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**Reducing transportation emissions – a reaction to
stakeholder pressure or a strategy to increase
competitive advantage**

ABSTRACT

Purpose: This paper evaluates why companies reduce transportation emissions by examining the relative importance of external drivers vs. internal motives for companies in considering CO₂ emissions in freight transportation.

Design/methodology/approach: A framework is suggested that captures internal, competitiveness-driven motives and external, stakeholder-driven drivers for companies seeking to reduce CO₂ in freight transportation. These factors are tested in a large industry survey in Sweden. The survey resulted in 172 responses from corporate heads of logistics, a response rate of 40.3%.

Findings: Variations in responding to stakeholder pressure vs. company strategy for reducing transportation emissions are identified. Company strategy outweighs stakeholder pressure in determining whether a company intends to green its transportation. The strategy leads to company-internal motives for reducing transportation emissions which differ from company to company. These differences, in turn, lead to different levels of intended reductions. Stakeholder pressure sets the minimal levels that elevate the performance of a group of companies in an industry or a country, but the differentiation effect across companies is lost. The intention to reduce emissions is greatest if a company has both economic and image motives. The logistics resource configuration does not seem to impact drivers and motives.

Research limitations/implications: The research is based on companies in Sweden. Studies across several countries are needed to investigate the impact of national requirements.

Originality/value: The paper shows that the combination of the resource-based view and stakeholder theory presents a better explanation as to why companies reduce transportation emissions than either of them do separately. By combining the two theories this research differentiates between how stakeholder pressure and company strategy influence intents to green transportation.

Keywords: CO₂ emissions, Driver, Freight transport, Motive, RBV, Stakeholder, Survey, Sustainability

Article classification: Research paper

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1 INTRODUCTION

The current discussion on greenhouse gas emissions in policy and practice has caught the attention of companies across many industries. Transportation emissions are a prominent topic in transport policy (EU, 2011). They are related to infrastructure decisions (Harris et al., 2011), economic analysis (Litman, 2011), and the development of emission calculators (e.g. GHG Protocol, 2011). Emission calculation is an important topic in logistics, whether from the perspective of the actual calculation (McKinnon, 2010; Litman, 2011), when assessing transportation-related drivers of emissions (McKinnon and Piecyk, 2009), or when considering the calculations on different levels: product, consignment, company, and SC (McKinnon, 2010; Piecyk, 2010).

Already in 1995, Wu and Dunn (1995) discussed logistical decisions in light of their environmental impact. Regarding transportation, they highlight three areas with high environmental impacts: (1) the construction of transport networks related to infrastructure and inventory location, (2) the operation of vehicles, including fuel choice, and (3) the disposal of vehicles. Whilst all industries have their own ways to reduce emissions in manufacturing, a common problem for all is emissions that stem from the transportation of their products between various echelons of their supply chain (SC).

The extant literature does not agree on why companies choose to incorporate environmental considerations in transportation. Wolf and Seuring (2010) list customer demand, laws, and environmental product development as three main reasons to reduce transportation emissions. ElTayeb et al. (2010) consider four drivers: regulations, customer pressure, social responsibility, and expected business benefits. Eng-Larsson and Kohn (2012), conversely, differentiate between two reasons for greening transportation: the driver of “external pressure” and the internal motive of “business and logistics strategy”. The purpose of this paper is to evaluate why companies reduce transportation emissions. Our research questions are as follows:

- What are the roles of company strategy and external pressure to reduce transportation emissions?
- What factors influence companies in their intent to reduce transportation emissions?
- What company-internal motives and external drivers are the most effective in terms of reducing transportation emissions?

- What is the role of logistics resource configurations (a component that helps explain the company strategy) to reduce transportation emissions?

By combining two theoretical lenses in section 2, the resource-based view (RBV) and stakeholder theory (ST), we identify company-internal motives vs. external drivers for reducing transportation emissions. Section 3 summarises the methods used. Based on the findings presented in section 4, we evaluate the relative importance of internal motives vs. external drivers that leads companies to attempt to reduce CO₂ emissions. Based on a survey of various transportation-heavy industries, we further consider the logistics resource configuration (LRC) as an alternative explanatory factor leading to a focus on CO₂ emissions. Finally, a discussion and conclusions are presented along with managerial implications.

2 COMPANY STRATEGY VS. EXTERNAL PRESSURE TO REDUCE TRANSPORTATION EMISSIONS

There are several competing views on how and why companies consider the natural environment in their operations. Sarkis et al. (2011) list fourteen organisational theories used in green supply chain management (GSCM) literature, including complexity theory, institutional theory, the resource-based view, social network theory and transaction cost economics. They argue that the first reason to examine industrial pollution was to determine how it could be taxed. Only later were warnings of climate change attended to. Thus, governmental policy was the first driver for considering pollution, with taxation systems as a form of institutional, or stakeholder pressure to reduce emissions. Ever since, ST has been frequently applied to GSCM research (Sarkis et al., 2011). Hence stakeholder engagement is one of four facilitators of GSCM that Carter and Rogers (2008), and later Carter and Easton (2011), present alongside strategy, risk management, and organisational culture.

Yet, external pressure is but one explanation as to why companies choose to be green. Eng-Larsson and Kohn (2012) contrast external pressure with company-internal motives for greening. Internal motives stem from a business strategy that is ultimately operationalised in a logistics strategy. This strategy perspective asserts the notion of agency as the source of a company's existence rather than that of satisfying stakeholder pressure. Carter and Rogers (2008) use RBV to emphasise the ability of a company to achieve competitive advantage through the effective use of its heterogeneous resources.

An obvious question is whether strategy or stakeholder pressure alone can account for why companies choose to be green. The logistics literature often relates greening to RBV or ST. Sarkis et al.'s (2010) starting point is that RBV and ST are complementary lenses through which to examine the adoption of environmental practices. Hart (1995) refers to stakeholder integration as a key resource in the natural resource-based view (NRBV). There is some overlap between the two theoretical lenses that we highlight after having first investigated the two separately.

