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A MODEL OF VIRTUAL ORGANISATION: A STRUCTURE AND PROCESS PERSPECTIVE

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ABSTRACT

Increasingly, the trends of agility, mass-customisation, globalisation of markets and supply sources and the increasing demand for extended products by consumers, are shifting the competitive focus to complex and rapidly changing virtual organisations. The primary contribution of this paper is to develop a model of the virtual organisation that provides insight into its dynamic mechanisms. These are mechanisms of configuring and switching. Furthermore, the model may serve as a basis for future empirical research on different types of virtual organisation. Instead of defining a new set of characteristics, the model is based on several recent contributions in literature, specifically contributions in the field of dynamic networks and virtual organisation. The model builds on two different perspectives: a structure perspective defining elements and relationships of a virtual organisation and a process perspective defining functions and roles needed for the reconfiguration and renewal of the virtual organisation as an answer to changing customer demands or market conditions.

KEYWORDS:
Inter-organisational co-operation, virtual organisation, dynamic networks

1. INTRODUCTION

In an era of rapid technological development and increasing competition organisations co-operate in many different ways. New ideas and concepts that emphasise the role of virtual organisations and networks are currently introduced to cope with the changing business environment and customer needs. Important drivers for the rise of organisation networks are mass-customisation, extension of products, globalisation, and agility.

Mass customisation is a production and delivery process through which mass-market goods and services are individualised to satisfy a very specific customer need, at a competitive price. Based on the public's growing desire for product personalisation, it serves as a combination of “custom-made" and "mass production". Unlike mass production, which produces an item in high volumes, mass customisation is characterised by small volumes, in many cases lot sizes of one. Other characteristics are competitive costs, timely deliveries and a move away from centralised manufacturing to more distributed production. Consequently, when combined with the latest digital

technology, mass customisation not only benefits the consumer, it offers the manufacturer significant benefits as well. Via modularisation of the product design and the production, a high degree of product/service flexibility is reached. The modular production approach opens the way to joint purchasing on e-markets, which reduces the costs of the products.

Because the physical characteristics of products have become similar and of high quality and provide only little basis for differentiation from competitors, other attributes – in many instances information oriented services – are given emphasis. It is increasingly clear; products are not just things with features. They are things-with-features bundled with services (Fuller, 1993). To produce and deliver these extended products, a number of organisations contributes to the demand oriented and dynamic network.

Globalisation of trade and production enables economic activity to take place at locations at which this is most profitable. To cope with the increasing competition in a globalised market, organisations focus on a relatively small number of core competencies and co-operate extensively with other organisations to keep up with technological developments or to improve their efficiency to achieve low costs to remain their competitiveness.

In this environment, traditional organisations find themselves outflanked by competitors that adapt dynamically to unanticipated changes in their turbulent environment or to opportunities revealed through interactions with customers. Sometimes described as ‘virtual’, ‘hybrid’ or ‘lean’, virtual organisations are built ad hoc from small, sometimes globally dispersed, independent organisational entities. These organisational entities reshape themselves dynamically as customer requirements change or as the environment evolves. Contributing entities are added to the network when they can add value and are disengaged as their competencies are no longer required. This poses a specific set of requirements on the capabilities and resources of organisations that take part or want to take part in a virtual organisation. The pace of adjusting, the intensity of co-operation and the number of organisations in the network create new challenges for organisations that aim to establish and co-ordinate virtual organisations. Therefore, the ability to form, operate, and end an organisation in a timely manner, is the key of virtual organisations. This means that within a virtual organisation the mechanisms of creation and reconfiguration, both in a timely manner, are important.

The aim of this paper, then, is to develop a model of the virtual organisation that provides insight into the mechanisms of the virtual organisation. To describe these dynamics we consider both structure and process components. Most contributions in recent literature deal with structure of virtual organisations. Little emphasis is put on the process of formation, operation, and termination of virtual organisations. In combining both structure and process, we can not only understand and comment the structure and process of virtual organisations, but we can also explain, by using a process perspective, how the structure of a virtual organisation comes about. If we can clarify the relation between structure and process of virtual organisations, it becomes possible to drive the process of organisational change in the virtual organisation. In organisation literature, Mintzberg (1979) and Robey (1991) describe structure and process of organisations. However, authors have not yet explicitly integrated structure and process into a single model for virtual organisations. In this paper, we consider the integration of structure and process with respect to virtual organisations.

So far, empirical analysis of virtual organisations is limited to the description of a number of examples of successful organisations such as Dell (Margetta, 1998), Amazon (Kotha, 1998), and Airbus (Thornton, 1995). While a number of authors have suggested that virtual organisation leads to agile response of organisations, at present there seems to be little or no literature available that either empirically justifies this conjecture or provides logical arguments for it. However, intuitively it does makes sense to assume that virtual organisation is a well suiting organising principle to create quickly an organisation out of modular components to respond to the requirements of mass-customisation, extended products and globalisation.

The model of virtual organisation defined in this paper is relevant for practitioners as well as researchers. From a practice perspective, it provides a framework to identify opportunities for the improvement of existing static supply chains in their growth towards more flexible organisational networks that fulfil the needs of customers for products and services. From a research perspective, it provides a conceptualisation of the mechanisms of the virtual organisation independent of the

limited number of success stories of virtual organisations today, and may function as a framework for further empirical analysis.

The structure of this paper is as follows. In section 2 we provide an overview of the literature on virtual organisations and introduce the process and structure perspective. The structure perspective is elaborated in section 3. Section 4 continues with the process perspective. The two perspectives are integrated into a single model of the virtual organisation in section 5. Finally, further steps for the refinement and empirical validation of the model are presented.

