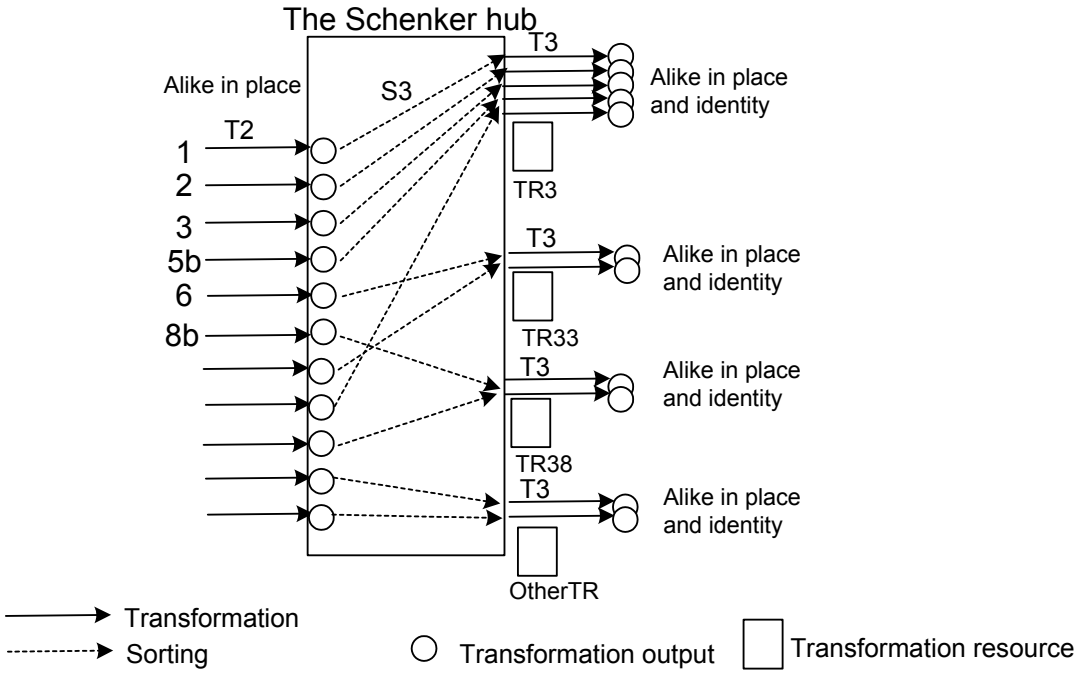


Figure 7.6 The Schenker hub as a crossing point

In this case, the objects are sorted from being alike in one dimension of place to a new dimension of place. The sorting by identity means that the objects that are assigned to the same trailers also become alike in place - related to this new identity. The objects' features in the place dimension have thus changed compared to their features in this dimension 'before' the crossing point, i.e. the transvections have been redirected in the place dimension.

This example illustrates how the identity of an object sets some limits with regard to how the object can be sorted but this also depends on how the transvection crosses other transvections. When the objects in this example are assigned to the same transformation resource due to their likeness in identity, they also become alike in place. This, in turn sets some economic limitations regarding how they can be further sorted. The economic limitations are related to the fact the firms need to capture economies of scale by using the same transformation resource for the undertaking of many similar activities.

7.9 Summing up the crossing point analysis

This chapter has illustrated how objects undergo changes at crossing points. A crossing point is defined as a transformation resource to which objects belonging to different transvections are assigned. The transformations undertaken at these crossing points result in the objects being changed in one or more of the following dimensions: form, time, place. An object can also be assigned to a certain actor, i.e. it can be assigned an identity. The reason for objects being assigned to the same transformation resource is related to the objects being potentially alike in one or several dimensions. These potential likenesses can be taken advantage of in a way that creates economies of scale in transformations.

An important issue concerning the utilisation of transformation resources is that it is not given how a specific object is assigned with regard to alternative transformation resources. This means that once an object is assigned to a transformation resource some features might be 'locked' that restrict it from being assigned to other transformation resources that would be advantageous from some other point of view. Depending on which actor decides how an object is to be assigned, different features of the object will be accentuated. The fact that different actors perceive objects in different ways enables different features to be focused on when objects are assigned to transformation resources. The ways that likeness can be created is not a given, but is closely related to the perspectives of actors. This means that 'potential likeness' from one actor's perspective will perhaps not be perceived as 'potential likeness'

from another actor's perspective. This difference in perspectives provides a foundation for the shaping of variety in distribution networks. Different firms will from their own perspectives, take decisions concerning sorting of objects related to what they consider 'efficient sorting', and the results will be perceived differently by various actors. The degree of efficiency that can be obtained is related to the use of a certain transformation resources in terms of how many and which objects can be assigned to this transformation resource. Furthermore, each transformation needs to be considered in relation to the succeeding transformations and sortings. The degree to which an actor is aware of the succeeding activities and their nature will therefore also be an important condition for how objects are assigned. This issue is dealt with further in the next chapter, focusing on sorting.

Some conclusions from this chapter can now be drawn. (1) One is that the utilisation of crossing points is essential for obtaining efficiency in distribution networks. With regard to a single crossing point, the logic is that the more objects identified as alike in some dimension and thereby assigned to a certain crossing point the better, since economies of scale can be obtained. (2) It is therefore decisive to the efficiency in distribution networks how sorting is performed in transvections with regard to how objects are assigned to transformation resources. (3) Different conditions in the distribution network with regard to the prevailing resource structure of more or less fixed transformation resources provide the foundation for how objects can be assigned to different transformation resources, and thereby how potential likeness can be taken advantage of. For example, some transformation resources can be adapted in different ways and thereby increase flexibility in how likeness can be created. It may also be possible to increase the capacity of a transformation resource, so that more objects can be assigned to it. Some transformation resources are fixed, but a change in sorting resources, e.g. new information systems, might still enable sorting in new ways and thereby make better use of the fixed transformation resources.

The nature of the transformation resource structure and the way objects are sorted within this structure with the use of sorting resources therefore plays a crucial role for the creation of variety in distribution networks. Consequently, sorting is fundamental to the creation of variety. In the next chapter sorting is elaborated on in greater depth. Chapter 9 then returns to the main phenomenon approached in the thesis - variety in distribution.

8 Sorting

Crossing points, embodied as transformation resources, were highlighted as a central aspect of distribution networks in chapter 7. Each of these is part of a larger structure, involving a very large number of more or less interrelated transformation resources. They are very different in nature. For example, some are quite fixed, not easily moved or changed in the short run. Examples of such transformation resources are warehouses, goods terminals, and production facilities. Others are less fixed, for example, light assembly equipment, trailers, and forklifts. In every firm, a more or less 'fixed' resource structure is available at any given point in time. This means that from different firms' perspectives, some part of the resource structure can always be regarded as 'given'.

Sorting means making use of this transformation resource structure. By selecting and assigning objects the transformation resources are utilised. The assignment of objects results in an activity structure composed of transformations as well as sortings. How objects are assigned is partly related to the nature of the transformation resource structure per se, in terms, for example, of the capacity and flexibility of each resource. Furthermore, sorting resources play a crucial role in determining how objects are sorted. Sorting resources include information systems, databases, product catalogues, etc. The assignment of objects to transformation resources with the use of sorting resources is the key to how objects are transformed in time, place, form and identity in the distribution network. Furthermore, by assigning objects among transformation resources, the transformation resources are tied together into a resources structure.

In the previous chapter it was pointed out that it is essential to use crossing points to obtain efficiency in distribution networks. Each crossing point has certain 'internal' features in terms, for example, of capacity. However, each crossing point also needs to be seen in relation to how its connections to other crossing points since the output of one crossing point is input in another. This means that if we are interested in efficiency in distribution networks our focus should not only be on efficiency in individual transformation resources but also the transformation resource as part of a larger resource structure.

By assigning objects to different transformation resources, potential likeness can be taken advantage of. The fact that each transformation resource is linked to others as a result of their being parts of a larger structure thus provides some opportunities as well as restrictions in terms of how the objects can be sorted.

Taking advantage of potential likeness in one dimension in one transformation resource might limit the possibilities of taking advantage of potential likeness in the same or other dimensions in another transformation resource. By giving objects certain features some possible future directions of the transvection become locked, while others are opened up. One of the main issues for firms is therefore how potential likeness among objects can be taken advantage of in different dimensions in a cost effective way, not only with regard to single transformation resources, but also in a transvection as a whole and among transvections. For example, assigning an object to an end-user at an early stage in a transvection sets economic limits for how it can be assigned in the place and time dimensions. Keeping objects un-locked in terms of end-user identity and, instead, changing the identity many times along a transvection can result in flexibility in the time and place dimensions, providing more options for creation of likeness in these dimensions with regard to other objects and thereby obtaining economies of scale in transformations.

The aim of this chapter is to discuss sorting as a phenomenon related to some aspects identified in the frame of reference in chapter 2. In line with the introduction above, the way sorting is performed is closely related to the underlying structure of transformation resources. With this as our point of departure, sorting can be discussed in terms of how the resource structure is used by firms, and thereby activated.

In the following discussion, sorting is dealt with in relation to some themes elaborating on these activity structures. First, sorting is discussed in relation to postponement and speculation in section 8.1. Second, sorting is discussed in relation to similarities and complementarities among activities in section 8.2. Third, likeness among objects is related to sorting in section 8.3.

8.1 Sorting in relation to postponement and speculation

Sorting and postponement

‘Pure’ postponement implies that no transformations are performed until a selection has been made by the end-user, placing an order. This means that the end-product is specified in identity with regard to the end-user from this point on. This further implies that the involved transformations need to be coordinated with regard to where it is directed. The ‘early’ assignment of an end-user identity, characterising transvections based on ‘pure’ postponement, also has consequences for how the objects can be sorted in terms of time, place, and form.

In this way, the conglomerate resources are assigned the identity of the end-user at the very first sorting, and the identity does not change along the transvection, i.e. the identity of the objects is the same from conglomerate resources to end-product. In this type of transvection all transformations are closely complementary and hence sequentially dependent along the whole transvection, meaning that the objects involved never change identity until the end-product reaches the end-user. In order to ensure that the end-product ends up with the right features from the end-user's perspective, the coordination of transformations is crucial. The way objects are assigned therefore becomes critical. When many actors are involved in a transvection the coordination of transformations needs to be accomplished across firm boundaries. This coordination, in turn, requires exchange of information about the features of objects, so that the transformations can be coordinated with transformations being parts of other transvections, utilising the same resources within each firm. This highlights the importance of sharing and accessing sorting resources, such as databases and information systems. Owing to the strong sequential dependence, this kind of transvection is sensitive to disturbances. If some part of the transvection is disturbed for any reason, this can affect the coordination of the entire transvection. The degree of disruption will depend on the time schedules of the actors involved: the greater the time margin, the smaller the risk of disturbances. The capacity of the shared transformation resources is also crucial when it comes to disturbances. This is owing to that the capacity of one transformation resource is related to how other transformation resources can be used in succeeding transformations.