2.1 The role of the strategy view in reducing transportation emissions

The myriad of approaches in RBV or resource-based theory range from resource dependence theory to the dynamic capability model or in sustainability research, to NRBV (Hart and Dowell, 2011). All of these share the assumption that resources and

capabilities are heterogeneous across firms and that differences in their combination help explain differences in firm performance (Barney et al., 2011). For example, whether to use logistics service providers (LSPs) or to perform logistical activities in-house is an aspect of the firm's logistics resource configuration (LRC) – and LRCs differ across industries (Kovács and Tatham, 2009). Hence, an initial difference is expected in the motives of manufacturing companies vs. LSPs for reducing transportation emissions since logistics activities are the core of LSPs. LSPs and manufacturing companies that manage logistics operations in-house are expected to pursue a lean approach to transportation emissions, realising fuel efficiencies and economies of scale from bundling transportation and filling backhauls.

The causes of CO₂ emissions from freight transportation can be decomposed into five factors: 1) tonne-km per tonne, 2) vehicle-km per tonne-km, 3) kWh per vehicle-km, 4) tonne, and 5) CO₂ per kWh (as in Woxenius, 2005). Changes in any of these factors lead to changes in CO₂ emissions from freight transportation. Here, factors 1-3 are considered as they are the only ones that depend on logistics. The first factor can be reduced through shorter distances obtained by having suppliers located close together or by relocating production plants and warehouses. As for the second factor, the total amount of vehicle-kilometres can be reduced again by shortening distances or by improving fill rates. Fill rates, in turn, are affected by the weight or volume efficiency of packaging or loading capacity in vehicles. From a logistics perspective, the third factor can be reduced by changing transportation modes to less energy-intensives ones. Altogether, how these reductions in CO₂ emissions are obtained depends on LRC of a firm, which we define as a combination of (a) logistics structure (modal choice, routing, direct vs. terminal distribution) and (b) control over logistics operations (i.e. the use of in-house vs. outsourced logistics services). Our definition follows Olavarrieta and Ellinger's (1997) distinction of logistics resources in terms of logistical assets the firm has control over vs. logistical capabilities that enable the firm to utilise assets through organisational processes. In particular, we expect companies with in-house control over transportation to have stronger motives for reducing transportation emissions than companies that have outsourced transportation. We hypothesise that:

H1. The resource configuration (H1a. logistics structure; H1b. level of control over logistics operations) of a firm positively influences the motives/drivers for reducing transportation emissions.

H1 follows the RBV logic of retaining resources that are core for a company's competitive advantage. Thus, if logistical activities such as transportation are outsourced, they are not perceived as crucial. In-house control over transportation emissions applies to manufacturing companies that have not outsourced logistical activities and to LSPs.

The resources of a firm are “all assets, capabilities, organisational processes, firm attributes, information, knowledge, etc. controlled by a firm” that enable a firm to improve its performance (Barney, 1991, p.101). RBV elucidates how heterogeneous, often inimitable resources can be combined into unique capabilities to develop a long-term economic competitive advantage (Carter and Rogers, 2008; Barney et al., 2011), also called “sustained competitive advantage” (Barney, 1991; 2012) or “sustainable competitive advantage” (Olavarrieta and Ellinger, 1997; Molloy et al., 2011). To distinguish it from the social-environmental aspect of sustainability, we use “long-term competitive advantage” to denote what RBV encapsulates in “sustained” or “sustainable competitive advantage”. We hypothesise that:

H2. The opportunity to obtain long-term competitive advantage positively influences a company's intent to reduce transportation emissions.

The efficient and effective use of resources can be described in terms of cost and value advantages (Christopher, 2011). Cost advantage translates into resource productivity that, if applied to greening, would increase eco-efficiency. This is differentiated from value advantage, which relates to creating value through green product innovations and a green image. Similarly, from an NRBV perspective, Hart (1995) distinguishes between the competitive advantages of:

- a) lower costs through pollution prevention and continuous improvement,
- b) pre-empting competitors through product stewardship stakeholder integration, and
- c) a future position, through a shared vision and sustainable development overall.

Combining Christopher's (2011) and Hart's (1995) views on competitive advantage, we differentiate between short-term “increased company profitability” (as opposed to long-term competitive advantage) and “marketing advantage”. We follow the logic of

Christopher's (2011) argumentation that value advantage is achieved through differentiation in the market. "Marketing advantage" is defined as the possibility to differentiate a company's product or service offering in the marketplace, which in this study is through the reduction of transportation emissions. This term corresponds to Christopher's (2011) "value advantage" or Carbone and Maotti's (2011) "strategic intent" to position the company as green. In contrast, "increased company profitability" is defined as a short-term increase of the financial performance of the company as achieved through a cost advantage. The two aspects of competitive advantage may be pursued in series or parallel. We formulate separate hypotheses to highlight them both:

H3. The opportunity to obtain marketing advantages positively influences a company's intent to reduce transportation emissions.

H4. The opportunity to increase short-term company profitability positively influences a company's intent to reduce transportation emissions.

Differences in resource configurations lead to variations in the ways companies achieve competitive advantage. Apart from LRC, there are other aspects of resources and capabilities that pertain to logistics management. From a logistical perspective, Olavarrieta and Ellinger (1997) categorise resources into input factors (e.g. raw materials, skills), assets (infrastructure, stock) and capabilities (bundles of skills and assets to organise resources). Carter and Rogers (2008) and Sarkis et al. (2010) further argue that knowledge and learning lead to further competitive advantages, implying that firms should focus on employee development to reap this advantage. Firms have started to recognise that a reputation of being an environmentally responsible employer is important for attracting new talent (Jackson et al., 2011), which is how we define being an "environmental employer". Firms are perceived as environmental employers if they have a positive image for being active in environmental management. Such a perception can be crucial for attracting and retaining talent (Sarkis et al., 2010). In RBV, employees are particularly important to a company since skills – as opposed to assets – are non-degradable resources (Molloy et al., 2011).

Similarly, reducing transportation emissions can be seen as showing corporate social responsibility, "whereby companies decide voluntarily to contribute to a better society and a cleaner environment" (Commission of the European Communities, 2001). Our construct of being seen as socially responsible refers to communicating that this

definition is fulfilled in reducing transportation emissions. This can, for instance, be done by declaring carbon targets and actual emissions publicly (McKinnon and Piecyk, 2012). The resulting hypotheses are:

H5. To be seen as an environmental employer positively influences a company's intent to reduce transportation emissions.

