

Allocating environmental effects - a company vis-à-vis a network perspective

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Abstract

Environmental effects have attracted increased interest in the past years. In this paper, we discuss how a company vis-à-vis a network perspective on allocation of environmental effects may lead to quite different decisions by firms. Empirical examples based on four case studies describe logistic solutions and what effects are seen from a single company and a network perspective. It is concluded that if only considering environmental effects from an individual company's perspective, certain aspects are left out. This in turn has consequences for the environment. For society it becomes vital to find the appropriate analysis level for environmental effects, and also to reconsider allocations of environmental effects on company levels as this may actually counteract environmental-friendly intentions.

Keywords: Networks, Environment, Logistics, Case study, Allocation

Introduction

Defining boundaries of economic units have attracted research interests in various disciplines (e.g., Coase, 1937; Richardson, 1972). Legally, such boundaries are referred to as company borders, meaning that it is the individual companies that carry contracts, are parties in deal-making, and so forth. In most economics and management literature, the company is also the common unit of analysis. The network approach (Håkansson, 1982; Ford and Håkansson, 2006) emphasises that individual companies are part of larger settings, indicating that the context of firms needs to be acknowledged when analysing company activities (Håkansson and Snehota, 1989). Whereas this potentially would mean that researchers would aim to include as large portion of the network as possible, such unrestricted studies are not easy to accomplish, and also for companies, limitations in subjective sense-making mean that only limited parts of a network become viable for the company (Håkansson and Snehota, 1995). With networks being infinite, network horizons become a way to describe that no single actor can comprehend an entire network (Holmen and Pedersen, 2003). Network horizons define the outer end of networks as understood by a specific actor (cf. network pictures, Henneberg *et al.*, 2006). This also illustrates the subjectivity of networks as various actors would not share the same network horizons; the horizons are not existent per se.

An area that have attracted increased interest in the past years in environmental effects (Murphy and Poist, 1995; Sarkis, 1995; Faruk *et al.*, 2002; Aronsson and Hüge Brodin, 2006). Pollution, noise, damp, and the like, have become increasingly focused on by companies, researchers and society. Sustainable solutions that include the development of environmental-friendly solutions and entirely new alternatives with no or limited negative impact on the environment have become a key concern in company operations (Buisse and A., 2003; Stock *et al.*, 2005).

The environment carries several resemblances with companies in networks; effects from one party's activities may have consequences for others, and it is difficult to grasp the entire picture of environmental effects and their spread. Environmental effects consequently are embedded in wider structures both in an actor and a time dimension; something that has environmental consequences would affect also other parties' environment, and may also have effects that appear long-term.

In its attempt to come to terms with environmental issues and also to foster a development of environmental friendly solutions, society increasingly charges individual actors for the effects they cause. Taxes, emission trading and mandates all aim to restrict environmental effects, and with the principle of redistribution they aim to allocate such effects to individual companies. Allocation means that products or companies are seen as carriers of environmental effects and therefore also should carry the costs of pollution, and the like (cf. Desey and Dobias, 1992). Cost-benefit analyses and the idea of companies as utility maximising units, underpin these charges. Life cycle assessment is increasingly discussed in relation to environmental effects. It focuses on capturing entire effects of a single product from a cradle-to-grave perspective (Reap *et al.*, 2008). While this means that products' environmental effects are considered in the perspective of several actors, it does not capture actors' behaviour related to the environment. The allocation of environmental effects, where the legal unit of the company becomes the unit for allocation further fails to recognise voluntary environmental friendly undertakings by companies (Buisse and A., 2003), and also: they do not recognise the borderless structure of environmental effects. As such, an attention to individual companies' activities rather than environmental effects as seen from a wider

perspective, may ultimately lead to decisions and activities that do not act in the best interest of the environment.