Since the identity of the objects is the same along the whole transvection this needs to be taken into consideration when discussing the possibilities of creating likeness among objects. This also means that the way a certain object can be assigned is determined partly by the identity and partly by which other objects it can be sorted with and their respective features.

In order to allow the objects within this kind of transvection to be sorted with other objects, exchange of information concerning the objects is crucial. For each firm involved in the transvection, this means coordinating these objects with regard to other objects in a way that does not 'interrupt' the transvection. Hence, coordination in time and place is crucial, both regarding the sequential coordination within the transvection and the coordination across transvections, related to the utilisation of specific transformation resources.

In order to be able to take advantage of potential likeness among objects in transvections characterised by postponement, the resources involved need to be organised in a way that allows this. How this is done is related to the 'degree and nature of specification' allowed with regard to the end-user. A specification 'in detail' concerning form, place, and time, of the end-product requires different organising than if one or all of these three dimensions are more 'open'. The situation will be different where the form dimension is locked to certain very specific conglomerate resources or if the end-user is more flexible in what conglomerate resources are used, because this impacts on how the resources need to be organised. Organising the resources in a way that allows objects to be sorted in certain ways with regard to different dimensions therefore becomes crucial in transvections characterised by postponement.

Sorting and speculation

Pure speculation[82], in turn, means that each transformation involved in a transvection is triggered as a result of the speculation of some actor. In pure speculation the objects are not assigned an end-user identity until the end-user selects the object from a pre-defined collection of objects, being the result of speculation. As compared with the transvection characterised by postponement, the objects in this transvection change identity at least once. This implies that the objects are successively given new identities, not related to an end-user but to different actors who are involved in the transvection. Hence, every time an actor involved in the transvection selects an object from the collection of objects resulting from the speculation, this results in a change of identity. These changes in identity can be said to lead to a high degree of 'decoupling' among parts of the transvection. This 'decoupling' implies that the main coordination of the activities takes place within the firms involved in these decoupled parts of the transvection. i.e. where the objects change identity due to speculation. This is a result of the aim of making internal activity structures more efficient from the perspective of the firms involved in each part of the transvection. The activity coordination within firms may then achieve a high degree of similarity in internal operations as a result of the efforts to make use of transformation resources as efficiently as possible.

The decoupling of parts of the transvections in terms of the changing identity of the objects is related to the flexibility in term of how objects can be sorted by time, place, and form. This type of transvection is therefore not as sensitive to disturbances as the type characterised by postponement. This is owing to that

[82] With regard to the empirical material, transvection 6, discussed in section 6.8, illustrates pure speculation.

the ‘decouplings’ of the transvection can be seen as ‘buffers’, often embodied as inventories of objects.

Objects are assigned to different collections, as illustrated in Figure 8.1. The composition of the collections is a result of speculation from a supplier point of view with regard to how the customers will select. For example, firm (b) speculates when selecting different objects to be assigned to a collection of objects. Firm (c) then selects an object from this collection of objects. The figure also illustrates how the objects of a focal transvection (marked in bold) successively change identity from (a) to (b) to (c) and finally to the identity of the end-user.

From an end-user perspective this type of transvection allows for selection from the collection of objects held by (c). These objects have predefined features in form, place, and time. The end-user thus has no possibility to influence the objects’ features, more than to select from a pre-defined collection of objects. However, the end-user can turn to other suppliers, providing other objects. Regarding the coordination of activities, there is little coordination between the end-user and the rest of the transvection. This is to be compared with the transvection characterised by pure postponement, requiring a different kind of organising among the involved firms.

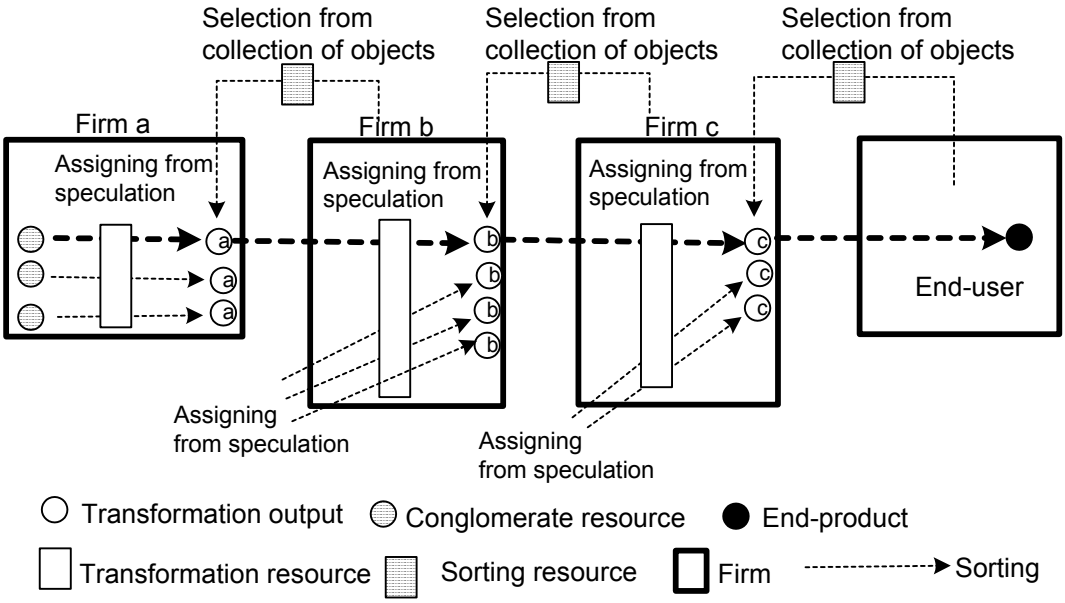


Figure 8.1 Speculation and sorting

Implications for sorting

The most common type of transvection is characterised by both postponement and speculation, but in different parts of the transvections and in different dimensions. For example, some parts of the form transformation can take the form of speculation so similarities can be created in form transformation. However, the final form transformation may be postponed until an end-user order arrives. Mixing speculation and postponement in a transvection has some effects on the dependencies in and among transvections. Depending on in what dimensions transformations are postponed, some parts of the transvection can be more or less decoupled from other parts and from other transvections. This decoupling, in turn, can enable flexibility in the way objects are sorted as well as a means for creating similarities among transformations.

The way transvections are triggered has a great impact on how transformations are organised in transvections. The points in the transvection where objects get specific identities set some limits for how they can be sorted in relation to other objects. This, in turn, affects how transformations can be organised. By changing the identities of objects in a transvections, flexibility in sorting can be provided.

Some conclusions concerning how postponement and speculation relate to each other in different dimensions can now be discussed. Speculation in form transformation means that some degree of flexibility in the time, place, and identity dimensions can be obtained. Postponement of form transformation, on the other hand, means that the object is directed to a certain customer, e.g. distributor, or end-user identity. Therefore, postponement of form transformation requires that the time and place transformations need to be organised in accordance with this ‘locked’ identity. How the activities are organised has implications for how the objects can be co-ordinated with regard to time and place transformation. Postponement in form has an impact on flexibility with regard to how objects can be sorted in the time and place dimensions. Form transformation can also be performed at different steps in the transvection, some form transformation being triggered by speculation and some, later, by postponement. By combining speculation and postponement in one dimension, e.g. form, the flexibility with regard to how objects can be sorted in time and place can be greater in comparison to pure postponement.

The use of the principle of postponement can admit end-user involvement in specifying the features of objects in form, time, or place. For example, form postponement can enable end-user involvement in the selection of

conglomerate resources, while speculation does not. However, postponement in form transformation does not automatically mean that conglomerate resources can be selected. It may also be the case that there are some predefined combinations to select from. Nevertheless, the form transformation can still be postponed in relation to the customer. Furthermore, postponement can also allow customers to specify place of delivery and time of delivery. The degree of customer involvement impacts on how transformations need to be coordinated and how similarities among activities can be created and made use of in terms of economies of scale. This type of customer involvement in time, place, and form is not possible if pure speculation is applied. However, by applying speculation in parts of the transvection and postponement in others, the end-user can be allowed some involvement. For example, it might be possible to get deliveries to the end-user's facilities at a specific time. In this case, all transformations are triggered by speculation until the very last time and place transformations that are postponed until an end-user order arrives. Further, even if the end-user cannot be involved in the specification of the form per se, there is often a possibility of choosing from different predefined objects. It may also be the case that very late modifications in form can be made with regard to a specific end-user's requirements, which then allows for some end-user involvement. By applying postponement in some dimensions and speculation in others a variety from an end-user perspective can be obtained.

8.2 Sorting in relation to similarities and complementarities

Sorting and similarities

One of the main implications of transvections characterised by speculation is that they provide possibilities of creating similarities among activities, due to the way activities and resources are organised in this kind of transvection. However, as pointed out in the section above, similarities can also be created among transvections characterised by postponement and thus close complementarity, since parts of different transvections may be similar with regard to common resource use. This applies to sortings as well as to transformations, as illustrated below in Figure 8.2.