H6. To be seen as socially responsible positively influences a company's intent to reduce transportation emissions.

2.2 The role of stakeholder pressure in reducing transportation emissions

ST presents a different perspective on companies. Often used in GSCM (Carter and Rogers, 2008; Sarkis et al., 2011), ST explains greening efforts as reactions to stakeholder pressure. Stakeholders are interested individuals, groups, companies or organisations, ranging from customers to governments. Whether or not their stake is considered important to the company depends on the pressure these stakeholders exert, their individual salience in terms of their necessity and contingency (Friedman and Miles, 2004), or their power, urgency and legitimacy (Mitchell et al., 1997). The necessity of customers and suppliers as stakeholders is encapsulated in their contracts with the company (Friedman and Miles, 2004), which makes SC members the company's most salient stakeholders.

Customer pressure is not only a driver for environmental considerations in the company but also upstream in the SC, with the greatest influence on green purchasing stemming from customer pressure (Carter and Jennings, 2004). The question is, though, to what extent customers require environmentally friendly transportation, considering that extended producer responsibility focuses on products and production only and has been criticised for neglecting other transportation emissions (Kovács, 2008). Yet, Carter and Easton (2011) cite transportation as a classical area of GSCM, and customers also consider transportation emissions in their choice of LSPs (Wolf and Seuring, 2010). Customers can require changes in transportation-related decisions (e.g. modal choice, routing, use of less polluting vehicles), as well as exercise their stakeholder pressure in the sheer choice of LSP. Both of these issues are encompassed in the notion of "customer requirements". Our hypothesis is formulated as follows:

H7. Customer requirements for greening positively influence a company's intent to reduce transportation emissions.

Whilst stakeholders that are not contractually bound are seen as contingent (Friedman and Miles, 2004), they may still exert pressure on the company. Governments are legitimate and usually powerful stakeholders who can exert pressure through legislation, regulations and policies (Sarkis et al., 2010). Transport policy and infrastructure decisions are the result of the governmental interest in transportation emissions. We use the term "authority requirements" to encompass stakeholder pressure from governmental organisations which are often codified in laws and regulations and ultimately reflected in the "legal responsibilities" (Carroll, 1991) of a company. Adhering to legislative pressure is a basic responsibility of the company (Carroll, 1991), though other governmental instruments such as policies are not attributed the same power. We hypothesise that:

H8. Authority requirements for greening positively influence a company's intent to reduce transportation emissions.

In addition to external pressure, ST considers pressure arising from internal stakeholders such as owners (Sharma and Henriques, 2005) and employees (Sarkis et al., 2010). The stakeholder pressure from various owner groups (private owners, shareholders) is referred to as "owner requirements". These stakeholders become salient through a combination of power, urgency, legitimacy and necessity and contingency. Owners are seen as the most powerful and legitimate stakeholders of any company as their profits are at stake if the company performs poorly. Hence economic stakeholders, such as owners, influence the likelihood of adopting sustainability practices (Sharma and Henriques, 2005). Our final hypothesis is:

H9. Owner requirements for greening positively influence a company's intent to reduce transportation emissions.

Employees can exert their own pressure on the company for greening and are also instrumental in adopting and implementing environmentally friendly practices as seen in section 2.1 on RBV. This is why Sarkis et al. (2010) apply both ST and RBV to examine their role. They outline the interdependence of these two views as a virtuous cycle where the implementation of environmental training leads to the recruitment of new employees who prefer to work in "green" companies. From a human resource

management perspective, Jackson et al. (2011) argue that the importance of employees for greening starts with their recruitment and ends with their exit from the organisation. New recruits implement the environmental strategy and increase the internal pressure on the company to do so. In more general terms, facing stakeholder pressure, companies develop the capabilities to respond to it (Sarkis et al., 2010). These new capabilities can then be used to develop a competitive advantage. The role of employees is encapsulated in H5. That is why we do not develop a separate hypothesis from the ST perspective.

3 METHOD

A survey of freight transportation-intensive industries in Sweden was carried out and focused on the disposition of these industries to reduce CO₂ emissions. This section explains the development of the survey instrument, data collection and data analysis. An overview of the research process is presented in Figure 1.

TAKE IN FIGURE 1.

3.1 Developing the survey instrument

The survey instrument covers three areas: 1) motives and drivers, 2) industry and LRC, and 3) logistical actions to reduce CO₂ emissions. The theoretical foundation of the first and second areas is described in section 2, where hypotheses for motives (H2-H6) and drivers (H7-H9) are developed. The LRC construct is described in section 2.1. Figure 2 illustrates the combined framework with all hypotheses.

TAKE IN FIGURE 2.

To identify logistical actions to reduce CO₂ emissions for the third area of questions, the causes of CO₂ emissions from freight transportation were derived from a decomposition model with three logistically-dependent factors that affect CO₂ emissions (as in Woxenius 2005). The model is described in section 2.1. Each of the logistical actions investigated is linked to one of these factors. In the survey, the drivers and motives as well as the intention of the actions being implemented in the next decade at the responding firm were investigated on a five-point Likert scale ranging from very low to very high. LRC was measured regarding logistics planning (internal/external operator) and execution (internal/external operator), the share of the freight using different means of transportation (money spent on road, rail, sea and air), type of distribution chain in the responding company (direct delivery/via

warehouses), type of freight transportation (fixed/unique routes). In addition, we collected data regarding company location, number of employees, turnover, profit, industry and type of products manufactured (the survey are shown in the Appendix).

The survey instrument was developed in three steps. First, the three areas of questions were defined. Then a draft survey was developed and tested (as suggested by Flynn et al., 1990). The testing phase facilitated the creation of easy-to-understand wording and format, which according to Trost (2007) usually results in high reliability of survey studies. The survey was then pre-tested on eight logistics academics. Modifications were made based on their feedback about the structure and clarity of the survey: a few questions were rephrased for clarity, or deleted and then discussed with the respondents. The revised survey was tested on five industry representatives, again resulting in minor modifications in structure and some rephrasing of questions.