In this paper, we discuss how delimitations of networks and specifically how the inclusion and exclusion of companies in the analysis of environmental effects (Håkansson and Snehota, 1995; Dubois, 1998) may lead to unexpected environmental consequences. The paper concerns allocation of environmental effects, and its fostering purpose, where the perspective of companies vis-à-vis networks becomes central. An area where environmental effects are considerable is that of transportation (Abukhader and Jönsson, 2004; EEA, 2007; Kohn, 2008). This is a consequence of increased transportations and also that transportation accounts for a sustainable part of CO₂ emissions (Kohn, 2008; McKinnon, 2008). Empirical examples describe logistics solutions and what effects are seen from a single company perspective vis-à-vis a network perspective. The paper contributes to research on environmental effects through discussing effects related to inclusion and exclusion of actors. Studies on environmental assessment in logistics systems remain limited (Aronsson and Huge Brodin, 2006), and few studies applying a network approach focuses on environmental issues (see Veal and Mouzas, 2008 as an exception). Life cycle assessment and cost-benefit analyses have illustrated problems related to capturing and allocating environmental effects, while less is known about their consequences on behaviour.

The paper is structured the following way: The next section presents our theoretical building blocks: ways to look at networks, and environmental effects. This is followed by the method section, and thereafter by a section presenting our cases. The cases are analysed based on a company vis-à-vis a network perspective on environmental effects, where limitations of network analyses are discussed related to the cases. The paper ends with a concluding discussion including ideas for further research and managerial implications.

Theory

Networks

The network approach emphasises the interconnectivity of companies (Håkansson, 1982; Håkansson and Snehota, 1995). Such interconnectivity means that companies' activities affect and are affected by other companies, and that companies cannot act without regarding (or becoming aware of) other companies' activities (Håkansson and Snehota, 1989; Håkansson and Ford, 2002). Studies based on the network approach therefore aim to capture companies in their context, where the unit of analysis may be one single company, a dyadic relationship, several relationships or entire networks. Regardless of unit of analysis, the awareness of company interconnectivity is however stressed and also marks a key characteristic for the network approach according to the IMP tradition (Håkansson, 1982).

Since networks are infinite, the researcher would have to decide what parts of the network that should be included in an analysis (Halinen and Törnroos, 2005). Also for companies, it is not possible to take entire networks into account. In studies on companies in networks, the researcher may choose to base its analysis on the network as understood by the researched companies, or may build its analysis on the researcher's comprehension of interactions. The analysis may take a bird's eyes view on networks or may base it on capturing perception from individual company's viewpoint.

Network horizons refer to what part of a network that a single company comprehends (Anderson *et al.*, 1994; Holmen and Pedersen, 2003; van Liere and Koppius, 2007). Holmen and Pedersen (2003) define the network horizon as “the part of the network that a firm is aware of and thereby can take into account” (p. 409). This means that there are limitations with regards to what part of the network a company manages to grasp (cf. Snehota, 1990; van Liere and Koppius, 2007). In that sense, network horizon would be similar to actors in a company’s network picture (Ford and Redwood, 2005; Henneberg *et al.*, 2006). Differences mainly lie in that network pictures deal with *how* actors are perceived, while network horizons simply describe *what* actors are included.

Those actors that are included based on a company’s network horizon may not necessarily represent the same actors as those that affect, or are affected by, a company’s activities. Anderson *et al.* (1994) use the concept *network context* to describe relevant actors of a company (cf. focal net, Möller and Halinen, 1999). Based on Anderson *et al.* (1994), the network context is found within the company’s network horizon, meaning that a company would be aware of all its relevant actors. But is this necessarily the case? The network horizon changes due to the company’s experience (van Liere and Koppius, 2007), but limitations in processing information and in perception of individual actors (Håkansson and Snehota, 1995) would mean that certain actors or activities could be disregarded, although these may prove to be important for the individual actor.

Companies’ activities will be influenced by their surrounding network; the network provides opportunities, but also constrains activities (Ford and Håkansson, 2006). Network horizon and network context imply that there are limitations in a company’s comprehension of a network. And, although a company is aware of other network actors, it is not certain that all decisions are based on an inclusion of all actors and consequences for these. A company may well try to act in the best of interest for itself, with the risk of inducing changes in the network. Economic theory describes companies as utility maximisers. This means that the companies will make decisions that are the most prosperous for the company itself. Related to the allocation of environmental effects, it is expected that companies are utility maximisers, where charging for environmental effects become a way to direct behaviour.