2. THE CONCEPT OF VIRTUAL ORGANISATION

The research field of virtual organisation is pre-scientific, with contributions that have not yet amalgamated into a broader theoretical framework. Many of the contributions focus on functional aspects, like information technology required in the virtual organisation (Espinasse et al., 1998; Strader et al., 1998), logistic issues (Bastos and Sousa, 1998), legal issues (Pletsch, 1998), human resource management (Coyle and Schnarr, 1995), and financial aspects (Swagerman and Steenis, 1998). Authors relate the concept also to other business concepts, like knowledge management (Campbell, 1997), flexible or dynamic networking (Miles and Snow, 1992), agile competition (Goldman et al., 1995), business process redesign and supply webs (Franke, 1999). Again, others describe different types of virtual organisation (Van Aken et al., 1998) or its life cycle (Strader et al., 1998; Sieber, 1998). Each of these authors emphasises different characteristics of the virtual organisation. Their contributions are valuable to a better understanding of the virtual organisation, but do not yet provide a comprehensive view on its design and dynamic functioning.

Most definitions of the concept of virtual organisation start with stating that it is “a network between organisations or individuals ...”. Because these definitions focus on the building blocks of the virtual organisation and their properties, we call this the structure perspective towards virtual organisation. Few definitions take a different starting point and state that virtual organisation is an approach to management or a strategic approach. We consider this the process perspective, because the focus is on behaviour or operation. Indeed, the term ‘organisation’ has different meanings that reflect the idea of organisation structure and process. First, an organisation can be thought of as a number of individuals systematically united for some end or work. Here, organisation is used as a noun. Second, it can be considered an act of organising: a state of being organised (Webster's, 1996). The distinction between structure and process is also suggested by Ackoff in his framework of system concepts (Ackoff, 1971).

Structure perspective

In terms of system theory we can depict the virtual organisation as a purposeful system that is composed of a set of interrelated elements (Ackoff, 1971). Authors consider the virtual organisation a type of co-operation (network, alliance) between organisations, companies, groups, or individuals. Other authors define the network as a combination of core competencies or activities:

> A temporary network of independent companies that come together quickly to exploit fast-changing opportunities (Byrne, 1993, pp 36-37)
>
> An opportunistic alliance of core competencies distributed among a number of distinct operating entities within a single large company or among a group of independent companies (Goldman, Nagel and Preiss, 1995, p 7)
>
> Less a discrete enterprise and more an ever-varying cluster of common activities in the midst of a vast fabric of relationships (Davidow and Malone, 1993, pp 4-7)

Thus, the elements within the virtual organisation are actors (such as organisations and individuals), resources (such as core competencies), and activities. Actors, activities and resources are interrelated by, for example, control structures, interdependencies, and exchange relations. The state of a system at a moment in time is the set of relevant properties, which that system has at that time. The properties that authors associate with virtual organisation are for example: temporariness (Byrne, 1993; Wüthrich and Phillip, 1998), opportunism (Wildeman, 1998; Davidow and Malone, 1993), and ICT-based (Byrne, 1993). Furthermore, the organisation is called dynamic (Wüthrich and

Phillip, 1998), flexible (Davidow and Malone, 1993), or continuously changing, amorphous, hybrid, and reforming (Grenier and Metes, 1995; Davidow & Malone, 1993).

Process perspective

Ackoff (1971) defines a process as 'goal-producing behaviour that is composed of events that constitute changes in the structural properties of the system or its environment'. For a virtual organisation this implies that when there is a change in the environment and/or internal state that reduces its efficiency in pursuing one or more of its goals, it reacts or responds by changing its own state or that of its environment. This system process is something which Mintzberg (1979) calls design. Design assumes the ability to alter a system. In the case of organisation process, design means turning those knobs that influence the division of labour and the co-ordinating mechanisms, thereby affecting how the organisation functions, how materials, authority, information, and decision processes flow through it.

There are a few authors that study the concept of virtual organisation in terms of a process in order to describe its behaviour. Venkatraman and Henderson (1998) define, what they call 'virtual organising', as 'a strategic approach'. Their strategic approach is focused on

> creating, nurturing and deploying intellectual and knowledge assets while sourcing physical assets in a complex network of relationships (Venkatraman and Henderson, 1998).

This purposeful '(re)positioning' of assets in the network alters the structural properties of the organisation. In terms of Mintzberg, Venkatraman and Henderson consider the virtual organisation a design principle; by the creation and sourcing of assets, the division of labour is influenced and the way materials, authority, information, and design processes flow through it are affected. In Mowshowitz' view virtual organisation is a way of structuring, managing and operating (Mowshowitz, 1997). He defines dynamic organising as an

> approach to management, that (...) may be considered a decision-making approach that is open to all possible options, explicit about goals and selection criteria, objective in making choices, and ever-responsive to changing conditions (Mowshowitz, 1994, 1997).

Mowshowitz distinguishes between four management activities that facilitate this process, that he calls 'switching'. These management activities are closely related to the phases in the life cycle of a virtual organisation that other authors discern: identification, formation, operation, and termination of the organisation (Strader et al., 1998). This is a cyclical process of creation and destroying. According to Katzy (1998), then, the essence of the virtual organisation is a process of restructuring. Hale and Whitlaw put this notion of change strongly forward. They state that

> a virtual organisation is the name given to any organisation which is continually evolving, redefining, reinventing itself for practical business purposes (Hale and Whitlaw, 1997).