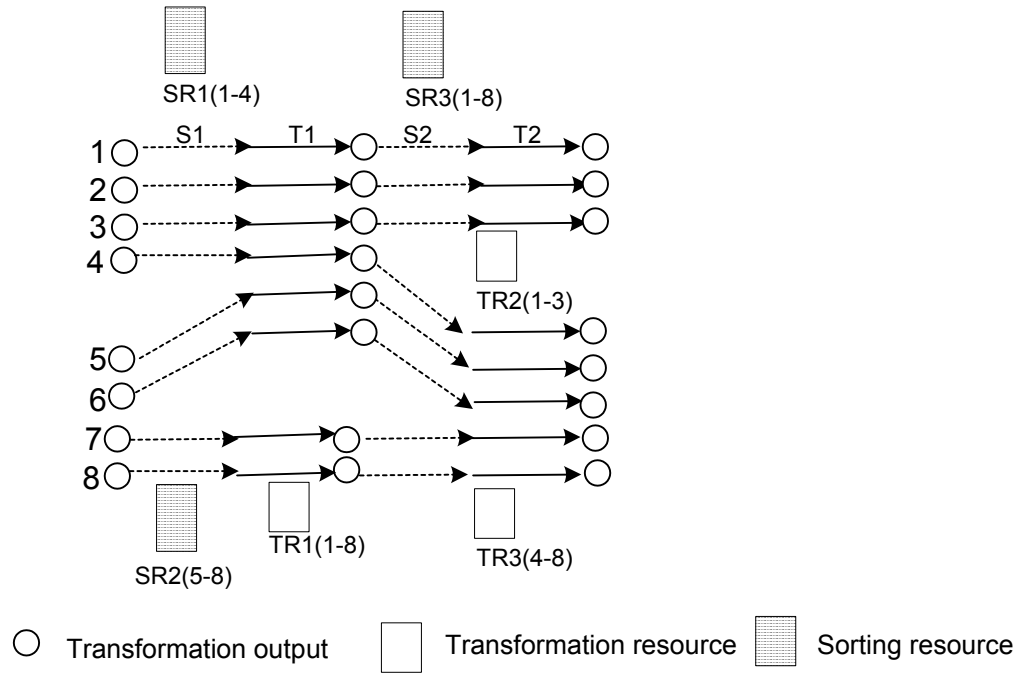


Figure 8.2 Similarities with regard to sortings and transformations

The parts of transvections 1-3 illustrated are similar with regard to all sortings and transformations. Further, in relation to transvection 4 these transvections are similar with regard to S1, T1, and S2. However, the transformation output of T1 in transvection 4 is assigned (S2) to a different transformation resource (TR3) than the transformation outputs of T1 in transvections 1-3, which are assigned to TR2. After this point, starting with T2, transvection 4 is no longer similar to transvections 1-3. All transvections are, however, similar in relation to (S2) as they all make use of the sorting resource (SR3). After (S2) the objects are assigned to two different transformation resources (TR2 and TR3). Further, all transvections make use of TR1, which implies that they are similar with regard to (T1)

The figure also illustrates how both sequential and parallel dependencies sometimes need to be handled simultaneously. Imagine that the transformations in transvection 3 are closely complementary with regard to an end-user. The other remaining transvections are characterised by speculation. All these objects are, however, assigned to the same transformation resource (TR1), and the activities (T1) are similar. The transformations (T1) therefore need to be coordinated with regard to each other. At the same time, transvection 3 also needs to be coordinated as a result of the sequential dependence resulting from it being characterised by close complementarity. The remaining transvections also need to be coordinated sequentially. Hence, similarities among transvections result in a need to handle both parallel and sequential

dependencies among the activities. However, the mix of the nature of the transvections to be coordinated will have an impact on how this needs to be handled.

Sorting and complementarities

While one of the main implications of transvections characterised by speculation is that they provide individual firms with certain possibilities of creating similarities among activities, one main implication of postponement is that it implies close complementarity, as the result of objects being directed to a certain actor. Hence, when an object is assigned a new identity the object becomes locked to this actor, which we refer to as A. This means that the activities undertaken from the point when the object is assigned the identity of A until the object is delivered to actor A, are closely complementary. However, this does not mean that the way the objects are sorted is given. The limitations concerning the close complementarity are only restricted by the fact that the object reaches actor A with some features specified by A. These features can be obtained in various alternative ways, i.e. by the activation of alternative parts of the total transformation resource structure. In Figure 8.3 below, three different ways of landing object A at actor A is illustrated. For example, the illustrated part of transvection 1 activates TR2 and TR4, transvection 2 activates TR1, TR2, and TR6, and transvection 3 activates TR3 and TR5. How object A can share the transformation resources with other objects is decisive for which of these resources to activate. By assigning objects to the same resource, likeness can be created and similarities among activities utilised.

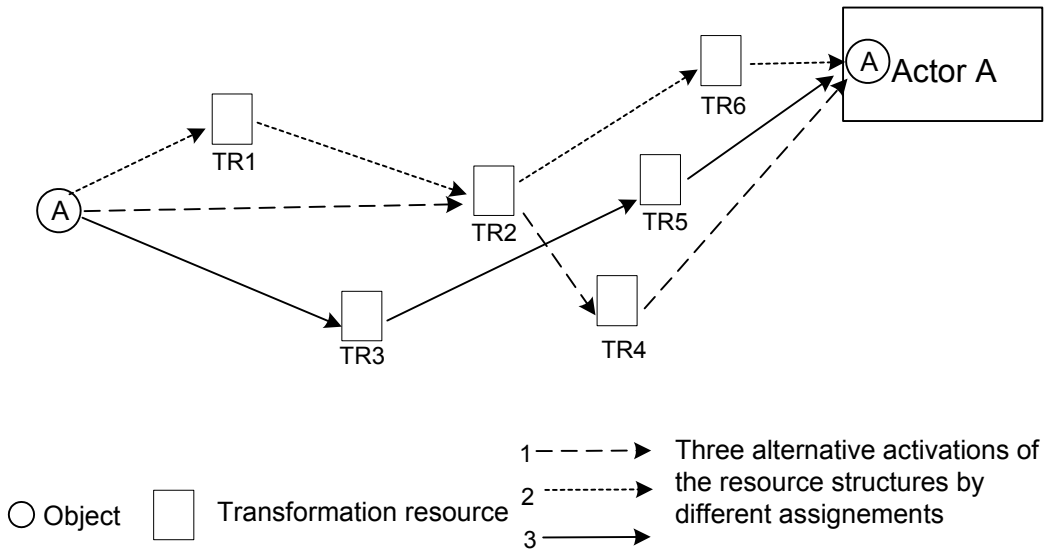


Figure 8.3 Alternative assignments of an object in a resource structure

This implies that by identifying potential likeness with regard to transformation resources, similarities can also be utilised in transvections characterised by close complementarity. The way objects are sorted is related to the fact that more or fewer similarities can be utilised in relation to other transvections. This is a critical issue for firms, as the capturing of similarities is closely related to efficiency in distribution networks. For firms involved in transvections characterised by close complementarities, the possibilities of assigning objects to the same transformation resources is a crucial aspect for capturing similarities and thus efficiency in distribution networks.

8.3 Relevant boundaries for sorting

The way potential likeness among objects can be taken advantage of is, to some extent, discussed above. However, the fact that features of objects are partly a matter of perspective also needs to be taken into consideration. This implies that different features are accentuated for different actors, and tht one must ask how far the actors can 'see' into the network and how the actors interpret what they see. This is related to what Dubois (1998) refers to as a firm's awareness and influence boundaries for a given activity structure.

From the perspective of this study, the awareness boundary sets the conditions for what potential sorting possibilities an object has from a specific actor's point of view. It relates to what transformation resources can be identified and made accessible for the sorting of an object, and to the identification of other objects and the creation of likenesses among these objects. The awareness boundary is not static but changes as firms interact and get to know more about each other's resources and operations. The awareness boundary can change, and new objects as well as new features of objects can be identified. This, in turn, can affect how objects are assigned and thereby how potential likeness among objects can be taken advantage of. Furthermore, new transformation and sorting resources can be identified and activated.

The influence boundary delimits the structure a firm can influence in terms, for example, of how objects are assigned to transformation resources as well as the actual features of these transformation resources. For example, if a customer can influence a supplier to adapt its logistics hub to the handling of this firm's objects, this may mean that the objects can be sorted in new ways, and new potential likenesses can be taken advantage of by the customer. However, adaptations towards one customer can limit the supplier's possibilities of handling the objects of others. This points out that the adaptation of transformation resources can both increase and decrease the possibilities of

taking advantage of potential likeness, but in different parts of the network and from different actors' perspectives.

It is therefore important that the awareness boundary is wide enough to enable the firm to identify the effects of a certain extension of the influence boundary in order to limit the risk of sub-optimisations in the network when trying to take advantage of potential likeness among objects when sorting.

Our main conclusion in relation to sorting is that as a phenomenon it is central to understanding variety in distribution. This chapter has shown how sorting is related to the organising of activities and the use of transformation resource structures, and how sorting creates likeness at crossing points, which seems to be a prerequisite for the possibility of providing variety. We now go on to elaborate on the main phenomenon approached in this study – variety.

9 Variety

Variety is the phenomenon in focus in this study. Chapters 1 and 4 illustrate variety in distribution networks with regard to different 'distribution channels', varying in delivery times to end-users, customer service and customer support, direct and indirect distribution, type of middlemen, and breadth and depth of assortments offered to the end-users. In chapter 5, variety was discussed in terms of the various ways in which production and distribution of PCs can be organised and of different situations from an end-user perspective.

This chapter elaborates on variety in distribution. We take our starting point in what Alderson (1954) labels 'technology of use' and 'technology of production'. We start with an end-user perspective, discussing variety with regard to technology of use in section 9.1. Section 9.2 deals with variety in technology of production, embodied as a structure of transformation resources activated by the use of sorting resources. Section 9.3 discusses 'the object' in terms of its relation to the technology of production on the one hand and the technology of use on the other. The 'perspective of the object' is important, as the object links the two sides together as objects are transformed in the setting of the technology of production to eventually end up in the 'assortment of the end-user'. The chapter ends with a discussion on the implications of variety for actors involved in distribution in section 9.4.

9.1 Variety and the technology of use

From an end-user perspective, variety in distribution is regarded from the logic of 'technology of use'. Alderson (1954) states that for an end-user, the product has:

> *...the possibility of contributing to what might be called the potency of assortment. That is the range of capacity for future action provided by all of the goods in his possession. The consumer judges the product in relation to anticipated patterns of behavior and considers how it will fit in with other products he expects to use.* (ibid., 1954, p. 10-11)

On the basis of this quotation we can discuss variety in terms of how end-products 'fit in with other products, the user expects to use'. These products need to fit in the technological context of the end-user. The 'consumer judges the product', making what knowledge the end-user has about the end-product per se in terms of its functions and features and his or her experience related to

the use of the end-product important. These issues, the context of the end-user, and the end-user's perception of the end-product with regard to three dimensions, form, time, and place, are discussed below. PC users will be used as examples. The different contexts set requirements on the end-products and their features, and each end-user has certain knowledge about the end-product and its use. For example, in terms of PCs, different end-users have different knowledge about how a PC is designed with regard to the types of components included, how a PC functions, and how it can be used. We therefore now turn to the end-products, their features, and how they are perceived by the end-users. The features are also discussed in three dimensions: form, time, place.

A general distinction can be made between the private consumer, who uses the PC in his or her home, and a business user. Furthermore, there is also variation within each of these two categories with regard to the different contexts.

Form context of end-users and form features of end-products

First, the *form context* relates to aspects concerning how the end-product fits together technologically with other products as well as with the 'technological context' for example with regard to the end-users' facilities. The context of a home is very different from a network environment at a large firm. A 'typical' end-user at a home uses a PC for word processing, spread sheets, playing games, etc. In order to do this, software is needed. The end-user might also want to be able to print documents, so a printer is also required. In this context, it is important that the end-product, i.e. the PC, fits together with the printer and the software. Furthermore, if the end-user wants to use the Internet there need to be certain devices, for example a modem or a broadband connection to the home. Furthermore, a socket for electricity supply is needed. Hence, the end-product needs to be connected both to other products as well as to the facility, the home. The degree of technological dependency in the home is quite limited in this case as the socket, for example, is of a standardised nature within certain geographical areas. The same is true for the connection between the printer and the PC, which has more or less standardised interfaces. However, some printers work better with some PCs there is not a total lack of technological dependency. The same is true of software. Some software is designed for PCs and some for Macintosh computers. Although the technological interfaces are more or less standardised the products' functioning is very interdependent. The functioning of the printer depends on the functioning of the PC.