Environmental effects

The past years have seen an increased interest for assessing environmental effects. Environmental effects refer to undesirable, negative effects that an activity may have on the environment. The effects may appear as pollution, noise, damp, and the like, which interfere with ecological systems. The long-term goal is to decrease negative effects on environment, where the allocation of environmental effects becomes a way to foster environmental-friendly activities, and also to be a driving force for companies to develop other solutions. Allocation means that products or companies are seen as carriers of environmental effects and therefore also should carry the costs of pollution, and the like (cf. Desey and Dobias, 1992; Rebitzer *et al.*, 2004; Reap *et al.*, 2008). It is believed that through pricing environmental effects, companies will make rational choices that have positive effects for the environment.

Assessing environmental effects is not always an easy task. Commonly, a measurable common will have to represent the environmental effect. Bäckström (1999) however stresses that it is not fuel consumption as such (for example), but its effects on the environment that should be the key concern, and that the effects from fuel consumption need not always be known, or easily measured. Cost-benefit analyses of environmental effects (Pearce, 1976; Elliott and Yarrow, 1977; Smith, 1977) aim to capture economic and other effects of

resource-usage decisions (Prest and Turvey, 1965; Webb, 1976; Sen, 2000). Much of the literature concerns difficulties of pricing environmental effects and other methodological problems related to the method (Munda, 1996; Ackerman and Heinzerling, 2002; van den Bergh, 2004). Practical use of cost-benefit analyses of environmental effects often compare and discuss various inflation rates, and similar, and mostly focuses on a single source of environmental effects (Bollen *et al.*, 2009). Equally, life cycle assessment (Curran, 1996; Rebitzer *et al.*, 2004; Spielmann and Althaus, 2007; Reap *et al.*, 2008) is associated with several problems (Reap *et al.*, 2008). These include problems with finding and setting modelling parameters, and problems related to setting boundaries of products (Weidema, 2001; Bare and Gloria, 2006; Reap *et al.*, 2008). This latter describes what is a product, what functions (economic and others) do it fulfil and what environmental consequences are considered. Both cost-benefit analyses and life-cycle assessment are mainly tools to evaluate environmental effects, and much publications concern how to actually measure environmental effects on a conceptual basis. Studies on environmental management in companies and supply chains (e.g., Walton *et al.*, 1998; Buysse and A., 2003; Srivastava, 2007) foremost look at how companies may develop sustainable choices based on marketing advantages (Stock *et al.*, 2005) or driven by the companies' own will. In cost-benefit analyses and life-cycle assessment, such voluntary undertakings are not considered, and allocation measures may consequently misappropriate environmental behaviour.

Whereas the network approach emphasises the interconnectivity of companies, it is still somewhat arbitrary to capture consequences in networks. When society aims to assess environmental effects, attempts is made to take all consequences into account, but to divide them on an individual company basis (or to follow single products, see life-cycle assessment). Since allocation of environmental effects also seeks to steer companies' activities, the allocation of environmental effects to individual companies may lead to activities that would not be optimal for the environment if seen from a network – or an overall environmental – perspective. It is thus not easy to allocate effects in a manner that actually represents the environmental effects. This paper concerns such allocation and its fostering effects, where the perspective of companies vis-à-vis networks becomes central for such fostering measures. This further means that the paper does not centralise around environmental management of companies, yet sees this as an additional source for decisions that may collide with allocation intentions.

An area that represent a sustainable source for environmental effects is transportation (Aronsson and Huge Brodin, 2006). According to Eurostat (2003), the transport sector accounted for thirty-two percent of total energy consumption and forty-four percent of the total CO₂ emissions from fossil fuels in the EU in 2001. Globalisation means that transportation volumes are increasing and does so at a more rapid pace than overall economic growth (EEA, 2007). Measures are taken to decrease environmental effects of transportation, which include changes in transportation modes, reduction in demand, and better utilisation of existing transportations (European Commission, 2001).

Method

This paper is based on case study research (Yin, 1994; Halinen and Törnroos, 2005; Dul and Hak, 2008). We illustrate how the delimitations of networks and specifically the inclusion and exclusion of companies on the activity level may lead to unexpected environmental consequences, through four case studies. A central characteristic of case study research is that it allows the researcher to capture activities in their context, rather than separated from their context. The purpose of this study makes it important to capture company contexts and also

what actors are included and excluded. For that reason, the case study approach seemed to be a suitable choice. While case studies have benefits in terms of details and understanding connections between activities, context and actors, they may not allow for generalisation of results. The number of cases is limited and main concern is not (always) to find overall patterns, but to describe activities and their interconnectivity. What would be expected is however that results are transferable to other situations, thus creating a source of knowledge for other situations, but which also means that similar findings can be found in other cases than those specifically under study (Hirschman, 1986; Guba and Lincoln, 1989).