According to Hale and Whitlaw virtual organisations are continually changing, the notion of change is institutionalised. Venkatraman and Henderson, Mowshowitz, Hale and Whitlaw, all these authors describe the virtual organisation as a process, i.e. goal-producing behaviour that is composed of events that constitute changes in the structural properties of the system or its environment.

Table 1 provides an overview on authors and parts of their definitions, grouped according to the described structure and process perspectives. The table shows that we can discern between authors that define virtual organisation in terms of a specific organisation structure and authors that define virtual organisation in terms of a process. Within both groups a wide variety of terms is used. Furthermore, we observe that many authors define virtual organisation as a structure and only a few define virtual organisation as a process. There is no contribution that explicitly considers both structure and process.

Table 1: Authors and their main focus on virtual organisation

Perspective	Author	Terminology
Structure	Byrne (1993)	Network
	Aken et al. (1998)	Network
	Strader et al. (1998)	Network
	Wildeman (1998)	Alliance
	Grenier and Metes (1995)	Alliance
	Wüthrich and Phillips (1998)	Form of co-operation
	Mertens et al. (1998)	Form of co-operation
	Goldman et al. (1995)	Combination of core-competencies
	Davidow and Malone (1993)	Combination of activities
Process	Hale and Whitlaw (1997)	Continuous or institutionalised change
	Venkatraman and Henderson (1998)	Strategic approach
	Mowshowitz (1997)	Management approach
	Katzy (1998)	Action or ability

In this section we distinguished between a structure (network configuration) and a process perspective (strategy or management approach) on the concept of the virtual organisation. So far, the link between these two perspectives received little attention in the literature on virtual organisation. In the next two sections we elaborate further on these two elements. Finally, we introduce a model of virtual organisation that integrates both.

3. A STRUCTURE PERSPECTIVE ON VIRTUAL ORGANISATIONS

In the previous section we argued that a virtual organisation can be depicted as a purposeful system that is composed of a set of interrelated elements. The characteristics of its elements and the nature of the relationships between the elements define the properties of the system. The constituting elements of a virtual organisation, a set of independent organisations and their mutual relationships should possess characteristics that enable them to function as a single organisation to reach their common goal. For the network as a whole this implies that the requirements posed by the competitive and dynamic environment have to be fulfilled by leveraging the benefits of being a network of organisations. We will now analyse the different views on the structure of virtual organisations, which results in an overview of the dimensions of structure of virtual organisations (table 2).

Many scholars visualise the current business environment of organisations as a large network of organisations, in which single organisations are ‘embedded’. None of these organisations is the same. This large number of different and interrelated organisations makes the organisational environment complex and uncertain. *Complexity*, *uncertainty* and *interdependence* characterise the business environment in which organisations operate nowadays (Scott, 1998). Virtual organisations are assumed to lower this complexity and uncertainty by co-operating with other organisations in an organisation network that operates as a single organisation.

Scott, in his extensive work on organisations, describes an organisation as an organised body of persons, a collectivity, that is oriented to the pursuit of relatively specific goals that exhibit a relatively high degree of formalisation (Scott, 1998, p. 25). Organisations that co-operate in a virtual organisation *pursue a common purpose*. In the literature on virtual organisation this purpose is described as “to produce and offer collectively and rapidly a product or service that the market demands” (for example: Byrne, 1993; Wildeman, 1998; Davidow and Malone, 1993). The virtual organisation can be called *formalised*, because the structure of relations within the virtual

organisation is made explicitly by consciously formulated agreements and procedures. Potential partners of virtual organisation have agreed upon a set of (window-)agreements that may for example include agreements on resources, skills or roles. Furthermore, assignment procedures that allocate organisations to customer requirements may exist (Mowshowitz, 1997).

How differs the concept of virtual organisation from other organisation concepts? In answering this question, authors mention in their definitions of virtual organisation various properties. Many authors state that a virtual organisation is composed of distinct operating entities which are (legally) autonomous or independent (Goldman et al., 1995; Wüthrich and Phillip., 1998; Byrne, 1993). Activities that contribute to the realisation of the common purpose that the different entities have, do not necessarily have to be performed in the same place, at the same time. Furthermore, it is said that only together these organisations possess the competencies, i.e. their resources are complementary (Wildeman, 1998; Katzy, 1998), and as such participants may have different roles (suppliers, customers, rivals). Other authors present lists with comparable characteristics of virtual organisation.[1] The model of Wigand et al. (1997) summarises these characteristics in three dimensions: modularity, heterogeneity and time and spatial distribution. They argue that the virtual organisation consists of *modular* units, i.e. relatively small but manageable units with decentralised decision-making. *Heterogeneity* indicates that the units should have different but complementary performance profiles with regard to their strengths and competencies. Finally, as a consequence of the reconfiguration of the virtual organisation, the units will be *time and spatial distributed*. These dimensions can be used to describe characteristics of actors in the network.

In order to indicate the boundaries of the virtual organisation -what is part of it, what not, and why- it is necessary to define dimensions of the relationships among actors. Authors state that what holds the actors in the virtual organisations together is a common business understanding (Wüthrich, 1998; Mertens et al., 1998), trust (Wüthrich, 1998), the ability to create temporary co-operations (Katzy, 1998), and information and communication technology (Byrne, 1993; Mertens et al., 1998; Venkatraman and Henderson, 1998). In their model, Shao et al. focus on these relationships, i.e. the links between the nodes. They characterise them by purpose, connectivity, boundary, and technology (Shao et al., 1998). *Purpose* provides the incentive for creating the new organisation and serves as the cohesive force to hold the components at least temporarily together. *Connectivity* defines the leverage of co-operation. It may be a consequence of the sharing of physical assets, resources, intellectual and knowledge assets, or access to markets (Venkatraman and Henderson, 1998). *Boundary* indicates who is part of the virtual organisation and who is not, in the absence of any clear visible physical or legal borderlines. It defines who can share its activities and receive benefits. Finally, they consider *technology* the enabling factor that allows for the virtual organisation. Table 2 lists the dimensions that we use to describe the structure of virtual organisations.