3.2 Sampling strategy

To achieve internal and external validity, homogeneous groups were selected (Kerlinger, 1986) and a probability sample from a well-defined population was used (Sudman and Blair, 1998). The survey was directed at companies in freight transportation intensive industries in Sweden (Table 1). Sweden was selected because the authors have in-depth knowledge about trade and industry in this country and because Sweden is in the forefront of environmental logistics (among the 10 strongest environmental performers globally, Yale, 2012) and logistics performance (number 3 on the global LPI ranking, World Bank, 2012). In addition, several large industries in Sweden, such as ore, forest, retail and manufacturing, are freight transportation intensive. The span of logistical demands in these industries covers a variety of requirements in terms of costs, flexibility, delivery time and quality.

TAKE IN TABLE 1.

The population was defined as all companies in nine industries in Sweden (Table 1), which accounts for the majority of freight transportation emissions in the country (Trafikanalys, 2010). Companies with fewer than 50 employees were not considered. The remaining sample included 1095 companies. In addition to having the nine

industries represented, companies of different size were also represented. The general idea was that the larger the company, the more transportation it potentially generates. Large companies were defined as those with 500 or more employees, and SMEs were defined below this limit (OECD, 1997). A stratified sample was used to avoid an imbalance among the groups of companies with regard to size. First, all large companies (142) were included in the sample. Then, three equally large groups of SMEs with 50-99 (97), 100-199 (94) and 200-499 (94) employees were systematically selected. The SME division was done in order to capture potential variance among this large group of companies. The resulting sample size was 427 companies.

The pre-test indicated that corporate heads of logistics could be relevant respondents, but to identify key informants at each firm, we were guided by the recommendations provided by Bagozzi et al. (1991). The process of choosing the most suitable respondent started with a switchboard contact. To reach respondents knowledgeable about the current and future logistics decision-making procedures, logistics structure and transportation solutions of the companies, we called all 427 companies, explained the purpose of the survey and particularly the criteria for the respondents. This either resulted in a name and address of the respondent or in further contact with different people in the logistics departments to eventually identify the appropriate person. The appropriate respondents corresponded mostly with the corporate head of logistics (hereafter referred to as "logistics managers"), but in a few cases the company deemed another respondent, such as the transportation manager, to be more suitable.

3.3 Data collection

Data collection took place in Nov.-Dec. 2010. The logistics managers of the sample were e-mailed an explanatory cover letter accompanied by a link to a web-based survey. The cover letter explained the research, asked for their help to complete the survey, promised a prompt copy of the results of the study to encourage participation (as in Frohlich, 2002), and emphasised confidentiality. Reminders were sent to non-respondents weekly for 3 weeks after the first e-mail. Follow-up telephone calls were made three weeks after the initial e-mail to obtain additional responses. The 172 responses received represent a response rate of 40.3% (Table 2).

Eleven responses were removed due to incomplete data. Table 1 provides frequency distributions of number of the employees and industries. Several non-respondents were contacted by phone in the follow-up calls. The reason most often cited for non-response

was lack of time, followed by company policy. To check for non-response bias, respondents and non-respondents were compared on characteristics known a priori (Wagner and Kemmerling, 2010). No significant differences were found between respondents and non-respondents in terms of geographical location (the first digit in the postal code was used as a geographical divider), or in terms of company size which again points to the lack of non-response bias. Another test for non-response bias was to compare early responses from the first group of surveys sent by e-mail to late responses obtained after follow-up calls. No statistically significant differences or trends were found, which indicates the absence of non-response bias.

TAKE IN TABLE 2.

3.4 Data analysis

Initially, the entire sample was analysed as one unit to measure the importance of drivers and motives for CO₂ reduction from freight transportation (using SPSS). A t-test for the entire sample was followed by a data analysis where the LRC sub-hypotheses (H1a and H1b) were tested. To further investigate the importance of drivers/motives for CO₂ reduction, they were tested against the stated intent of implementing different logistical actions. To test this relationship, the companies were divided into groups based on drivers/motives using a factor and cluster analysis. The factors were extracted using principal component analysis. All factors with an eigenvalue greater than one were included in the analysis. To facilitate interpretation, the factor matrix was rotated using the Varimax criterion. The cluster analysis used Ward's method with squared Euclidean distance to obtain clusters of approximately equal size; variables were standardised to z-scores to eliminate scale bias. Based on the clusters of companies from this analysis, we investigated whether different drivers/motives increased or decreased the intent to reduce CO₂ emissions. Further descriptions of the factor and cluster analysis are reported in section 4.4.

4 FINDINGS

The extant literature indicates that the adoption of environmental practices can stem from both company strategy and external pressure. In this section we examine the role of these variables for reducing transportation emissions.

As shown in Figure 1, we first analysed all companies for their stated importance of each driver/motive. The different elements of LRC were then tested for all companies. Companies were clustered to test whether groups of companies with similar ranking of drivers/motives were different in their intent to reduce emissions from groups of companies with dissimilar ranking. This resulted in three clusters of companies. Finally, to discover the effect of drivers/motives on reducing the environmental impact of freight transport, the perceived intent to implement logistical actions that led to reduced emissions was analysed for each company cluster.

4.1 Descriptive statistics

A first graphical analysis shows variations for all drivers and motives as the companies used the whole spectra of answers (Figure 3). On average, all drivers and motives are quite strong (rated above 3), indicating that the companies see a variety of reasons to reduce CO₂ emissions.

TAKE IN FIGURE 3.

4.2 Importance of the logistics resource configuration of a firm

In H1, we hypothesised that the LRC has an impact on drivers and motives for reducing transportation emissions. Two dimensions of LRC were tested: logistics structures (H1a) and control over logistics operations (H1b). Wu and Dunn (1995) describe and discuss the options that logistics managers can choose from for environmentally responsible practices. Based on their discussion, logistics structures were analysed using three tests (Table 3). We tested main distribution structure (direct distribution or via warehouses), main route type (fixed or unique), and transportation mode (road, rail, air, and sea):

- H1a (direct distribution/via warehouses): Via warehouses significantly higher for long-term competitive advantage and social responsibility.
- H1a (route type): No significant correlations.
- H1a (share road), H1a (share rail), H1a (share air), H1a (share sea): None of these have any significant correlations to drivers/motives.