The four cases studied represent companies that have actively worked with decreasing environmental effects of operations. In a multiple case study, the individual cases may relate to each other in different ways; they may aim to confirm each other, bring additional aspects to a studied phenomenon, or aim to build a comparative analysis. The cases in this paper aim to illustrate various ways to delimit the network related to environmental effects, which means that our main aim with the four case studies is to add additional aspects to the discussion, while at the same time compare various set-ups. The case studies also address various dimensions of the European Commission's (2001) goals to reduce environmental effects of transportation (changes in transportation modes, reduction in demand, and better utilisation of existing transportations, cf. Aronsson and Huge Brodin, 2006), meaning that they have a practical representation set by these goals.

The individual cases are built on interviews and observations supported by secondary data analyses (Welch, 2000). Interviewees represent studied companies and logistics firms. In total, twenty interviews were performed with logistics managers, procurement staff, shippers and the like. The cases originate from different research projects on environmental effects of logistics solutions. The authors of this paper have either acted as participating researchers, discussant partners or supervisors in the individual case studies. Initial case descriptions have been analysed individually by the authors with the focus to capture how environmental effects are understood from a company vis-à-vis a network perspective. In order to achieve confirmability of case results, preliminary findings were thereafter discussed among the authors so as to see whether similar conclusions had been made from the cases (Hirschman, 1986; Guba and Lincoln, 1989). The individual conclusions did not suggest any contradictions in findings, which indicate that presented findings would represent the cases in an accurate way. In addition, and apart from one case, the companies are not anonymous but described under their real names. This makes it possible for other researchers to control the accuracy of the information provided.

Case studies

This section describes our four case studies: ICA, ITT Flygt, Northern Baker and Returpack.

ICA

ICA is a food wholesale company, partly owned by Royal Ahold N.V. in the Netherlands and by Hakon Invest AB, Sweden. ICA consists of 2,230 stores in Sweden, Norway and the Baltic states, where the stores are owned by individual retailers acting on a franchise basis, or by ICA itself. The company mainly distributes food and other fast moving consumer goods to the retailers, but also manufactures own products or distributes OEM-products with a private label. Environmental goals are clearly stated in ICA's corporate responsibility report (ICA, 2008).

Traditionally, ICA functioned as an umbrella organisation, while transportations were performed by food producers directly to the retailers. In the early 2000, ICA decided to rearrange transportation through making itself a coordinator. Previous transportations between food producers and retailers were to be centralised. Routes were exchanged for a system where ICA acted as a node through which all transportations would pass. In practice this meant that ICA would manage the transports from food producers to a central store and further to the individual retailers. In a first step, food producers continued to provide transport to the ICA central warehouses, but soon ICA also wanted to provide the transports from the food producers. This would mean that ICA would get a better overview over the whole system for supplying the retailers, and that the company could also organise the logistics system in a more efficient way. With regards to environmental considerations, the new transportation routines would contribute to better fill-rates of transports, thus decreasing costs and reducing the environmental effects in their logistics systems.

From food suppliers' perspective, the new routes of ICA and ICA taking care of transportation from suppliers, through a central store to retailers, meant a significant change. While the routes made ICA's transportations more efficient both in cost and in environmental effect terms, it simultaneously affected such aspects negatively for suppliers. Besides ICA, suppliers also distributed food to other customers, including independent retailers, restaurants and industrial kitchens. ICA taking care of its own transports could on an aggregated level be seen as a reason for suppliers to decrease their transports. However, while this was partly the case, ICA's solution also meant that suppliers had problems to maintain a high fill-rate in their transports. They had problems to coordinate their transportations, resulting in that some transports were half-empty. The consequence of the lower fill rates is in turn higher costs as well as higher environmental stress, given that the delivery service is kept at the same level as before.

ITT Flygt

ITT Flygt is part of an international company group, International Telephone & Telegraph Corporation, and manufactures submersible pumps and mixers. The company is represented in over 130 countries throughout the world, and has manufacturing sites in Sweden, Germany, the Netherlands, Italy, Argentina and China. For Europe, its main production site is situated in the south of Sweden. The company has environmental-related ambitions and is certified according to the ISO14000 standards (Kohn, 2005).