Table 2: Dimensions of structure

Term	Definition
Goal-specificity	Activities and interactions of participants are co-ordinated to achieve specified goals. Goals are specific to the extent that they are explicit, are clearly defined, and provide unambiguous criteria for selecting among alternative activities (Scott, 1998, p.25).
Formalisation	The co-operation among participants is conscious and deliberate; the structure of relations is made explicit and can be 'deliberately constructed and reconstructed'. A structure is formalised to the extent that the rules governing behaviour are precisely and explicitly formulated and to the extent that roles and role relations are prescribed independently (Scott, 1998, p.25).
Modularity	The extent to which the virtual organisation is based on integrated, customer-oriented processes composed of relatively small, manageable units (modules). These units are characterised by a decentralised decision-making competence and responsibilities. These are units, consisting of assignees, which can belong to different legal institutions (Wigand et al., 1997, pp. 161, 342).

[1] Virtual organisations may be distributed along a number of dimensions, such as autonomy and geographic dispersion. It could be argued that these dimensions should be depicted as a multi-dimensional, continuous space instead of a dichotomy. However, it is not our intention to get into this argument here.

Heterogeneity	The extent to which the components of the organisation have different performance profiles with regard to their strengths and competencies (Wigand et al., 1997, p. 342).
Time and spatial dispersion	The extent to which the components of the organisation are dispersed in place and time (Wigand et al., 1997, p. 343).
Purpose	The objective that provides the incentive for creating the new organisation and which serves as the cohesive force to hold the virtual organisation components ate least temporary together (Shao et al., 1998).
Connectivity	The creation of unity or linkage through structural change, breaking of constraints, or overcoming of previously existing barriers (Shao et al., 1998).
Boundary	An indication for the separation of those who are part of the virtual organisation and those who are not, in the absence of clearly visible physical border lines (Shao et al., 1998).
Technology	The enabling factor that allows the breakthrough and makes the virtual form possible (Shao et al., 1998).
Complexity or diversity	The number of different items or elements that must be dealt with simultaneously by the organisation (Scott, 1998, pp.229-230).
Uncertainty or unpredictability	The variability of the items or elements upon which work is performed or the extent to which it is possible to predict their behaviour in advance (Scott, 1998, pp.229-230).
Interdependence	The extent to which the items or elements upon which work is performed or the work processes themselves are interrelated so that changes in the state of one element affect the state of the others (Scott, 1998, pp.229-230).

4. PROCESS PERSPECTIVE ON VIRTUAL ORGANISATIONS

From a process perspective the focus is on the way a virtual organisation can account for changes in its environment and renew itself. A virtual organisation has to enable a repositioning in a changing environment, rather than to build any particular sustainable position (Eisenhardt and Brown, 1999). The idea of the virtual organisation implies that continually new business processes are designed and implemented (Katzy, 1998). The organisation as an arrangement of roles and relationships is not the same today, as it was yesterday or will be tomorrow: to survive is to adapt and to adapt is to change. Important questions to be answered from a process perspective are: What is subject to change within a virtual organisation? How can change processes be defined? How are changes in the virtual organisation triggered? What type of decision processes lead to change? Who is involved in or responsible for these changes?

Katzy (1998) proposes a conceptual theory of the design and implementation of the virtual organisation. This theory describes the dynamic mechanisms. Katzy builds his theory on three constructs: (a) the network, consisting of the relevant pre-existing industrial structures, i.e. relationships with partners in a trusted co-operation or a market, pre-existing resources as well as experienced routines and processes; (b) the virtual operation, the co-operative process that combines competencies and resources for the period needed to realise value; and (c) value as the force that drives the virtual organisation to restructure. Change processes in the virtual organisation relate to the design of the network, the restructuring of the dynamic operation and to the creation of new business opportunities or dynamic competition (see figure 1).

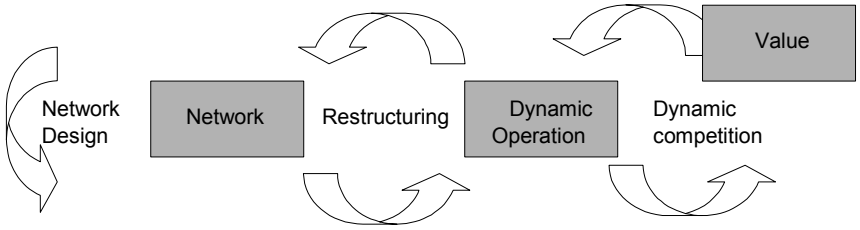

Figure 1: A conceptual model on design and implementation of virtual organisations (Katzy, 1998)

Most descriptions of change divide time into broad stages. Each stage consists of groups of activities aimed at roughly similar goals and the transition between stages may be smooth or turbulent (Garvin, 1998). Studies of change (e.g. Van der Ven, 1980; Kimperly and Quinn, 1984) focus on four broad stages: creation, growth, transformation and decline. Each stage is critical in the individual or organisational life cycle. According to Strader et al. (1998) virtual organisations go through four distinct phases during their life cycle. This life cycle constitutes an identification, a formation, an operation and a termination phase (see figure 2). Each step is accompanied by distinctive challenges and tasks. Mowshowitz (1994) and Strader et al. (1998) propose tasks, decision processes and management activities that initiate and support the change process.