The only support identified in the data is that companies that distribute via warehouses have significantly higher motives to obtain long-term competitive advantage and show social responsibility than companies that employ direct distribution. The other drivers/motives did not vary for distribution structure (see Table 3). No significant differences were found for the type of route used. We used modal split in transportation expenditure to test for the influence of transportation modes on drivers/motives (road transport had a higher limit as it is used to a great extent). None of our four tests (share of road $\geq 90\%$, share of rail $\geq 10\%$, share of air $\geq 10\%$, and share of sea $\geq 10\%$) revealed any significant differences. In part, a lack of significant differences in relation to modal split can be explained by Sweden's transport geography, with large sparsely populated areas without other than access by road. Therefore, the general modal split within Sweden is in favour of road transportation (with over 70% of freight transported by road both in weight and volume) – whereas the modal split to and from Sweden is equally geographically motivated towards sea transportation (Trafikanalys, 2010). Results may differ though in geographic areas without such a clear dominance of certain transportation modes.

TAKE IN TABLE 3.

Control over logistics operations, the second dimension of H1, was analysed in two tests: 1) whether transportation planning was conducted in-house or outsourced; 2) whether transportation execution was conducted in-house or outsourced. Neither of these sub-hypotheses were supported; thus, H1b was not supported. These are very surprising. If the LRC of a firm does not explain why companies would want to green transportation, it goes to show that greening considerations stem from other areas than logistics, which attributes such initiatives even greater importance.

4.3 Importance of different drivers and motives

A one-sample t-test was conducted to analyse H2-H9. We tested against the hypothesis that a company partly agrees with each driver/motive (Table 4, $H_0 = 4$). Thus, those drivers/motives that are significantly higher than H_0 are perceived as very strong, while those significantly lower than H_0 are perceived as weak. Drivers/motives that cannot be separated from H_0 are perceived as strong. The analysis shows that the motives to be viewed as an environmental employer and show social responsibility are significantly higher than H_0 for companies in Sweden (see Table 4). The companies partly agree that reduced CO₂ emissions from transportation will result in long-term competitive advantage and marketing advantage. Finally, the drivers that come from different types of requirements from customers, authorities and company owners, as well as an expected short-term company profitability of reducing the CO₂ emissions are significantly lower than H_0 .

TAKE IN TABLE 4.

4.4 Clusters of companies with similar drivers/motives

Cluster analysis was used to determine whether different types of companies have different drivers/motives. We first tried to identify the underlying structure in the data material by doing a factor analysis of driver/motive variables. A principal component analysis resulted in a Kaiser-Meyer-Olkin value of 0.75, which is characterised as middling (Kaiser, 1974). Bartlett's test is significantly large, indicating that it is unlikely that the correlation matrix was an identity. As shown in Table 5, all variables were usable in the analysis as the communalities did not reveal any extreme values.. The correlation matrix revealed that all variables except authority requirements were correlated to at least one other variable for a value of 0.3 (significance level 0.01). Finally, Cronbach's alpha (Cronbach, 1951) was 0.78, which is above the recommended level of 0.70 indicating acceptable internal consistency among items (Hair et al., 1998).

TAKE IN TABLE 5.

With one as a lower limit for eigenvalue, three factors that explain 70.2% of the variance of the drivers were used. Interpretation of the rotated component matrix resulted in the driver/motive factors shown in Table 5:

Factor 1: Image motives

Factor 2: Economic motives

Factor 3: External requirements drivers

Based on these factors, a cluster analysis using Ward's method with squared Euclidean distance and standardised z-scores was conducted. This identified three distinct groups of companies with similar drivers/motives for reducing transportation emissions (see Table 5):

Cluster 1: Image motives (n = 49)

Cluster 2: Economic motives (n = 42)

Cluster 3: Both economic motives and image motives (n = 62)

The clusters were named by combining a numerical review of driver/motive factors versus clusters and a graphical review of driver/motive variables versus clusters (Figure 4). ANOVA tests showed significant differences for all variables except customer and authority requirements. To test the relevance of the clustering, a discriminant analysis was conducted. It showed that 90.2% of the companies were correctly classified (90.2% cross-validated) compared to the prior probability of 33.3%.

TAKE IN FIGURE 4.

4.5 Expected CO₂ reduction for companies in different cluster

Seven potential logistical actions were used to investigate the intent to reduce transportation emissions in different clusters (see Table 6).

TAKE IN TABLE 6.

The intent to implement these logistical actions is significantly higher for companies that combine economic motives and image motives (cluster 3) than for companies that reduce transportation emissions only because of either economic or image motives. Clusters 1 and 2 have lower intentions to reduce transportation emissions than cluster 3, but there are no significant differences between clusters 1 and 2.

5 DISCUSSION AND CONCLUSIONS

5.1 Company-internal motives and external drivers

This study shows that the combination of RBV and ST presents a better explanation as to why companies reduce transportation emissions than either of them do separately. By combining the two theories it is possible to differentiate between how stakeholder pressure and company strategy influence intents to green transportation. This finding confirms the view of Sarkis et al. (2011) and Carter and Rogers (2008) that RBV and ST are complementary theories in SCM research. It further supports Hart's (1995) view that factors related to the natural environment are internalised in RBV. Both company-internal motives from RBV and external drivers from ST have a role in explaining a company's intent to reduce transportation emissions, but our findings show that their roles differ: External drivers lead to a reduction of transportation emissions to a predetermined point (the actual requirement) for all companies, while internal motives differ between companies.

A factor analysis provided further details on the differentiation between stakeholder pressure and company strategy. Three factors represent motives and drivers for greening transportation: external requirements, economic motives and image motives. The effect of external requirements on intended emissions reductions did not differ significantly across clusters of companies. Our conclusion is, again, that companies face similar requirements – which they fulfil but do not necessarily exceed. Nonetheless, stakeholder pressure has a role in greening transportation. It sets minimal levels that elevate the performance of a group of companies in an industry or a country, which in turn can become more competitive – at least when compared to the same industry in other countries where requirements may differ.