For a business user, a PC might be required to communicate with thousands of PCs across national borders in an extensive network environment. In such a context the technological dependencies are of utmost importance in order for the whole network environment to function satisfactorily. In such a context the standardisation of hardware and software is of great importance, both with regard to the operation of the system but also for service reasons. A business end-user has to think more about the fit with other products, not only the products used by himself but also products used by others.

How the *form features* of an end-product are perceived by an end-user is linked to the knowledge the end-user has concerning this type of product. In the case of a PC, therefore, this degree of knowledge determines whether the PC is considered as a 'system of interconnected components' or as a 'black box'. This perception is also related to how the PC can be integrated into the end-user's context. If the PC is considered a 'black box', there have to be standardised interfaces to other products. However, if it is perceived as a system of components it can be integrated into the context in more ways, thanks to possible adaptations of the set of components to better fit into a certain network environment, for example. The level of knowledge hence affects the way the end-product fits into the context of the end-user. Different end-users will have different requirements. Some end-users want to be able to tailor a solution in terms of specifying components to fit the end-product into an existing form context in a certain way. Others have very limited knowledge of the end-product and strive for standard solutions with standardised interfaces to the form context.

The user's knowledge of the end-product will also affect how end-products are selected. The end-user can be more or less involved in the 'design' of the end-product. One end-user might want to select specific components and how they should be linked in a certain way. Another end-user might not want to be involved in the specification of form features at all. Instead, he or she wants to have a standard PC of a well-known brand. With limited knowledge about PCs, this end-user needs help in this choice. He or she can turn to a local dealer, where there are a number of such PCs to chose from and where help is offered.

Time context of end-users and time features of end-products

The end-users also have different *time contexts*. This is related to the fact that for example when the PC is delivered can be more or less important. Some end-users will need a PC very fast, as they are very dependent on it to perform some operations. The extent to which the different products are interdependent plays

a crucial role in this sense. For example, if the PC breaks down, neither the printer nor the Internet connection can be used. This implies that in some situations the time for delivery can be crucial, as some other products cannot be used if the end-product is not functioning. In a business environment, the time context is often more important than in the home.

This sets different requirements on the *time features* of end-products. For some end-users short delivery times are crucial. This is especially true when the end-product is a part of a larger technological system that is dependent on the functioning of this end-product. For other end-users short delivery times are not the main issue. Instead, it might be very important to know exactly when the end-product is delivered, since the installation of an end-product may need to be prepared in terms of locations and with regard to other objects to be installed at the same time. Furthermore, specific personnel might be needed to receive and install the end-product when it arrives. The end-product may also be intended to be used as input in some transformation. This means that the delivery of the end-product needs to be coordinated with regard to the end-user's transformations. In other cases, it might be enough for the end-user to choose between different specified alternatives. For example, the end-user can choose between delivery at 8a.m. to 9a.m. and 1p.m. to 2p.m. When end-users go to a local dealer they are limited to the opening hours of stores. This is also the case when end-products are delivered to some 'pick-up' location. One reason suppliers change to 'pick-up' locations rather than post-offices is that 'pick-up' locations, as for example grocery stores, often have more suitable opening hours for private consumers.

Place context of end-users and place features of end-products

The *place context* refers to the end-user's situation with regard to the location of its facility. This is related to the location of the facility in terms of service providers, suppliers, and infrastructure. Depending on the place context, deliveries of end-products and service can both be more or less smooth from the end-user's perspective.

When the end-user chooses to go to a dealer, geographical proximity is very important to the end-user. The end-user is unable to influence the end-product's place features except by choosing which dealer to go to. In some cases, however, the end-products are delivered to the end-user facility or to some 'pick-up' location, for example a post-office or a grocery petrol station. This is the case with different kinds of mail order and e-commerce solutions.

Each end-user is related to a certain end-user context, which can be divided into a context in form, time, and place. Each end-product needs to fit into this context and therefore needs to have certain features. The requirements of the features of the end-product are also related to the knowledge of the end-user concerning the end-product and the context of the end-user.

Having dealt with variety in the 'technology of use', from an end-user perspective, we now turn to the perspective of those who provide this variety, the suppliers, and their contexts, which can be said to represent the 'technology of production'.

9.2 Variety and the technology of production

If variety from an end-user perspective can be linked to the 'technology of use' variety from a supplier perspective can be discussed in relation to what Alderson (1954) refers to as the 'technology of production'. In a similar way as the end-user strives to increase the 'potency of assortment' the actors involved on the supplier-side strive to create their own 'assortments', in terms of collection of objects, based on their logic related to the 'technology of production'. The fundamental idea underlying this is that variety based on the logic of the technology of use needs to be approached in a way that takes the economic aspects of the logic of the technology of production into consideration.

The technology of production is embodied as the transformation resources and sorting resources made used of when actors supply end-products with different features for different end-users. From a supplier perspective, variety in distribution is mainly an issue of how resource structures are used in different ways.

According to Gadde & Håkansson (2001, p. 79):

> *The efficiency of the activity structure is contingent on the way the resources in the network are utilised. In a short-term perspective, when the resource structure is perceived as more or less given, increasing similarity in resource utilization enhances efficiency.*

If selection was the main sorting activity from an end-user perspective, assigning is the main sorting activity from a supplier perspective, although selection is also of great importance. The focus on how assignment of objects to transformation resources is performed is central, as it determines the

conditions for economic efficiency. From a supplier perspective each object involved is somehow a result of the activation of this resource structure as the objects are assigned to transformation resources by the use of sorting resources. In order to obtain economies of scale when making use of transformation resources it is important to identify and take advantage of potential likenesses among objects. Hence, from the point of view of the logic of 'technology of production' the creation of likenesses among objects is related to the efficient use of individual transformation resources.

This 'existing' structure of transformation and sorting resources is the foundation for technology of production. However, the 'existing' resource structure is not fixed in the long run, as argued by Gadde & Håkansson (2001, p. 79):

> *In the long run, however, the resource structure may be changed. The resources available can be combined in new ways, which introduces dynamics and innovation.*

Although the resource structure is dynamic by nature, in the long term, it can be regarded as quite stabile in the short term. Therefore, from the supplier point of view, parts of the resource structures can be regarded as fixed and '*fixed resources must be efficiently utilised*' (Ford et al., 1998, p. 47). In the short run, the main challenge for a supplier is thus to make use of the existing transformation resource structure as 'efficiently as possible'. In the long run the challenge also lies in trying to change the resource structure, for example, by introducing new resources.

In the chapter on sorting, postponement and speculation were highlighted as two, in principle different, principles for activation of the resource structure. It was shown that in both cases, crossing points play a central role for how efficiency in distribution networks is obtained. If we turn back to the need for variety from the user's perspective it is obvious that this variety can be obtained by activating different parts of the resource structure and by applying different principles, i.e. postponement and speculation. The analysis in chapter 6 pointed out that the ways in which resource structures are activated with regard to these principles are numerous, displaying varying degrees of postponement and speculation. Although they are very different they both play a central role in approaching the variety in technology of use and they both do it by utilising crossing points.

If each object was assigned only out of consideration of its own features and not of consideration to how it is alike with others, it could very well provide the variety on the user side. However, this is not efficient utilisation of the resource structure as a whole and would lead to expensive end-products from the end-user perspective. By making use of common resources, in terms of crossing points, and thereby obtaining economies of scale in transformation, the suppliers can provide a certain degree of end-user variety in an efficient way. This implies that the variety in the 'technology of use' side of the network has to be balanced against the variety in the 'technology of production' side of the network. By creating likeness in some points in the network, variety can be obtained with regard to the perspective of technology of use.

This indicates that all firms benefit from sharing resources. For each firm involved, it becomes crucial to identify objects to which 'its own' objects are potentially alike and transformation resources to which they can be assigned. Access to transformation resources becomes crucial.

As argued above, variety with regard to the end-user perspective can be obtained in different ways. First, the nature of the available resource structure matters. For example, the capacity of different resources is crucial, as the output of one transformation resources provides input to others. By changing the capacity of some resources, the efficiency of the resource structure as a whole can be improved. One example is using two lorry drivers instead of one. In a resource structure activated by postponement, this kind of increase of capacity can be of great importance. Furthermore, the flexibility in terms of what different operations that can be performed in a transformation resource is important to how efficiently the resource structure can be used. For example, the introduction of more flexible equipment for moving material changes the ways that objects can be handled, opening up new ways of making use of potential likeness among objects. This means that the variety on the user side can be provided in new ways. Furthermore, the introduction of new kinds of sorting resources also affects the way the existing transformation resource structures can be used. For example, the introduction of computer based information systems enhanced the possibilities of sharing information between firms. Together with more flexible transformation resources, this provides opportunities for using postponement more and providing the users with different degrees of customisation, with regard to form, time, and place dimensions. For example, the introduction of the Internet as a phenomenon provided a tool for sharing information with end-users in a cost effective way. This opened up for different e-commerce solutions that could be used as tools for selection by end-users. By combining the possibilities provided by e-

commerce solutions with flexible production methods, flexibility in providing end-user variety can be obtained.

With regard to the principles of postponement and of speculation, technological development has improved the possibilities of making use of postponement strategies. For example developments in information technology, flexible manufacturing equipment, and flexible equipment for materials handling have enabled postponement strategies to be used increasingly. The increasing use of postponement compared to speculation was predicted by Bucklin (1965) who argued that, for example, the increasing use of air transport '*has the effect of reducing the relative advantage of speculation over postponement*' (ibid., p. 31). However, he also said that the increasing use of postponement would result in that '*intermediate inventories will tend to disappear and be replaced by distribution channels which have a direct flow* (ibid., p. 31). In this study we have shown that this is not quite true. Although the trend is towards activating more resource structures by using the principle of postponement, resource structures activated largely by speculation still exist. More importantly, they exist for their own sake, because they contribute to the variety in the technology of production. It is the variety in terms of the activation of resource structures that enables the variety on the end-user side to be provided. The main reason for this is that the differences between the underlying kinds of logic of postponement and speculation allow objects to be sorted in different ways, thereby making use of potential likeness among objects in various ways.

This means that with regard to different distribution approaches they should not be regarded as 'isolated' phenomena. Instead, different approaches, embodied as different types of transvections, need to co-exist in order to provide variety in different end-user contexts. This implies that it is impossible to find an optimal distribution solution: there is no such solution that can satisfy all end-user contexts efficiently. Instead, there need to be a variety of different approaches, focusing on some of the diverse end-user contexts. These approaches not only need to co-exist, they are also dependent on each other, owing to the importance of resource sharing to obtain economic efficiency.