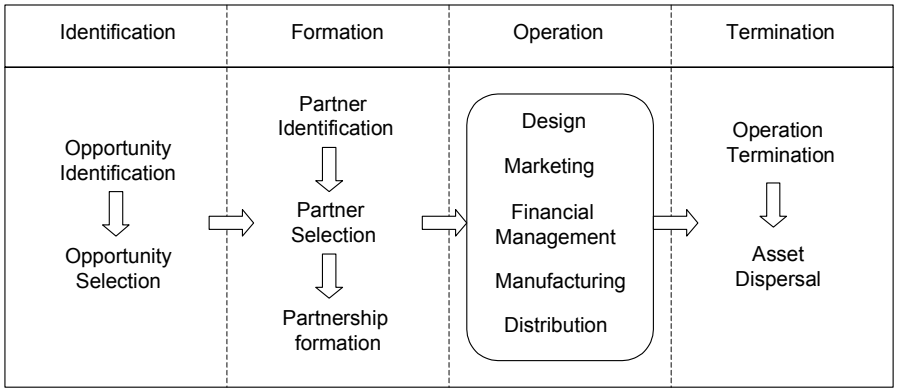

Figure 2: Virtual organisation life cycle model (Strader et al., 1998)

Strader et al. define two or more major decision processes for each of the four stages of the life cycle (see figure 2). The identification phase involves opportunity identification and opportunity evaluation and selection. These decisions are sequentially related. The identification stage ends once the best available market opportunity has been selected to pursue. The most important decisions in the second stage include partner identification, partner evaluation and selection and partnership formation. The partnership formation involves the actual formation of these selected firms into the actual virtual organisation. Once the organisation has been formed, it can begin its operation phase. In the operation phase important decisions relate to the five functional areas of design, marketing, financial management, manufacturing and distribution. When the market opportunity is fulfilled or has ceased to exist, the virtual organisation will be terminated. The major decision processes in the termination phase include operation termination and asset dispersal.

Mowshowitz (1994,1997) argues that switching is the key managerial innovation of the virtual organisation. The concept of switching consists of a managerial approach that enables firms to identify and select the best or most appropriate means for satisfying a need. A continuous evaluation of needs and the means to satisfy those needs implies that the principle of switching enables an organisation to be responsive to changing conditions. According to Mowshowitz, four components of managerial activity are essential to the virtual organisation: formulation of abstract requirements (e.g. customer needs or orders); tracking and analysis of concrete satisfiers (e.g. suppliers); dynamic assignment of concrete satisfiers to abstract requirements, based on an allocation procedure; and exploration and analysis of the assignment criteria.

The identification of concrete functions, decision or managerial processes suggests that within the virtual organisation, change processes are deliberately initiated of facilitated. New roles for designers are described in writings on virtual organisation as ‘broker’, ‘entrepreneur’ or ‘promotor’ (Katzy, 1998). Miles and Snow attribute three roles to the broker, that are performed in the life cycle of the co-operation. First, he or she is the architect of the co-operation, second the lead operator and finally, the caretaker. Katzy, Schuh and Millarg (1998) take a similar approach by implementing six roles: broker, competence manager, project manager, manager of in- and outsourcing, network coach, and auditor. Here, the relationship between the structure and process perspective becomes more clear. The roles and tasks focus on the realisation of structural elements of the virtual organisation by taking the process perspective as discussed in this section.

5. AN INTEGRATED MODEL OF VIRTUAL ORGANISATION

In order to get a comprehensive view on the mechanisms of a virtual organisation, we combine the structure and process perspective. To achieve this integration, we introduce a three layered model in which each layer represents structure elements and the transitions between the layers represent process elements. For each of the layers, we define structure elements and relate them to the functions that need to be performed to initiate and complete the process of transition to the next layer. The three layers that we use are the universe of modules, the dynamic web (Goldman et al., 1995), and the dynamic operation (Katzy, 1998; Strader et al., 1998).

In our model, we adopt the concept of network activation (Wassenberg, 1985). The concept indicates that organisations that form a virtual organisation are part of a larger network of which a selection is made (Wildeman, 1998). This implies that organisations forming a virtual organisation at a particular moment are already familiar to each other, i.e. they know each other. For instance, from an earlier co-operation or from discussions originating from expectations that the organisations can realise added value or synergy by co-operating with each other. Goldman et al. (1995) introduce the term 'virtual web'. They define the virtual web as an open-ended collection of pre-qualified partners that agree to form a pool of potential members of virtual organisations. These potential members are selected from the universe of modules. The universe of modules is the set of all organisations and is composed of the individual organisations of, for example, a specific industry or economy. While in the virtual organisation, the objective is to exploit a specific market opportunity, the purpose of the dynamic web is a disposition to work together in a future market opportunity (see figure 3).