Traditionally, distribution was performed from the Swedish manufacturing site to customers throughout Europe. In the late 1990s, the company decided to centralise distribution through building a central warehouse. The central warehouse was located in Metz (in France), which meant that individual transports to customers were shortened, while at the same time all goods were transported from Sweden to France, since manufacturing would remain in the south of Sweden.

The reorganisation of transports meant that the total transport kilometres increased. In the reorganisation of transportation, questions concerning mode of transportation arose. Based on mode of transportation, transportation by train was considered more environmental friendly than transportation by lorries. Also on the cost side, trains would be the preferred option. However, precision in deliveries would be harmed by the train transports. This would either require that ITT Flygt would be able to also deliver complementary products on demand, or increase its safety stock. Through including safety stocks in the analysis, initial downsides

with the relocation and train transports could be met. Thus including additional activities of the firm uncovered previously disregarded options.

Northern Baker

Northern Baker (anonymous case) is a family business located in the north of Sweden. The company produces bread in three bakeries. The three bakeries are all located in the northern part of Sweden, while much of the customer base, as a result of Sweden's population structure, is located in the southern parts of Sweden. The company has a sales organisation that sells bread to retail stores, which means that the company covers the entire Sweden. Still, with the production sites being located in the north, the company transports its bread long distances.

The company is cautious about its environmental effects. In 2009, the company was certified according to the environmental standard ISO14001. The environmental awareness means that the company tries to minimise its environmental effects. Still however, when society aims to allocate environmental effects, Northern Baker's transportation accounts for a considerable part of the company's negative environmental sources. This is a result of that environmental effects are measured per kilometre rather than on a network level. At a first glance, this would seem appropriate, but allocating environmental effects per kilometres means that no attention is paid to the actual routes of transports.

If looking at the transport routes between the northern and southern parts of Sweden, it becomes evident that more transports run from the south of Sweden to the north, than the other way around. This is a result of the infrastructure of the Swedish society, where more goods are manufactured in the south than in the north. Statistics on transportation show a clear imbalance between transports from the south to the north, and transports from the north to the south. In its strive to minimise negative environmental effects, Northern Baker has considered to move south. From the individual company's perspective and from the scheme derived from society's allocation of environmental effects, this would be a rational move. However, if the imbalance in transportations between the north and the south of Sweden is taken into account, the environmental effects become less clear. As it is, Northern Baker can use lorry space that would otherwise be empty when transportations to the northern parts of Sweden are to return to the south. The use of empty space in lorries positively affects the fill-rate (cf. the goals of the European Commission, 2001).

Returpack

Returpack is a company dealing with returnable bottles and cans. The company is the result of rules regarding supplier responsibility in the area of bottled and canned soft-drinks and takes care of bottles and cans that consumers return to retailer stores. Consumers deposit money that they receive in return when they return bottles and cans to the retailer stores. Returpack's business mission is thus in the environmental area, where it aims to take care of and recycle waste products.

Returpack is jointly owned by retailers (distributors), the brewery sector (producers) and the packaging industry (manufacturers of bottles and cans). In order to optimise the use of the current transport system, Returpack uses retailers' and producers' empty return transports to transport used bottles and cans. Such a solution is made possible since the companies own Returpack jointly. The use of return transports did however mean that several transports were taken from retailers to producers, and then further on to Returpack and the manufacturers of

bottles and cans. In total, this meant several short-distanced transports including reloading at various actors' destinations.

Through instead incorporating the entire reverse flow of material, it became evident that the transportation of empty bottles and cans should preferably be done directly from retailers to Returpack. This also allows for changed transportation modes, where lorries could be exchanged for trains, and if such solutions are not possible: an improved fill-rate could be accomplished.

Analysis

The four cases reveal various logistics problems related to environmental effects. The ICA case illustrates how a solution that seems to decrease the individual company's negative effects on the environment at the same time harms other actors' environmental effects. ITT Flygt indicates that also other activities need to be included in an environmental analysis. Northern Baker illustrates how environmental effects are understood differently when studied on a national vis-à-vis a company level. The Returpack case shows that while already focusing on coordinated transports, a solution that partly disregards coordination actually proves to be less harmful to the environment. In addition, ITT Flygt and Returpack illustrate that based on taking a larger perspective, other transportation modes may become more favourable. The cases also demonstrate environmental solutions that meet the European Commission's (2001) transport goals in various ways. ICA and Northern Baker deal with how to best utilise existing transportations. Returpack aims to reduce overall demand, and Returpack and ITT Flygt entail the described changes in transportation modes.