The effect of economic and image motives on the intended reduction of transportation emissions differed across clusters of companies. Companies with a strategy that led to either economic or image motives had similar intent to reduce transportation emissions, but companies that combined these motives showed the highest intent to reduce transportation emissions. Since motives are derived from RBV, the results indicate that a company's strategy influences its intent to green transportation. This implies that green transportation is not only a logistics or SCM consideration, particularly as the main reasons (e.g. environmental employer, social responsibility, and marketing advantage) appear to be outside the logistics domain. Our study

indicates that greening transportation should imbue an entire organisation in the overall corporate strategy. This is supported in a study by Banerjee et al. (2003) who emphasise that top management has a key role for pointing out the direction for greening transportation.

The three factors stem from eight motives/drivers. Related to the image factor, it is worth noting that being seen as an environmental employer and showing social responsibility were the strongest motives. In the economic motive factor, obtaining long-term competitive advantage was strong, while short-term company profitability was the least important motive, even though the survey was conducted among public companies. Our results show that positive impacts on performance are expected in the long run rather than in the short term. This seems to support that reducing transportation emissions is not primarily a decision based on improving efficiency in logistics or transportation, but rather a part of a company's strategy to improve their image and long-term competitive advantage. This would help explain why companies have not implemented environmental practices to the extent that is discussed as economic potential in the literature, which often relates to concurrent economic and environmental benefits of environmental practices (Rao and Holt, 2005). All dimensions of the external requirements were seen as having lower importance. However, we have not investigated if customers and owners have indirect roles, such as if customers prefer to do business with a company that shows social sustainability or if owners want the company to be seen as an environmental employer to attract future employees. Such potential linkages need further research.

In line with the discussion that greening transportation is more than just an issue for logistics, our study showed that LRC has only a limited impact on drivers/motives: neither logistics structures (only two out of 48 tests showed significant correlations) nor control over logistics operations seem to affect drivers and motives. Previous research has shown that changing logistics structures can reduce the environmental impact of logistics (Aronsson and Huge Brodin, 2006), but our findings show that the motives to change are not related to the LRC. For instance, the motives do not seem to be affected by the geographical spread of plants, warehouses or suppliers.

5.2 Managerial implications and avenues for further research

A practical implication of this research is that companies that want to position themselves as green leaders in transportation should implement a combination of

image and economic motives in their organisations. This extends Carbone and Moatti's (2011) findings that a green image would be a first step on the road to greening the SC as our findings highlight the need for green leaders to also consider economic motives. Image motives could be implemented by increasing the awareness and communication of green transportation solutions internally in the company and by including green transportation requirements in purchasing decisions. These implementations would involve various functions in a company, such as human resources, marketing and purchasing. To implement economic motives, managers should learn how to obtain economic benefits from green transportation initiatives by participating in environmental-education and research programmes, and starting to use environmental and cost calculators for transportation. A threshold for undertaking green transportation practices based on company-internal motives is that companies need to be much more innovative and proactive for such practices than for those related to stakeholder pressure as they are not linked to guidelines or regulations.

To maximise the reduction of transportation emissions, it is important for managers to i) go beyond stakeholder requirements and identify image and economic potentials from greening transportation, ii) be aware that LRC does not seem to hinder greening, and iii) realise that it can be beneficial to consider external requirements as opportunities to improve the company-internal resources by translating external requirements into internal motives.

Four limitations of this study should be acknowledged. First, the empirical data are captured from companies in one country. Additional studies across several countries would be needed to investigate whether country-specific legislation and business environment affect motives and drivers. Second, our study does not capture evolutionary aspects of drivers and motives. To do so, longitudinal studies would be needed. Finally, this study uses subjective measures of expected transportation emissions reduction. Future research could have a retrospective or contemporary view in order to use objective (e.g. archival) data.

A final observation is that while governmental policy used to be the first driver to reduce transportation emissions, our results indicate a stronger role of internal motives for considering transportation emissions. Thus, the role of logistics and SCM research from a strategy perspective may become more important for sustainable transportation at the expense of transport policy.