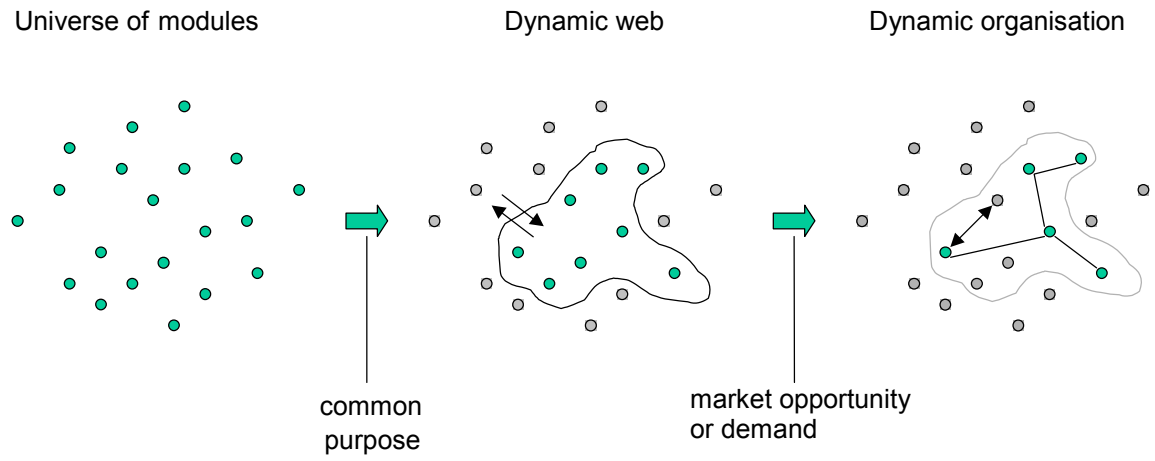

Figure 3: Three layers in the virtual organisation model

Market opportunity and market demands are the triggers that pull the virtual organisation together. A market opportunity can be defined as a (latent) area of need or requirement in which a company can perform profitably (Kotler, 1994, p 80). The virtual organisation can fulfil this need by bringing together the competencies needed for developing, producing and offering the appropriate products and/or services. The virtual organisation focuses on a particular market segment or target group. An example is the Smart Car in which Swatch and Mercedes-Benz took the initiative to develop and offer a new mobility concept based on a compact car.

A market demand can be defined as a want for specific products that are backed by an ability and willingness to buy them (Kotler, 1994, p 7). The specifications of the customer order determine what organisations need to be involved in the provision of the product or service. An example is Dell Computers. Dell Computers assembles and delivers computers on customer order and activates parts of its network of suppliers and logistics services providers (Margetta, 1998). In the remainder of this paper, we use the term market opportunity to refer to both, market opportunity and market demand. Our model does not specify how and why virtual organisations differ in this respect.

To clarify the process of transition from one layer to the other, we discuss the structure characteristics of each of the three layers and relate them to the functions that need to be performed to initiate and complete the process of transition to another layer. Figure 4 provides an overview of the process and structure elements in each of the three layers.

Universe of modules

The modules within the universe of modules represent actors with different objectives, strategies, competencies and resources. An actor can be an organisation, a group, an individual, etc. The actors are very loosely related. The large number and the diversity of actors make the universe complex and impossible for individual actors to oversee. Because of a lack of information there is uncertainty about market developments (e.g. technological developments, customer requirements) and the strategies, objectives and performances of potential partners and competitors. Furthermore, actors in the universe are interdependent, because the extent to which actors are able to reach their objectives depends of the actions, performance and developments of other actors in the universe. The possibility of an actor to exploit a market opportunity is determined by its relative strength compared to other actors (competitors) in the universe of modules. The universe of modules can be characterised by the terms: complexity, uncertainty, and interdependence (Scott, 1998, 229-230).

This universe of modules is where the formation process of the virtual organisation starts: To overcome the difficulties of complexity, interdependence and uncertainty, actors may organise themselves into dynamic webs. Each of the actors may or can take initiative to start the process of the formation of a dynamic web by approaching other actors. Actors may know each other from an earlier co-operation or may be approached based on the expectation that together they have the competencies and resources to create added value for a specific customer or a group of customers.

Dynamic Web

As stated, the dynamic web is defined as an open-ended collection of pre-qualified actors that agree to form a pool of potential partners of virtual organisations. We use the term members to indicate the actors participating in a web. The members make agreements about for what purpose, when and how they want to co-operate if a market opportunity emerges. This implies that both structure, i.e. the elements (members) and relationships within the dynamic web, and process, i.e. the process of selection of new members into the dynamic web and the process of selecting members to form a virtual organisation, are important in describing the characteristics of the dynamic web. The dynamic web is presented as the middle layer of our model.

Whereas in the universe of modules actors are only related by interdependencies, in the web the relationships can be characterised by the structure elements suggested by Shao et al. (1998): purpose, connectivity, boundary and information technology. First of all, the actors agree on the purpose of the web in terms of the products and markets to be served by the web. The purpose is based on a common view on market opportunities and the expected customer value that the partners can create in sharing their complementary competencies and resources. The motivation of organisations to form a dynamic web to exploit a specific market opportunity is defined by Shao et al. (1998) as connectivity. Connectivity indicates to what extent the core competencies of the organisations are complementary and to what extent the co-operation in virtual organisations will add value compared to participation in other (competing) webs or compared to not working together at all. The benefits of the dynamic web are higher if the need for co-operation for the realisation of a market opportunity is more urgent and the challenges that need to be resolved (e.g. in technological problems or in terms of market response times) become larger. The agreement defining the purpose of the dynamic web also defines the boundaries of the web, who is part of it and who is not.

The essence of the dynamic web or a disposition to work together is that explicitly or implicitly agreements are made about the way organisations will co-operate in a virtual organisation. These agreements may specify for example procedures, quality levels, the exchange of knowledge, the use of information, etc. Since organisations in the dynamic web already know each other and specify in the web how they prefer to co-operate in future virtual organisations, the members of a dynamic web should be able to form the desired virtual organisation quickly if a market opportunity requires this. The most important characteristic of a dynamic web is its pre-selection mechanism, that reduces the complexity and uncertainty in the selection of business partners from the universe of modules.