The case study companies were all dedicated to reduce their environmental effects. Still, they had managed to do so to various extents. It is also clear from the cases that especially Returpack, but partly also Northern Baker, had tried to grasp a larger picture of environmental consequences already in their initial solutions, while ICA and ITT Flygt mainly focused on the company's own environmental effects.

Table 1 summarises the case studies based on what goal of the European Commission they addressed, environmental effects from the individual company's perspective, and from a network perspective, as well as relevant actors of the network.

Table 1: Environmental effects in cases studied

	<i>ICA</i>	<i>ITT Flygt</i>	<i>Northern Baker</i>	<i>Returpack</i>
<i>Addressed goal of European Commission</i>	Better utilisation of existing transportations.	Changed transportation modes.	Better utilisation of existing transportations.	Reduce overall demand. Changed transportation modes.
<i>Environmental effects from the individual company's perspective</i>	Better utilisation from ICA's perspective as ICA became the coordinator.	When not including safety stock it would have been better not to have the central warehouse, or to continue with lorries.	Negative environmental effects based on the company's location. Moving the company would decrease environmental	While using return transportation, the company failed to acknowledge overall consequences.

			effects.	
<i>Environmental effects from a network perspective</i>	ICA as coordinator meant lower fill rates for suppliers.	Through including other activities, a decision that first meant an increase in transportation proved to be an advantage.	Northern Baker's transports utilised return-transport from the north of Sweden that would otherwise have run empty.	Through incorporating the entire reverse flow, it became evident that direct transportation was a better choice and also other transportation modes could be considered.
<i>Relevant actors provided in the case descriptions</i>	Suppliers, ICA, other logistics firms and customers (retailers).	The activity level of safety stock. Production unit, central warehouse and customers.	Customers, logistics firms, Northern Baker. National imbalance of transportation.	Customers (retailers), Returpack, breweries, packaging companies and other transport companies.

The company level

On a company level, the company's would be inclined to make decisions that would be positive for the individual company. For a company that actively works with reducing environmental effects, this would be expected behaviours (Stock *et al.*, 2005). For ICA, the idea of becoming a coordinator of transportation, where the company would perform transports from suppliers to retailers meant that ICA would improve its fill rates. ITT Flygt would, based on a single activity analysis resist the central warehouse and instead continue as previously with direct deliveries from the production site. Northern Baker would have moved to the south of Sweden. And Returpack would have continued to use return transportations on an actor-to-actor level. (It should be noted that in the Returpack case, and as a result of the company's ownership structure, the key analysis never included just a single actor, but transportation was performed between such single actors.)

This is also in compliance with how environmental effects would be expected to be taken into account if these are allocated to individual companies. When society allocates environmental effects – in terms of taxes, mandates or emission rights – it does so on a company level. Individual companies may in turn make deals with each other regarding emission rights, but still, the focus is on pricing environmental effects and allocating these to individual companies. The fundamental idea is not to achieve revenues from such operations, but to foster a company behaviour that matches society's environmental ambitions.

Based on our case studies, it can be concluded that if focusing on environmental consequences for individual companies, decisions may well be made that do not act in compliance with overall environmental intentions.

The network level

The four cases reveal that once the companies include also other actors or activities in the analysis of environmental effects, such effects appear in quite a different light. For ICA, the environmental gain of becoming a coordinator with better fill rates, is met by suppliers that

were not able to fill their lorries anymore. ITT Flygt saw another pattern of how to organise distribution once the activity layer of safety stocks was considered. Northern Baker did not seem to be wrongly located once return transports and geographical imbalance in transports were recognised. Returpack, that thought it had included contextual consequences, saw these in a different light when looking at the entire picture of transports and reloading. The cases consequently illustrate both added actors (ICA, Northern Baker and Returpack) and added activities (ITT Flygt) in the analysis of environmental effects.