In the classical distribution literature, on which parts of this study are based, e.g. Alderson (1954, 1957, 1965) and Bucklin (1960, 1965), distribution is mainly discussed as the distribution of the 'finished' product. Although Bucklin (1960, p. 64) argues that the production function needs to be considered as a marketing function since '*many marketing activities, such as the changing of styles and packaging, are almost inseparably related to production costs*', it is

still the distribution of 'finished' products that is in focus. As also indicated in the above quotation, the form dimension in distribution is mainly related to aspects such as 'changes of styles and packaging', and a main issue is where in the distribution channel these changes occur. The view of products coming out as homogeneous from the production line, to be differentiated in the distribution channel by sortings, as indicated by Alderson (1965, p. 33):

> *From this point of homogeneity the index of sortability rises as products move into the channels of distribution. Differences in branding, packaging, terms of sale place and date of purchase, accessories and type of installation, and patterns of use once the item enters a consumer assortment largely dissipate the homogeneity which existed as the product came off the production line.*

The present study has pointed out the importance of also taking greater changes in 'form' into consideration when studying distribution. The transvections analysed in chapter 6 illustrate the importance of sorting also in terms of form transformations. This has implications for how sorting was performed with regard to the time and place dimensions.

Objects start out as conglomerate resources ruled by the logic of technology of production and end up as end-products ruled by the logic of technology of use. The objects can therefore be said to be the link between these two kinds of logic, and consequently play an important role for how variety in the technology of production can be balanced against variety in technology of use. The objects and how they change in different dimensions when they undergo transformations is discussed below.

9.3 Variety and objects

Each object always has a set of features in terms of time, place, form, and identity. All features of objects are more or less 'temporary', as the objects continuously undergo different transformations. Furthermore, in the analyses in chapter 6 and 7 as well as in the discussion above, it became evident that objects are related to different contexts. For example, the object in the context of the end-user is very different from the object when it is transformed in a context characterised by the logic of technology of production. What is important to note is that in these different contexts the object is part of a meaningful heterogeneity from some actors' perspectives and as part of a meaningless heterogeneity from other actors' perspectives. From the point of

view of the end-user the object is regarded as part of a meaningful heterogeneity when it is seen in the context of technology of use. However, when the end-user considers the object as part of the context of technology of production, it is perceived as part of a meaningless heterogeneity, whereas for the firm undertaking the transformations ruled by the logic of technology of production, this is a meaningful heterogeneity. Different actors do not perceive an object, its features, and its context in the same way.

Nevertheless, at each point in time, the object can be ascribed a certain 'set of features' in terms of for example a specific place and time. However, even though the object can be said to have a certain feature in the place dimension, this place will have different meaning for different actors to which the object is related. Say a certain product is placed in a specific warehouse. The objective place feature can be defined in geographical terms, i.e. the warehouse is situated on the street X in city Y, etc. For the actors involved the fact that the object is situated at this specific place has different implications. For the manager at the warehouse, the important issue is to assign this object to other objects with which it is potentially alike in the form dimension or some other dimension in order to create a collection of objects that is logical from his perspective. For an end-user the place feature means a certain delivery time. How the object is placed in a meaningful heterogeneity consequently varies among the actors.

Although the features of objects change by definition after a transformation, these changes can be perceived differently from various actors' perspectives. In some cases a certain feature in a specific dimension is perceived as 'the same' and thereby fixed during several transformations from one actor's perspective but not from others. This stability in one dimension can be taken advantage of. For example, different products with very different features in form at one 'level' from an end-user perspective may be regarded as alike, perceived as having identical form features, at another 'level' by another actor. This was exemplified with PCs being very different from an end-user perspective but still packed in identical boxes. From the perspective of the actors handling these boxes the objects' form features were identical. This perception of the features as identical meant that potential likeness in the form dimension could be taken advantage of when assigned to the same transformation resource.

Objects are related to other objects. This means that an object and its apparent features will be perceived as part of a larger collection of objects and thereby be defined to some extent in terms of how it relates to other objects. For example, consider 'two identical physical PCs'. If one of them is integrated

into a network-environment as one part of a larger system, and the other stands alone in a home environment, they will be perceived very differently.

Different features of objects are thus accentuated in relation to different actors. This implies that one specific object can 'play very different roles' in different contexts. The differences in how the features of objects are accentuated lead, in turn, to the objects being sorted in different ways. Below there follows a more detailed elaboration on objects and their features in form, place, and time.

Form features of objects

The form dimension of objects can be discussed on three different levels: conglomerate resources, transformation outputs, and end-products, as well as from different actors' perspectives.

First, let us consider the form of an object from an end-user perspective. The end-user regards the object as an end-product, specified in form to fit the end-user's existing collection of objects in the form dimension. Hence, it needs to be seen in the form context of the end-user as discussed above. Depending on the end-user's context and level of knowledge, the end-user sees the form features at different levels. One end-user might be interested in participating in the specification of form features at the 'conglomerate resource' level, owing to a need to integrate the end-product in a technological context. Another end-user might see the form of the end-product as a 'black box'. The end-product's form on the level of conglomerate resources may not be of any relevance as long as the function of the end-product is in line with the specifications.

If we regard these two cases, the end-products seem very different from a form perspective from the end-users' perspectives. However, for another actor, they may be alike in the form dimension. For example, a firm involved in shipping, i.e. place and time transformation, will most likely perceive these objects as potentially alike in form, requiring the same kind of equipment for their handling. From another firm's perspective, involved in form transformation of the two objects, the objects might be perceived potentially alike as they make use of the same resources for form transformation.

Time features of objects

Time is important in several respects. First, delivery time can be crucial from an end-user perspective because internal operations depend on a certain end-product. Delivery time is closely related to the place dimension since the features of an object in the place dimension will affect, for example, the

delivery time. Keeping stock close to end-users can reduce delivery times under the condition that the object required is available in stock. Through speculation in form, time, and place, objects can be kept close to customers, ready to be delivered. However, keeping 'a total set of variants in form' in every warehouse needs to be considered in relation to the cost for doing so. Modular systems can handle this problem, postponing the final assembly late in time. Another solution might be to keep one central warehouse, with a total assortment, and focus on time-efficient deliveries from this warehouse. The time issue is consequently an important aspect, both concerning availability and delivery times from an end-user perspective and also with regard to related considerations concerning the variety in form and the costs for handling this variety. If one dimension is 'optimised' it will affect the other dimensions. By creating flexibility in sorting, in different dimensions, solutions suitable for many end-users can be created without renouncing the possibilities of capturing economies of scale in transformations.

Time is also important from the perspective of the transvection as a whole. The time from that the activation of the conglomerate resources to delivery of the end-product can be more or less crucial depending on the characteristics of the object. In the PC industry time is crucial to suppliers partly as a result of the heavy price reductions, so it is important that the objects are not kept in inventory for too long.

Time is also important in sorting when two objects with the same identity need to be coordinated. This requires coordination in both time and place. For the actors involved in the succeeding transformation, it will be important to get information concerning these objects in advance in order to plan for the transformations and how other objects can be assigned to the same resource in order to create likeness.

Place features of objects

From an end-user perspective, place is important as geographical closeness to suppliers is related to the possibilities to go and see objects 'on display' in a store, which can facilitate selection. Furthermore, the place dimension can also have consequences for where the end-product is delivered, e.g. to the end-user facility or to a pick-up location, such as a post office. As argued above, place and time are closely related in that, for example, the geographical distance between a supplier and an end-user may affect delivery times.

The different actors involved in a transvection will have very diverse requirements in terms of the place features of an object. This is related to geographical considerations from different actors' perspectives. For a firm involved in form transformation, it is important that the place where transformations take place is situated so that succeeding place and time transformations can be performed efficiently. This can be handled by keeping inventories close to end-users or by efficient time and place transformations directly to end-users from the place where form transformations are performed.

This section describes how objects can be perceived in various ways from different actors' perspectives. Even when transvections partly display a high degree of resemblance and seem more or less alike, the objects involved in different transvections can appear to have very different features from different actors' perspectives, because the features of the objects are not only dependent on features such as form, time, place, and identity, resulting from the transvection of which they are a part. How the features are perceived also depends on the other objects to which it is related and their particular features. Depending on which features are emphasised, objects are assigned into collections and potential likeness can be taken advantage of.

The objects, their features, and how they are changed and perceived by different actors thus represent the link between the technology of production on the one hand and the technology of use on the other.

9.4 Implications for actors

This section deals with the implications of the variety discussed above for different actors involved in supplying variety to end-users: linking 'technology of production' and 'technology of use'. Each firm involved in supplying products to end-users will reflect upon issues involving the question of variety. One is the degree of variety that should be offered to end-users and in what dimensions: time, place, form. Another is how a certain degree of variety can be offered efficiently.

These issues are now discussed in terms of a number of decisions each firm is confronted with. The first of these decisions is the balance between standardisation and adaptations of objects. The second concerns the balance between the use of internal and external resources.

Standardisation vs. adaptation

Standardisation of objects is linked to the ability to take advantage of potential likeness among objects in transformation resources. Adaptation, on the other hand, is linked to the possibilities of providing the end-users with objects of varying features. The balance between standardisation and adaptation is discussed in Lampel & Mintzberg (1996), referring to two different kinds of logic, the logic of aggregation and the logic of individualisation. The logic of aggregation is linked to the principle of speculation, and relies on the capturing of similarities among activities, and on economies of scale in transformations. This means that objects are assigned to transformation resources on speculation rather than being directed to any specific end-users. The most extreme strategy, based totally on the logic of aggregation is referred to by Lampel & Mintzberg (1996) as 'pure standardisation'. The logic of individualisation relates to the principle of pure postponement, as no transformations are made without an end-user order. In this case the object is assigned an end-user identity at the very first transformation. This other extreme is referred to as 'pure customisation'. The authors argue that between these two 'extremes' there is a continuum of other strategies. These strategies relate to the fact that customisation of objects can be performed in different dimensions. For example, an object can be standardised with regard to its form features but customised in time and place. Delivery, for instance, can be customised. Mass-customisation strategies, as discussed by Feitzinger & Lee (1997) are examples of such mixed strategies. This strategy is based on a modular thinking and implies that the objects are partly standardised in the form dimension, so different objects become alike in form to the extent that they can make use of the same transformation resources and at the same time provide some variety for the end-users. With regard to this kind of 'mass customisation strategies', Lampel & Mintzberg (1996, p. 29) argue that '*An important consequence of this trend is that, as consumers, we loose flexibility in one area while gaining it in another*'

With regard to the questions above, the degree of variety to provide, and in what dimensions (form, time, place) needs to be considered in relation to what variety the end-users value. From this knowledge, each firm needs to reflect on how this variety can be offered as cost effectively as possible. As argued above, this is related to taking advantage of potential likeness of objects in a way that enables efficient use of resources at the same time as offering the required variety. What resources to make use of in order to accomplish this becomes a critical issue, as well as to how these needed resources are accessed.