The process of selecting or pre-qualifying new members corresponds to Mowshowitz' selection of (concrete) satisfiers (Mowshowitz, 1994). The aim of the selection is to identify on the one hand organisations that can strengthen the dynamic web in terms of competencies and on the other hand to evaluate their capabilities to co-operate in a virtual organisational form. In general, organisations will qualify for the dynamic web if they have different, but partly overlapping, performance profiles with respect to their strengths, competencies and/or resources (moderate heterogeneity). Organisations consisting of modular units (relatively small but manageable units with decentralised decision-making competence and responsibility) are more likely to succeed in adjusting their process and participate in rapidly organised responses to market opportunities (Wigand et al., 1997). Organisations should also have up-standard ICT capabilities. Each partner must be able to bridge the gap of time and spatial distribution between the members of the web. These criteria reflect the design principles or characteristics of virtual organisations by Wigand et al. as discussed in section 3, although heterogeneity may not be a strict requirement for participation in the dynamic web. On entering the web, the new member faces the strategic challenge of positioning himself among the pre-existing members of the network. The established members may have some repositioning to do to accommodate the new entrant. In fact, due to both internal and external change, repositioning may be viewed as a perpetual process. (Thorelli, 1986).

The process of selecting members from the dynamic web to become partners in a virtual organisation starts with the identification of customers' requirements. Each time a market opportunity is identified within the scope of products and markets defined by the purpose of the web, members of the web need to be activated to fulfil the identified need. Mowshowitz (1994) refers to this activation as the dynamic assignment of satisfiers to requirements. The essence of the assignment process is that the selection of partners is objectively performed based on the pre-defined assignment criteria (Mowshowitz, 1994). The use of pre-defined criteria facilitates a timely reaction towards time-based opportunities. It is important that the criteria are clear and that the split of costs and benefits is such that also for non-selected partners, participation in the web remains attractive or profitable. Mowshowitz (1994) indicates that exploration and analysis of the criteria should take place continuously. On the one hand because of changes in customer demands or experiences in the co-operation within the virtual organisation and on the other hand because the dynamic web itself is continuously changing. New entrants to the dynamic web may lead to changes in the assignment criteria. The fact that the assignment is reconsidered each time a market opportunity arises guarantees the best possible selection of members from the web to become partners in the virtual organisation (Mowshowitz, 1994).

Virtual organisation

The virtual organisation is the co-operation between a subset of organisations from the dynamic web. The co-operation is focused on the realisation of a specific objective, a concrete market opportunity. Therefore, the virtual organisation is goal specific. The type of co-operation can range from a service level agreement to a strategic alliance. During the formation of the partnership, tasks and responsibilities for each of the partners, as well as the co-ordinating mechanisms are formulated in detail and allocated. The relationship between the partners in the virtual organisation is formalised. This co-operation "format" results in an operation in which different organisations jointly develop, produce and market products and services. Again, ICT is an important enabler in the co-ordination of activities between the various partners.

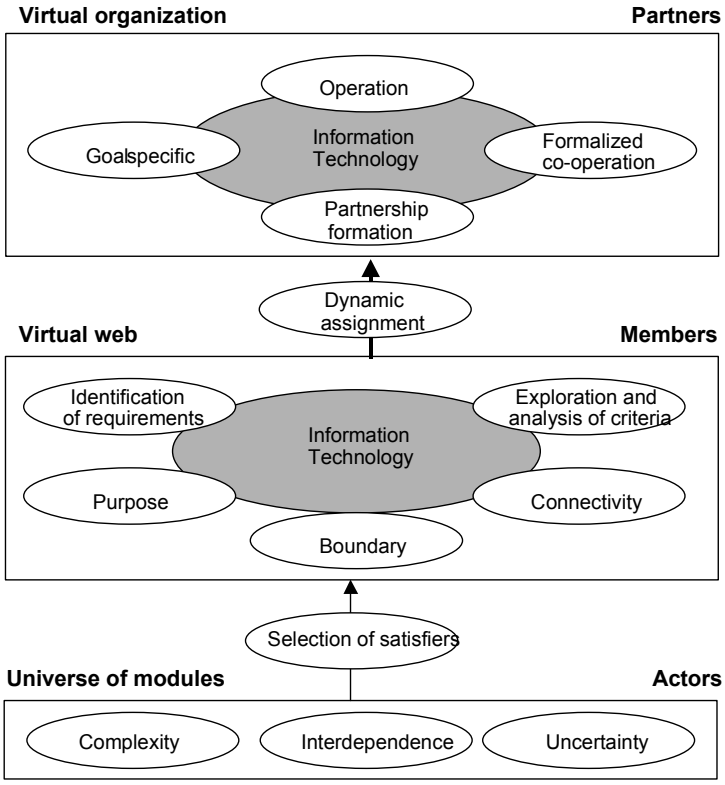

Figure 4: An integrated model towards a virtual organisation

When the market opportunity is exploited or has ceased to exist, the virtual organisation is terminated. On the one hand, this means terminating the operating processes of the virtual organisation (Strader et al., 1998). The remaining assets and materials are divided among the partners of the virtual organisation. On the other hand, this means that all knowledge and experience of working together in the virtual organisation is spread between the various organisations that will now return to the dynamic web. The experiences and knowledge gained during the virtual organisation may be used to update the assignment criteria and used in the evaluation of the various organisations and may be reflected in the way the members expect to work together in the future. As a result of mutual adjustments during the operating phase of the virtual organisation (Axelsson and Easton, 1992), the partners that have co-operated previously will be able to establish the virtual organisation again in an easy and smooth process. The relationship between the partners of the dynamic web has become tighter. As a result the strength of the dynamic web increases and therefore the competitive advantage of a new virtual organisation in case of a new market opportunity will increase.