Added actors

Through adding actors to the analysis of environmental effects, it becomes visible that environmental effects are not a single company concern, but rather transfers between companies. The inclusion of additional actors in the analysis of environmental effects may mean that advantages seen on a company level are erased, or may alter direction of what would be the most appropriate activities for each party. In the ICA case, the gains from coordinated and centralised transportations were erased once food suppliers were included in the analysis. The coordination only meant that environmental effects were pushed from one actor to the other. For Northern Baker, the inclusion of shippers that transported goods from the south to the north, meant that the long distance of Northern Baker's transports to customers could be disregarded in the calculation of environmental effects. Basically, the lorries would drive from the north to the south anyway, and that Northern Baker could use the empty space actually meant that goals of fill rate were better met (cf. European Commission, 2001). Returpack had already previously included several parties in their analysis of environmental effects. However, the use of return transports had been divided into parts (between each actor), and also, the analysis did not include parties beyond the owners of Returpack. The larger picture meant that other transportation modes could be considered, and also that individual transports could be decreased, which reduced environmental effects of operations.

Added activities

Adding activities to the analysis of environmental effects allows for finding solutions that are less harmful to the environment, than if only single activities are taken into account. This indicates that logistics solutions reach beyond transportation, and consequently also challenges goals that aim to only decrease transportation effects (European Commission, 2001), while not seeing them as part of larger systems. The ITT Flygt case revealed that various solutions proved to best fit environmental goals of the company, based on inclusion of activities: If only viewing the company's transportations, the better option would be to continue to deliver from the production site in Sweden, instead of building a warehouse in Metz. Deliveries on trains would not be the option, since it meant that additional transports were needed and since the fill rate was low, unless safety stocks were an option. It is first with the introduction of safety stocks that environmental effects are decreased and trains become a suitable choice.

The network level of environmental effect analyses consequently promotes quite different solutions from analyses on a company level. On a company level, effects sourcing from other parties are excluded. As a result, it would be important to take a network, rather than a single company, perspective on environmental effects. This complies well with that environmental effects may have consequences for other parties. However, also network analyses are delimited as results of that no single actor (or researcher) manages to grasp an entire network.

And, based on the cases, it should be noted that all case companies did not include such a wider perspective in their decisions. ICA chose the model of coordination, rather than including consequences for suppliers' transportations.

Limitations of networks

In the beginning of this paper, we discussed various ways to delimit network studies. The focus of such studies may be single companies, dyads, or various portions of a network. From a researcher's point of view, the aim may be to capture a network based on actors' understanding of the network, or based on the researcher's own definition of the network. For actors, network horizons and network context become ways to describe that only a limited number of companies are included in an actor's perception of a network. Network horizon describes what parties an actor is aware of, while network context include relevant actors of the company (Anderson *et al.*, 1994; Holmen and Pedersen, 2003). Both these are underpinned by dynamic forces, which mean that over time, included companies may change.

In the studied cases, not including external parties may be seen as that these parties were not included in the focal companies' network horizons. Seeing it that way would add a dimension to network horizons: that of inclusion of actors related to specific activities. ICA would for certain be aware of the food suppliers, but did not consider environmental effects related to them in the planning of centralised transportation, for example. However, this could also be interpreted as a result of that ICA put its goals at front, something that was also sanctioned by legal systems' distribution of environmental effects.

Still, the cases indicate that the companies had not managed to grasp the entire picture of relevant actors in their initial set-ups. To exemplify; although Returpack included external actors in its set-up of using return transports, it did not see that these in turn were part of larger systems of transportation. Equally, in society's concern with allocating environmental effects, it failed to recognise return transports (see the Northern Baker case). This would indicate that there is indeed a difference between network horizon and network context, where the network horizon may fail to include relevant actors. We have not followed the cases further in terms of additional actors, but presumably, presented solutions may find themselves challenged once additional actors are included.

Taken together, this means that while acknowledging networks as important in environmental analyses, limitations based on perception of actors mean that environmental consequences cannot be fully captured. Still, the network analysis would provide some important insights that would be completely disregarded if only focusing on single actors.

Concluding discussion

This paper discusses how delimitations of networks and specifically the inclusion and exclusion of companies may lead to unexpected environmental consequences. The paper has shown that based on inclusion and exclusion of actors, quite different decisions would be made, and quite different environmental consequences would be the result. With the environment being borderless, it seems to make better sense to treat such effects as borderless, and attempts to allocate them to individual companies may actually harm the environment further.