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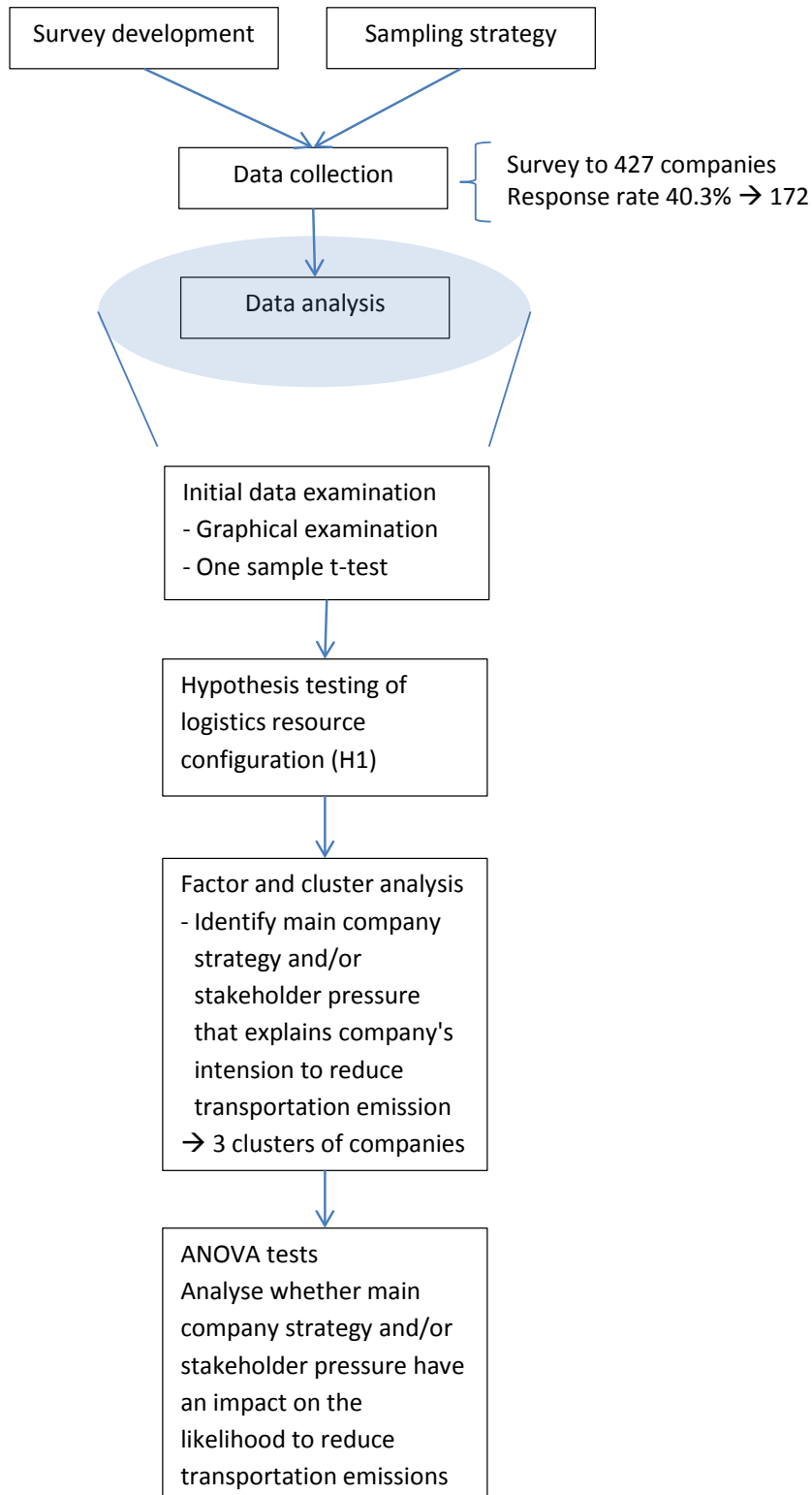


Figure 1 Flow chart of the research process

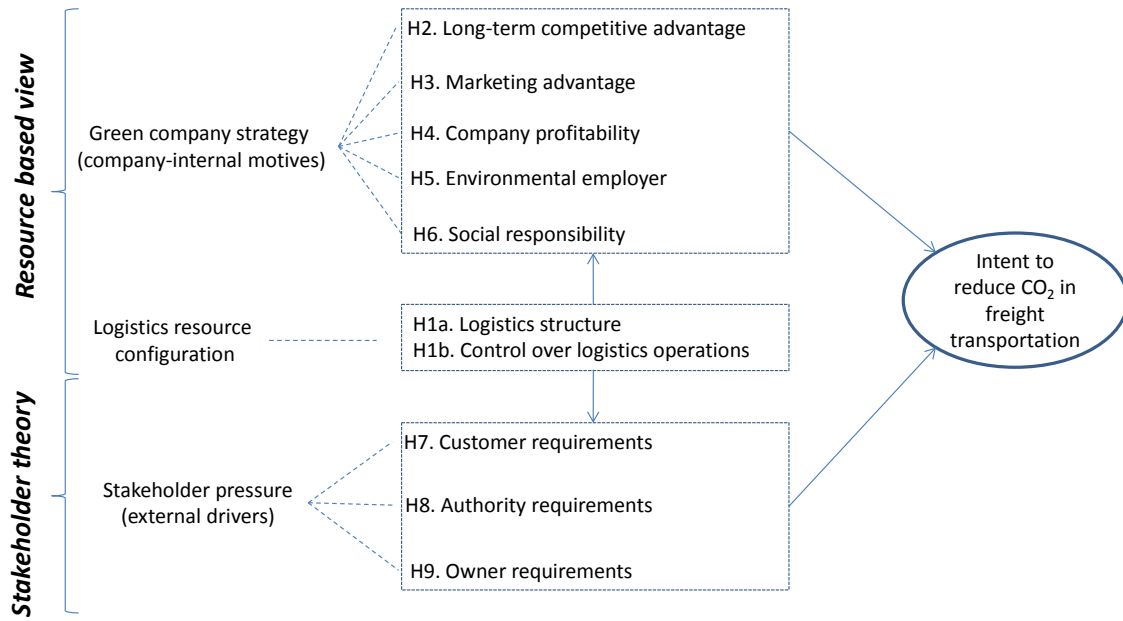
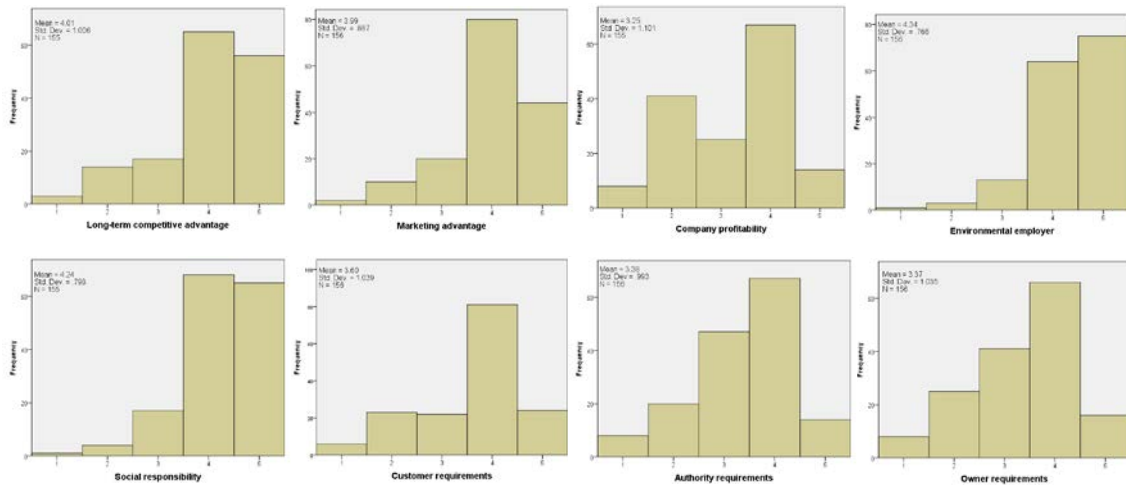
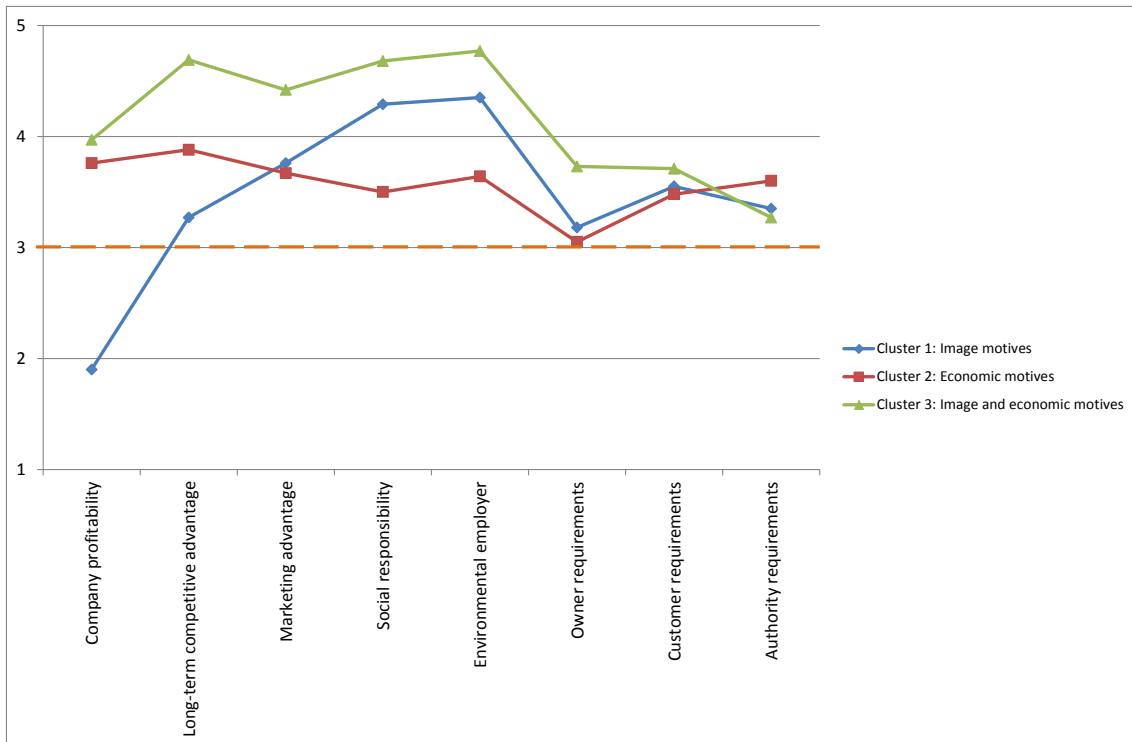