Internal vs. external resources

This brings us to another aspect to consider, access to firm-internal resources vs. access to resources provided by others. This study shows that the possibility of sharing resources is a prerequisite for being able to provide variety to end-users cost effectively. In order to be cost effective, the use of 'external' crossing points is an important issue for firms in their efforts to offer variety to end-users. By using crossing points, potential likeness with objects 'related' to objects of other firms can be taken advantage of. In the same way, letting other firms share one's own resources can increase efficiency. However, depending on the nature of the activity structures, some adaptations of the shared resources might be required. For example, in an activity structure based on speculation, indicating a relatively decoupled activity structure, it may be easier to create likeness among objects and share resources as the activities are not directed to any specific end-users. The analyses in this thesis have shown that it is also possible to share resources among activity structures characterised by pure postponement and thereby closely complementary activities. By sharing resources at different crossing points, economies of scale can also be captured in this kind of activity structure.

Variety and change

For actors, sorting is the key to handling variety in the technology of production in order to provide the required variety to end-users. This involves both selecting and assigning. In order to select beyond one's own firm boundary, the scope of the awareness boundary with regard to objects is crucial. The scope of the awareness boundary limits the options for selection of objects from other firms. In a similar way, it also limits the possibilities regarding which transformation resources can be used. Each firm taking decisions concerning how objects are sorted is therefore limited to the transformation resources within its awareness boundary. By extending this boundary new possible transformation resources can be identified. In a similar way, the influence boundary limits how sorting can be done. Changing these boundaries can, in turn, result in the objects of the firm being sorted in new ways and 'the variety offered' to end-users being changed with regard to the time, place, or form dimension. How variety appears at different points in a distribution network depends on the different firms' awareness and influence boundaries with regard to different objects. These boundaries change continuously as firms interact and identify new possibilities for sorting. Variety in the technology of production is contingent on these boundaries.

The analyses on which this thesis is based are static, but how variety is shaped in the technology of production and technology of use is continuously changing as a result of the interaction among firms and the changing boundaries, as argued above.

10 Concluding Discussion

The first section in this chapter, 10.1, sums up the main conclusions with regard to how variety in distribution networks can be understood. This is followed by a discussion of some implications of the results of the study in section 10.2. The dissertation concludes with a discussion of the trustworthiness of the research in section 10.3.

10.1 Understanding variety in distribution networks

In the first chapter in this thesis, we introduced the phenomenon of interest, variety in distribution. It was argued that variety is interesting to explore, both from a buyer and a supplier perspective. Furthermore, we illustrated this variety with examples from the PC industry. We can now sum up the main conclusions concerning how variety in distribution networks can be understood.

In order to approach our phenomenon, the *transvection* was brought forward as a fruitful concept for conceptualising distribution networks. One of the main points of departure for this study was the belief that distribution networks are not easily divided into clear-cut 'production' and 'distribution' parts. It has been shown that 'production activities' often take place within the 'marketing channel', and so the transvection concept proved useful, since it does not distinguish between production and distribution activities, but highlights two fundamentally different, but equally important, kinds of activities: *transformations* and *sortings*.

By defining *objects* in terms of what is transformed and sorted in distribution networks, it becomes possible to analyse objects, and how they change as they are transformed and sorted through the distribution network. The objects start out as *conglomerate resources*, and are then sorted and transformed, and appear as *transformation outputs*[83] in the distribution network until they end up as *end-products* at the end-user. Each object, no matter where in the distribution network it appears, always has a set of features in terms of *time, place,* and *form*. Furthermore, objects are assigned *identities* when directed to a certain actor in the network.

[83] Each 'transformation output' is, by definition, also used as input in the succeeding transformation.

Transformations change objects in time, place or form by the use of *transformation resources*. Sorting is the activity that 'decides' where the object will be directed next and is performed by the use of *sorting resources*. Two kinds of sorting are focused on in this thesis: the *assignment* and *selection* of objects. These relate sorting to the supplier and the buyer respectively. Selection thus relates to how an object is related to other objects from a buyer perspective. Assignments are the result of selections. The assignment of an object can be made to a certain transformation resource, or to a particular actor, which means assigning an identity to the object.

The way an object is assigned depends on a number of factors. First, the extent to which objects are *alike* is important. By identifying potential *likeness* among objects, transformation resources can be utilised more efficiently, thanks to the sharing of resources among transvections. The possibility to create likeness among objects by the identification of objects that are potentially alike needs to be discussed from a given actor's perspective, as different actors perceive features of objects differently. The importance of creating likenesses brings us to a second unit of analysis. Second, the existing transformation resource structure is of importance as it determines the possible options for how objects can be assigned to different transformation resources. The 'existing resource structure' must be regarded from some actor's perspective since its awareness boundary sets the limits for what are considered possible transformation resources to use.

Alderson (1965) focused on individual transvections. In this thesis we have extended the scope of analysis to capture the interrelatedness among transvections. The analysis indicates that distribution networks could fruitfully be conceptualised as a set of crossing transvections. Alderson initiated the idea of focusing on the connectedness among transvections by introducing sortings as an important part of transvections. *Crossing points* were introduced as a way of capturing the connectedness among individual transvections. A crossing point is defined as a transformation resource to which objects belonging to different transvections are jointly assigned. The main reason for the 'existence' of crossing points is to improve economic efficiency in individual transformations. Hence, resource sharing can be obtained by the assignment of objects to the same transformation resource and thereby taking advantage of potential likeness among objects. This therefore becomes a means for handling variety in distribution networks as it enables the focus on specific end-user contexts at the same time as it enables efficient resource utilisation among transvections by the creation of likeness.

If distribution networks are conceptualised in terms of transvections, the organising of transvections becomes an important issue. Two main principles with regard to this have been discussed, speculation and postponement. The extent to which these principles are applied in distribution networks has implications for how objects can be sorted and hence for how activities are organised. The crossing of transvections implies that each transvection cannot be organised in isolation from other transvections. This also sets some limits for how transvections can be organised.

The 'analytical framework' summed up above laid the foundation for our understanding of variety in distribution networks. The study points out that in order to understand variety in distribution networks, both *technology of production* and *technology of use* need to be considered. It has been shown that variety exists in both these technologies, and that they are ruled by different kinds of logic. The variety in technology of use is related to the diversity of the *end-user contexts*. Each end-product that ends up with an end-user will therefore need to fit into an end-user context, which, in turn, can be described in terms of a form, time, and place context. This means that the transformation resource structure will need to be activated in different ways to serve these diverse end-user contexts. This is what variety in technology of production is all about. By assigning objects in different ways in the distribution network, objects with diverse features appear and can be sorted and transformed in order to provide variety in end-user contexts. And so, in order to obtain economic efficiency in these activities, likenesses among objects have to be taken into account, which means making use of crossing points.

Transvection analysis involves two main levels, the single transvection and the crossing point. By taking both these levels of analysis into account, different fragments of the distribution network and its inherent variety can be revealed. Using transvection analysis, the focus shifts from the traditional definition of distribution as 'bridging the gap between producer and consumer' to 'linking the heterogeneity in technology of production with the heterogeneity in technology of use'.

10.2 Some implications of the study

This section discusses some implications of the study. The first deals with the extent to which the distribution reality is under restructuring. The second is related to how 'products' are perceived in distribution. The third questions the mainstream view of distribution conceptualised as 'channels'.

The ‘restructuring’ of distribution networks

In chapter 1 it was indicated that technological development and changing end-user needs have a more or less extensive effect on distribution reality. Obviously, distribution patterns constantly change. However, the radical changes as argued for by, for example, Pitt et al. (1999) seem to be far too drastic. To recapitulate, they argue that the Internet will be the ‘death of distance’, and bring about the ‘homogenization of time’, and ‘irrelevance of location’.

The results of this study point in a different direction. For example, when ‘new’ technology is used as a tool in sales and distribution, location remains highly relevant even when the end-user is not directed to a certain location for the selection of products. Location is important in terms of how the product ends up at the end-user, and in terms of its features in the place dimension along the way when transformed from a set of conglomerate resources to eventually end up at the end-user as an end-product. Furthermore, distance will always be of importance, as the physical distance from the location of the conglomerate resources to the end-user will always need to be bridged. However, the way this is done is not given. Time is a crucial issue when it comes to coordinating activities, especially when relying on postponement strategies involving closely complementary activities.

This brings us to another aspect of distribution, the increasing reliance on postponement strategies, which also relies on the use of, for example, integrated information systems. This kind of approach means that differentiation of products can be postponed until orders from end-users arrive. Postponement strategies are important means in order to handle the existing variety in end-user contexts. Furthermore, in order to be able to offer customised solutions producers often rely on direct contact with the end-user. This implies that intermediary firms that do not take title to the products are not involved in these distribution structures, and so these distribution structures have been labelled ‘direct channels’. This has led to the perception that there is a smooth and uninterrupted direct flow between the producer on the one hand, and the end-user on the other, when such an approach is adopted.

The results of this thesis implies, on the contrary, that this kind of transvection often involves an even larger number of actors, undertaking transformations and sortings, in terms of, for example, information processing and physical handling. However, these actors become ‘invisible’ because the actors not taking title are not considered included in the channel. In a transvection

analysis, the focus is not on who does or does not take title. This means that 'all' firms that are somehow involved in transformations and sortings in the transvection are taken into consideration. Another factor is that these transvections are often characterised by postponement and closely complementary activities meaning that the use of crossing points is crucial from an economic point of view. These transvections thus require the sharing of resources with others, in terms of, for example, logistic hubs, goods terminals, and trailers, in order to be efficient from an economic point of view. This, in turn, means that sorting becomes a main concern for all actors involved in such a transvection. Furthermore, in order to coordinate different transvections, characterised by sequentially dependent activities, information exchange among the actors is necessary, which often calls for rather close interaction among the firms involved.

Our conclusion is that the term 'direct channel' is misleading for such distribution structures. In fact, these distribution arrangements require close interaction among many firms in order to coordinate all activities in these transvections characterised by postponement, to different end-users. In fact, they are anything but 'direct'.

New technology, like the Internet or new kinds of information and manufacturing equipment, change the conditions for the technology of use and the technology of production. This means that new technology creates new possibilities for transformations and sortings and for how likeness can be created. However, new technology does not make location, distance, and time irrelevant. On the contrary, location, distance, and time, are highly important, and will always be 'relevant' but they will appear as central at new points in the distribution network and possibly in different combinations than before. These dimensions are interrelated and new resources used for transformation and sorting, like the Internet, can change the way that they are interrelated. This needs to be considered when organising activities, as different ways of organising means that different interdependencies among these dimensions are highlighted.