We stress that our model is a theoretical construct. For example, two dimensions of organisation are said to be goal specificity and formalisation. However, it may not be possible to hold on too strictly to these dimensions. Because members in the dynamic web already agreed upon some important decisions, some degree of formalisation exists already in the dynamic web. At the same time the degree of goal specificity may also vary from virtual organisation to virtual organisation. A virtual organisation that aims at fulfilling a specific customer order has a very specific goal, while the aim of fulfilling a more general market opportunity may be less defined. Therefore, it may be difficult to make a clear distinction between the virtual organisation and the dynamic web in some cases.

Dell Company

An example of a virtual organisation is Dell Computers Corporation (Dell). Dell is an organisation that grows very quickly. Founded in 1984 by Michael Dell, now reached a turnover of $12 billion with 29,300 employees world-wide. Dell's mission is 'to be the most successful computer company in the

world at delivering the best customer experience'. Dell has a broad product scope, ranging from home PCs to products for businesses , such as network servers and workstations.

Dell's organisation principle is based on matching (dynamic assignment). The necessary operation to fulfil customer needs is performed on the basis of a standardised customer demand. Customers choose their computer components from a limited, predefined set of requirements. The partners involved in this operation are selected by Dell, based on a match between these customer requirements and the available capacity and capabilities of suppliers, i.e. satisfiers.. This makes Dell a virtual organisation: a collaboration of many companies that operate via one interface (Dell) to customers, using the principle of dynamic assignment (a continuous mapping of demand, requirements, and suppliers, satisfiers).

This dynamic assignment has several important implications. First of all, standardisation of customer orders is acquired by offering a limited, predefined set of components and having the customer fill in a standardised order form on the internet. Furthermore, Dell does not aim at offering all possible computer technologies, but at offering solutions, thereby limiting the variability of items. The products Dell offers are based on a well maintained customer profile. Databases provide the memory to record transactions and to develop this customer profile. Dell divides the market into very fine segments, which enables the company to identify opportunities and forecast customer needs. The customer-mix Dell serves is such that orders are more or less equally spread through time, which allows Dell to order materials from its suppliers in a very consistent and predictable way. Dell buys modules and only does the final assembly of products when it receives actual customer orders.

Another implication of dynamic assignment is that Dell selects from a well-known pool of suppliers (dynamic web), those suppliers that are able to fulfil this customer demand at a specific moment, based on requirements of customers and available capacity. Thus, of strategic importance is the composition of this pool of suppliers. Dell continually keeps track of product and technological developments and innovations, and searches actively for potential suppliers (a continuous tracking and analysis of satisfiers). Dell takes care not to be fully dependent upon one supplier for a specific computer component. This is done by a partial overlap in resources. This means that the suppliers in the network complement each other, but are competitors as well. Also, Dell assesses the suppliers in the web on their performance in technology, quality, flexibility, and service. Dell works with autonomous service providers to set quality standards and data linkages. These are the basis for the exploration and analysis of the criteria in the allocation procedure, that drives the dynamic assignment.

Dell is continuously managing the activities in the network by actively mapping, co-ordinating and evaluating not only information, but also the organisation structure and processes. Dell collects detailed information on its customers and suppliers and co-ordinates the activities in its network based on this information.

6. CONCLUSION

This notion of change is one of the key-concepts in the virtual organisation. It incorporates the ability to form, operate, and end a network organisation in a timely manner. An essential difference with traditional concepts is that the concept of virtual organisation incorporates change into the organisational design, whereas in more traditional concepts change is a force that frustrates organisational processes. While a number of authors have suggested that this ability of the virtual organisation leads to agile responses of organisations, at present there seems to be no or little literature available that either empirically or logically justifies this conjecture. Intuitively, this assumption seems to make sense and in this paper we did not aim to falsify this. The aim of this paper is to provide more insight into the dynamic mechanisms of virtual organisations.

The analysis of recent literature shows that in general two perspectives can be identified: a structure and process perspective. The former defines the virtual organisation in terms of the characteristics of the elements and the relationships within the virtual organisation. The latter focuses on the process of change. The combination of these two perspectives into a comprehensive model gives the management of a virtual organisation more insight how to organise external relations in a dynamic business environment. The comprehensive model has three layers: universe

of modules, dynamic web and virtual organisation. The different layers represent moments at which changes take place within the dynamic operation. For each of these layers, we identified and linked structure elements with functions that are required to trigger change.

Since it is a theoretical model, it does not specify the way these structure elements and functions should be modelled in a specific case. For organisations, it is interesting to determine what elements of the model should be adopted to contribute to flexibility and what steps need to be taken to realise these elements. Venkatraman and Henderson (1998) have identified three vectors (asset configuration, customer interaction, and knowledge leverage) to which the virtual organisation strategy can be applied. Sieber (1998) recognised five stages in the development of virtual organisation (creation of a complementary resource base, co-operation of partners by a common business understanding, integration of the resource base by a transaction governance system, formulation of a common network strategy, and socialisation by trust between the partners involved).

However, further empirical research on the mechanisms of virtual organisations remains necessary. Derived from the model, issues that have to be addressed are, for instance: What types of virtual organisation can be identified and in what situations can these be applied? What co-ordination principles are applied in virtual organisations? What are specific criteria according to which a dynamic web is organised? Is there a formalised agreement between all the partners of the web or creates each company its own web? Is there a difference in the formation of virtual organisations lead by a single powerful actor or broker as compared to those composed of actors with equal power? What is the boundary of the virtual organisation? The model presented in this paper can be used as the reference model in the analysis of different forms of virtual organisation in practice.

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