Table 2 summarises some of the consequences of regarding environmental effects on a company vis-à-vis a network level. The individual company perspective would expectedly

mean that each actor would attempt to minimise its environmental effects. This would be underpinned by taxes and emission rights, where the legal unit is the carrier of such charges. In order to be able to allocate environmental effects to individual companies, measures such as per kilometre-solutions would be used. And such allocations would not be able to consider return transports that would have been run anyway, for example.

If instead including network parties and additional activities in analyses of environmental effects, these effects would ideally be minimised in total, rather than for individual actors. We also propose that environmental effects should be treated as marginal effects, rather than evenly distributed between actors. Focus would be on what a specific actor or activity adds in terms of environmental effects to the entire network, instead of accounting for environmental effects per kilometres, for example.

Table 2: The company vis-à-vis the network perspective on environmental effects

<i>The company perspective</i>	<i>A network perspective</i>
Focus on optimising for the single actor.	Focus on finding fair solution for the individual actor as part of a larger system.
The individual company as carrier of environmental effects.	Larger systems as carriers of environmental effects.
Environmental effects are divided per unit (e.g., per kilometre)	Environmental effects can be distributed as marginal (rather than absolute) effects. What does an additional activity add in terms of environmental effects?

Theoretically, this paper deals with various ways to define units of activities: the company level or the network level. There are clear discrepancies between the company perspective, network horizons and relevant actors of a company. As stated previously, network horizons (but perhaps also relevant actors) are less than perfect ways of dealing with environmental effects, yet provides a more complete picture than a focus on single companies. The company vis-à-vis the network perspective however reaches beyond what parties are included in the analysis. Models of allocating environmental effects are built on assumptions about that single actors aim to maximise utility, where assessing costs to environmental effects becomes a tool to steer company activities in a certain direction. This means that inspiration about how a company acts is taken from economic theory. The network approach is built on quite different assumptions about companies. This includes assumptions about maximising versus satisfying, complete information versus limited information, and so forth (cf. Simon, 1957), where actors’ limited information is underlined through how individual actors are not capable to grasp entire networks, for example.

If relating our findings to cost-benefit analyses, life-cycle assessment and environmental management of companies, cost-benefit analyses and life-cycle assessment are underpinned by ideas of utility maximisation in decision making. Cost-benefit analyses would include environmental effects as costs in project estimates, with a focus to steer individual companies’ decisions. Life-cycle assessment follows individual products, which means that several actors may be involved in the analysis (cf. environmental management of supply chains), yet, it separates the product from surrounding resources. The ITT Flygt case indicates that it is important to include several product flows in the analysis. Environmental management includes that companies want to promote themselves as environmental-friendly or that they

put efforts on developing sustainable solutions. Also in this case, the analysis unit is the company level, where suboptimal decisions may be a result if seen from a network level.

Managerial implications

Environmental effects and social responsibility have increasingly come to companies' awareness. This study indicates that being truly environmentally aware would mean to be able to see beyond the own company's borders. The inclusion of additional actors and activities may lead to quite different behaviour than an analysis focusing on evenly divided environmental effects on a company level.

For society, it is important to consider what effects taxes and emission rights have on company's behaviour. Goals such as changes in transportation modes, reduction in demand, and better utilisation of existing transportations, could be interpreted quite differently if including external actors in the analysis. For society, the core goal is not to charge the companies, but to foster an environmental-friendly behaviour. It is therefore imperative that measures taken to allocate environmental effects have the desired effects, not for individual companies, but for society as such. Based on our findings, environmental effects would benefit from being studied from a network perspective, rather than based on single actors' activities. We also suggest treating environmental effects as marginal contributions rather than as evenly divided between companies.

Further research

Studies on environmental issues according to the network approach are limited. And, in logistics, few studies focus on environmental assessment. This opens up an excellent opportunity to explore issues on environmental effects further.

To further elaborate on consequences of how parties delimit their networks, and to study company vis-à-vis network consequences of certain activities are areas that we consider interesting for further research. Few studies have analysed network horizons of companies (Salmi *et al.*, 2001; Holmen and Pedersen, 2003; Hallén and Lundberg, 2004), and future research could include a further development of the concept.

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