Our conclusion is that no 'revolution' in distribution is ongoing. Still, we believe one major change has occurred that needs to be discussed further. This change is related to the 'product' exchanged in distribution networks and how it is perceived.

Objects in transition

In chapter 9, dealing with variety, it was argued that one of the main reasons for an increasing variety in the ways that end-users can be served, is that objects change as they are transformed and sorted in the distribution network.

This consequently stands out against the traditional view of a 'finished product' that is to be channelled forward in a one-way flow, starting with the 'active' producer and ending with the 'passive' end-user. In order to smooth this flow of products, intermediary actors are used. Their main function is to create and break assortments of finished products in different levels in the 'channel' in order to keep stock of the right combination of products with regard to the next level in the channel. Sorting then mostly becomes a matter of creating and breaking bulk by assigning standard products to new combinations.

By relying on a transvection analysis, we have shown that sorting plays a crucial role, not only in 'distribution activities', but also in 'production activities'. Sorting is also highlighted as a key concept, not only in distribution structures characterised by speculation, but even more so in those characterised by postponement. As indicated in the previous section, there has been an increasing reliance on the principle of postponement. This means that there are no, or very few, 'finished products' in a warehouse, or on a store shelf, ready to be channelled out to end-users. Instead, postponement implies that the end-user is more or less involved in specifying the end-product, which can involve the form, time, and/or place features. Consequently, the end-user is allowed to partly specify the end-product, in terms of design and when and where it is to be delivered, in order to fit into the end-user context.

We have discussed objects and their features, and how objects undergo changes in various dimensions as they are transformed in the distribution network. It is argued that it is not appropriate to define production as changes in form, and distribution as changes in time and place, but that this oversimplifies distribution reality. Instead, we argue that the exchanged product should be seen as an 'object in transition' with regard to all three dimensions and that these changes can take place at very different points in the distribution network.

It has been highlighted that various actors perceive the features of objects differently and that objects are very different when regarded in the context of the technology of production and in the context of the technology of use. With such a view, 'the product' is not regarded as 'given' but is instead seen as an 'object in transition' needing to fit into different contexts. This view enables

understanding of how potential likeness among objects is taken advantage of. This has implications for the view of the 'product' that is exchanged and how the firms involved handle the 'product'.

Questioning the channel perspective

With the two previous sections in mind, it is possible to question the strongly rooted view of distribution as conceptualised as channels. The channel concept was developed at a time where speculation was the main principle applied in production and distribution. This influenced the continued development of the channel concept; and it was adapted to this kind of reality. This, in turn, meant a focus on how to 'channel' large quantities of mass-produced standardised, finished products out to the end-users. This view of distribution is now questioned. First, the increasing reliance on postponement strategies is discussed. Second, the connectedness in distribution networks is elaborated on. Third, the distinct separation of production and distribution activities in the channel view is questioned. Fourth, the starting point at the producing firm in the channel is challenged.

In contrast to the 'channel view', this thesis points out a variety of distribution structures, some relying on speculation, as the one outlined above, but also others, being very different from the ones based on speculation. For example, with regard to the sorting function, this thesis provides a somewhat different, complementary picture of the sorting concept. When it comes to the use of postponement strategies, it has been pointed out that sorting is crucial in order to coordinate activities among transvections, some of which involve closely complementary activities, in a way that is efficient from an economic point of view. The use of crossing points is considered essential in order to accomplish this.

Another contrast to the channel perspective is the way in which connectedness in distribution is treated. This study highlights the existence of connectedness in distribution networks, which has turned out to be of great importance for the understanding of efficiency in distribution networks. This means that we argue for a perspective that shifts the focus from the nature of individual 'channels' to incorporating the interrelatedness among 'channels' and the different ways in which they are related through the sharing of resources among firms. However, a 'channel' perspective does not reveal this connective aspect of 'channels'. Therefore, we argue that the channel concept reduces the analysis in a way that means that some important aspects of the nature of distribution are lost. Instead, a transvection analysis, focusing on both individual transvections and

crossing points, is used to capture this connectedness. It is interesting to note that the transvection analysis, as brought forward in this thesis, is partly based on the very same ideas as those underlying the channel concept. However, the concepts have been developed and used to fit into the contemporary distribution reality. For example, a reinterpretation of sorting helps to analyse transvections ruled by the principle of postponement. Furthermore, crossing points help to understand how transvections, of very different nature with regard to how they are organised, are connected.

Another important factor is that the transvection concept does not separate the distribution network into a production part and a distribution part. The transvection concept deals with different transformations and sortings, but not in terms of production and distribution activities. The 'production activities', merely regarded as input to the 'distribution activities' in a channel view, are taken into equal consideration as the 'distribution activities' in the transvection concept. As the transvection is not divided into a production and a distribution part it is especially useful when dealing with transvections characterised by a high degree of postponement.

In transvection analysis, the end-user rather than the producing firm is taken as the point of departure. As opposed to the 'channel view', however, both 'sides' are taken into consideration to an equal extent as well as their different kinds of logic. The firms and their activities and resources are seen as parts of different contexts in terms of the technology of production and the technology of use. Alderson (1965, p. 279) describes the two points of view as follows:

> *Looking down the channel from the perspective of the producer, the sorts are a series of assignments to the appropriate facility for producing form, time, and place utility. Looking back up the channel from the viewpoint of the buyer, the sorts are selections into assortments which serve a significant purpose at the given stage in the marketing process.*

The view of the channel outlined above reveals a different picture of distribution than the prevailing definition of distribution as an 'isolated' bridge between the producer and consumer. It is shown that the relevant context when analysing distribution issues is often wider than that captured using the channel view. By going from a channel to a network perspective, more of the firm's connections to others can be captured. This study also points out that these connections are especially important to consider when analysing distribution structures characterised by postponement. A network perspective reveals that

firms and their counterparts are part of networks that are not easily demarcated into channels without narrowing the analysis to an extent that neglects too much of the inherent complexity.

10.3 The trustworthiness of the research

This final section deals with the trustworthiness of the research. We take our point of departure in the criteria suggested by Lincoln & Guba (1985). They argue that in qualitative research the main issue to consider when 'evaluating' research is trustworthiness.

> *The basic issue in relation to trustworthiness is simple: How can an inquirer persuade his or her audiences (including self) that the findings of an inquiry are worth paying attention to, worth taking account of?* (ibid., p. 290)

This quotation indicates that the judgement concerning the trustworthiness of a study can only be made by each individual reader. Hence, different readers will perceive the study differently. What the author can do, however, is to facilitate for the reader by providing a sufficient amount of information about the research process. In order to do so, I have chosen to place this part of the methodological discussion at the very end of the dissertation.

Lincoln & Guba (1985) propose four criteria: credibility, transferability, dependability, and confirmability. Credibility is highlighted as the most critical aspect in order to obtain trustworthiness and is divided into seven activities: prolonged engagement, persistent observation, triangulation, peer debriefing, negative case analysis, referential adequacy, and member checks. It is important to point out that an inquiry is normally not 'strong' in all criteria and that some of the criteria may be bypassed (ibid.) The criteria are discussed below with regard to the present study.

Prolonged engagement relates to spending an adequate amount of time in the empirical setting in order for the researcher to gain a sufficient understanding of the context of the phenomenon in focus. In my case, with variety in distribution as the focal phenomenon, I did not spend a long time at a focal company. Instead, during the data collection that went on from 1999 to 2002, the search for variety was a constant issue involving interviews at different firms as well as information from other sources. In this way, my contextual understanding of the phenomenon developed. The fact that the data collection was made over three years made it possible to successively analyse data and,

on the basis of that analysis, direct the study in new ways that might not have been possible if all data collection had been performed in a very short period of time. My five years of participation in the ERFA group, as described earlier, also helped me to obtain an understanding of the phenomenon of variety in distribution. One especially important aspect was the group members' diversity in terms of their taking working in very different industrial settings. Furthermore, the fact that many of the members participated throughout the whole period of time also gave me an understanding of how the structures in which they work are in continuous change.

Persistent observation is related to providing sufficient 'depth', as it can help the researcher to identify the aspects most relevant to the phenomenon approached. In my study, the transvection was soon identified as a useful tool for approaching my focal phenomenon. The identification of crossing points can be said to be a result of persistent observation, as the notion of the importance of crossing points was highlighted in interviews and in other sources of data. However, the identification of crossing points is closely linked to the underlying theoretical framework that emphasises the interrelatedness among activities and resources. For example, Richardson's (1972) framework and his notion of similarities among activities played a crucial role for the identification of crossing points as a central phenomenon. This implies that the identification of crossing points has to be viewed in relation to the underlying theoretical assumptions. If these assumptions had been different even infinite persistent observation might not have led to the identification of crossing points as an important aspect of distribution.

Triangulation usually refers to the crosschecking of data in order to secure a 'true' picture. However, Dubois & Gadde (2002) argue that a more important aspect of triangulation, in terms of the use of multiple sources, is to reveal new aspects previously unknown to the researcher. This aspect has been central in my study. Hence, the use of different sources of data was not primarily undertaken in order to secure a 'true picture'. Instead, the crosschecking of data in terms of taking different sources of data into consideration was done in order to secure logical coherence. This implies, that it must seem likely that the structure that was eventually outlined is in line with what I aimed at analysing - variety in distribution. As the data collection took place over three years, and the structure therefore continuously changed, it is inevitable that the material as outlined in chapter 5 does not represent exactly the same time period. However, my intention was to outline a structure that can be analysed in a way that brings clarity to the theoretical concepts and permits the illustration of patterns.

Peer debriefing relates to exposing the researcher and his or her research process to a devil's advocate by '*exposing oneself to a disinterested peer in a manner paralleling an analytical session and for the purpose of exploring aspects of the inquiry that might otherwise remain only implicit within the inquirer's mind*' (ibid., 1985, p. 308). In this thesis no formally appointed 'peer' was used. However, I have, throughout the research process, been exposed to different 'debriefers' at workshops, conferences, and internal and external seminars. Some of these debriefers can also be said to have been more 'devilish' than others. In this way, my research aim and issues, the theoretical framework and case analysis were continuously commented on by a number of persons, from different fields of interests.

Negative case analysis deals with the '*process of revising hypotheses with hindsight'* (Lincoln & Guba, 1985, p. 309). Negative case analysis has not been used in this study, for the same reason as argued for by Holmen (2002, p. 345): '*since the purpose of the thesis has not been to propose and test hypotheses.*' Instead, the case was used as a tool in the interaction with others. In interaction with others, other aspects of the case and new theoretical directions were identified in line with the process of systematic combining.

Referential adequacy means keeping some of the data 'raw' so conclusions can later be tested again. This was not done in this study for the main reason that 'raw' data is difficult to distinguish from analysed data. Already at the interview, the 'raw' data is analysed in the inquirer's mind, which makes it hard to talk about raw and objective data. This implies that the data in chapter 5 has already been somehow processed when outlined. Some data has been excluded and some included in the final version of the case, now seen as a 'product' in line with Dubois & Gadde (2002). They argue that the excluded pieces '*might have been very important for the learning of the researcher, but they can also obscure the reader's understanding. Singling out such pieces is a cumbersome task for the case researcher, but necessary to obtain parsimony*' (ibid., p. 560). Furthermore, not all data provided in the empirical chapter is used in the analyses in chapters 6 and 7. This is not a result of a desire to keep raw data for reanalysis. This data is included to provide a context for the analysed structures that are important to the reader's understanding.

Member checks refer to providing the opportunity for informants to check data. In this study one representative from each of the firms involved was given the opportunity to comment on the written material used in chapter 5 - 'The Empirical Inquiry'. This was not primarily done in order to secure the 'objective truth' but more in order to ensure that the respondent's perspective

of the structure was captured. The possibility for the informants to read the material was also important in order to secure good relationships with the informants so that no 'sensitive' information from their perspectives, in terms, for example, of facts and figures, was published. The comments from interviewees did not result in any major rewriting of the case description and did not affect the overall 'picture' I wanted to include in order to exemplify certain structures. Some of the comments given were 'no comments', minor revisions in terms of adding or removing some figures, and in one draft I had misinterpreted who was the initiator of a certain change process. One of the interviewees, a representative of Irish Express, who had 'no requirements for revision' sent the following additional comment that highlights a methodological issue regarding how to handle the continuous changes of the structures, which was also discussed earlier: '*However, the problem is that Irish Express is no longer involved in the distribution of Dell Computers. This is now handled wholly by Schenker BTL in Copenhagen. I hope you can still use this in you project though*.'

For me this was not a major problem. If I had considered it, I could not ever have written this thesis. As I have focused on structures rather than processes, the actual structures presented in the thesis are only 'valid' for a rather short period of time. I did not consider this a problem, however, as I was mainly interested in illustrating the variety of structures in terms of how their natures vary in principle.

We now turn to the second criteria, *transferability*, which Lincoln & Guba (1985, p. 316) refers to as the importance to '*provide only the thick description necessary to enable someone interested in making a transfer to reach a conclusion about whether transfer can be contemplated as a possibility.*' This is related to the extent to which the findings, generated from a (single) case study, can be transferred to other contexts (Holmen, 2002). I believe I have provided such a 'thick description'. I argue that the concepts brought forward can be applied in a number of empirical settings. Hence, the results are not only useful in the PC industry, but this area should instead be seen as an example used to illustrate and explore the theoretical concepts. The case can be used as an example of how transvections and/or crossing points are organised.

Furthermore, I believe that transvections and crossing points as analytical tools can be fruitfully utilised in studies with other purposes than exploring variety in distribution. One main argument for this is that the transvection, as originally developed by Alderson in 1958, was not meant as a tool for understanding variety in distribution. The transvection was initially developed as a

complement to transactions in order to improve our understanding of 'channel coordination' (Alderson, 1965).

In this study I have shown that the transvection is useful if the focus is on variety in distribution, and I also argue that it can be used as a tool to conceptualise distribution networks per se. This would imply that it is also useful for other purposes of exploring distribution related issues, for example when there is an interest in exploring efficiency or changes in distribution networks. Hence, I believe that the transferability with regard to both the empirical setting and the usefulness of the theoretical findings is high in this study.

Dependability relates to '*examining the process of the inquiry'* (Lincoln & Guba, p. 318). According to Holmen (2001, p. 347) this *'involves, for example, decisions made in relation to the inquiry, possible methodological shifts, whether the inquirer has been co-opted, and the extent to which practical matters have influenced the inquiry excessively.'* The research process is outlined in section 3.3, where I tried to explain some of the methodological problems I was confronted with and how these were handled. Furthermore, the concerns related to data collection are dealt with in 3.6 and the constant process of going back and forth between the conceptual and empirical world and the effects of this process is outlined 3.5. By outlining these processes at a fairly detailed level, I hope to have provided enough information for the reader to be able to get a sense of the nature of the research process underlying this thesis. My personal belief with regard to dependability in the process is that a researcher must be dependent on a number of things, e.g. on informants, on concepts, and on the research context. The issue is not to try to be 'independent' but to understand how the dependence affects the study undertaken. I have tried to outline this in previous sections in this chapter.

Finally, *confirmability* relates to assessing the product of the inquiry and to what extent the concepts used, the findings, and the data are consistent. I hope that the analyses in chapters 6 and 7 show that the concepts suggested in the theoretical framework match in a way that makes the findings in chapters 8 and 9 trustworthy. According to Dubois & Gadde (2002) it is a main concern to arrive at an appropriate match between reality and theoretical constructs. In this study, the continuous process of going back and forth between the theoretical world and the empirical world has facilitated this accomplishment. This process successively changed the focus of the study by expanding the boundaries of the framework in certain dimensions and removing others, and the same is true of the boundaries in the empirical study. This process has helped to create

parsimony in the study, which means '*avoiding ending up with weak theory that is overly complex and says very little about very much*' (Dubois & Gadde, 2002, p. 559). In case studies, theory generation and confirmation are inseparable (ibid.). It is therefore important to provide the reader with information so he or she can evaluate the research procedure and its outcome. In line with this, I hope that this section, together with the rest of the thesis, has provided enough information to claim the trustworthiness of this study and its findings.

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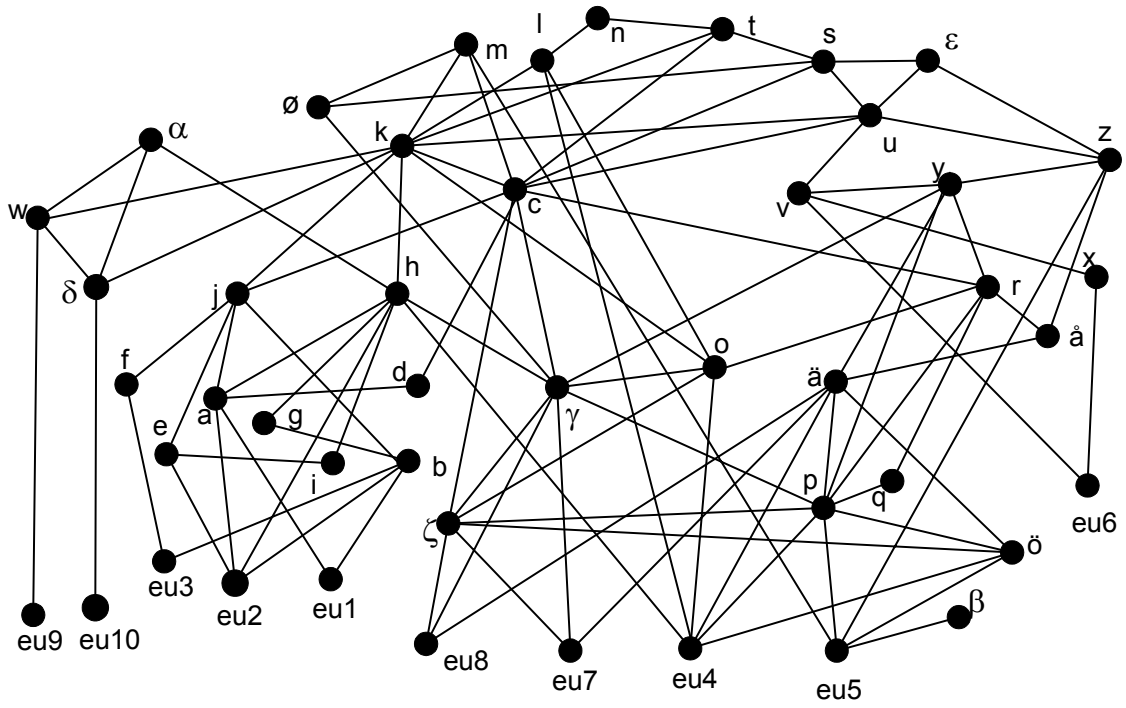
Appendix

Producers	Code	Section
Hewlett Packard	c	5.9-5.12
-Production site	s	
-Order administration unit	t	
IBM	o	5.6, 5.15-5.16
Dell	p	5.8, 5.11, 5.12, 5.14-5.16
-Production site	q	
-Customer service	ö	
CapTech	α	5.17-5.18
ProgramMäklaren	β	5.13-5.14
Distributors		
Ingram Micro	k	5.4-5.5, 5.10
Scribona	n	5.5, 5.9, 5.7
C2000	ø	5.7, 5.16
System Specialist		
Atea	γ	5.15-5.16
IMS	l	5.5-5.6
Resellers		
Westium Data (business store)	w	5.17-5.18
Dustin	m	5.7, 5.14
ComputerCity (part of Siba, g)	f	5.3-5.4
Retailers		
Siba	g	5.3-5.4
-Purchasing organisation	j	
-Local store	a	
-Warehouse (Siba.se)	i	
-Siba.se Internet shop	e	
Hewlett Packard's Internet shop	v	5.9, 5.11
-Sales department	x	
Westium Data (consumer store)	δ	5.17-5.18
Logistics providers		
Posten Logistik	h	5.4
Irish Express	r	5.8-5.9, 5.11-5.12
-Local office	å	
Schenker	u	5.9-5.10
-Logistic hub	ε	
ASG	y	5.8, 5.11-5.12
-Goods terminal	z	
Service providers		
ICL	ä	5.8, 5.12
Call centre	b	5.3
Repair shop	d	5.3



Individual consumer customer at:	**End-user code**	**Transvections (Trv) analysed in Chapter 6 &7**
Local Siba store	eu1	Trv1
Siba Internet shop	eu2	Trv2
ComputerCity	eu3	Trv3
Hewlett Packard Internet Store	eu6	Trv6
Westium Data consumer	eu10	Trv10
End-user at the following organisation:	**End-user code**	**Transvections (Trv) analysed in chapter 6 & 7**
Pharmacia	eu4	Trv4a, Trv4b
Chalmers	eu5	Trv5a, Trv5b, Trv5c
Volvo Car Corporation	eu7	Trv7
Volvo Group	eu8	Trv8a, Trv8b, Trv8c
Westium Data business store	eu9	Trv9

Explanation	**Text symbol**	**Graphic symbol**
Sorting (assigning or selecting)	S	
Transformation	T	
Information exchange		
Sorting resource	SR	
Transformation resource	TR	
Conglomerate resource		
End-product (Objects)		
Transformation output (Objects)		