Figure 2 Deriving the intent to reduce CO2 emissions in freight transportation



Scale: 1 = Strongly disagree to 5 = Strongly agree

Figure 3 Graphical descriptions of frequency of drivers and motives



Scale: 1 = Strongly disagree to 5 = Strongly agree

Figure 4 Drivers/motives for different clusters of companies

Table 1 Frequency distributions of number of employees and industry

Industry	No. of employees	50-99	100-199	200-499	> 499	Total
Agriculture/Forestry		1	7	2	1	11
Chemical		6	4	4	5	19
Food and drinks		10	7	5	8	30
Manufacturing			5	6	8	19
Manufacturing other				4	5	9
Ore/Metal		2	6	10	12	30
Pulp, paper and paper articles			3	5	7	15
Wholesale trade		7	1	1	13	22
Logistics service providers		1	8	6	2	17
Total		27	41	43	61	172

Response rate: 40.3% evenly distributed between the two dimensions.

Table 2 Summary of sampling strategy and data collection figures

Item	Number registered
Population \geq 50 employees	1095
Sample	427
Responses	172
Response rate	40.3%

Table 3 Results of two-sample t-tests for testing logistics structure

Driver/Motive	Distribution structure ¹	Route type ²		Mode of transport		
		p-value	p-value	Share road ³	Share rail ⁴	Share air ⁴
Long-term competitive advantage	0.012*	0.103	.848	.744	.097	0.582
Marketing advantage	0.112	0.450	.178	.769	.447	0.274
Company profitability	0.057	0.299	.589	.944	.376	0.095
Environmental employer	0.198	0.359	.968	.881	.115	0.947
Social responsibility	0.028*	0.673	.965	.231	.302	0.702
Customer requirements	0.277	0.211	.759	.375	.140	0.336
Authority requirements	0.164	0.409	.725	.685	.693	0.778
Owner requirements	0.455	0.681	.067	.753	.298	0.664

** Significantly true with 99% confidence

* Significantly true with 95% confidence

¹ Companies that mainly use direct delivery of goods (n=107) without using warehouses (with warehouses n=43) have greater drivers/motives for significant variables.

² Companies that mainly use fixed routes for delivery of goods (n=99) (opposite is unique routes n=52) have greater drivers/motives for significant variables.

³ Tested for companies that spend \geq 90% of their transportation costs on road transport (n=58) against the other companies (n=93)

⁴ Tested for companies that spend \geq 10% of their transportation costs on rail/air/sea transportation (n=42/32/78) against the other companies (n=109/119/73).

Table 4 T-test of drivers/motives for reducing CO2 emissions from freight transport

Driver/Motive	Mean	t-test ($H_0 = 4$)	p-value
Environmental employer	4.34	5.538	.000
Social responsibility	4.24	3.722	.000
Long-term competitive advantage	4.01	.160	.873
Marketing advantage	3.99	-.181	.857
Customer requirements	3.60	-4.777	.000
Authority requirements	3.38	-7.825	.000
Owner requirements	3.37	-7.655	.000
Company profitability	3.25	-8.535	.000

Table 5 Rotated component matrix for factors based on driver/motive variables

	Factor loading	Eigenvalue	% of variance	Cumulative %	Communality
Factor 1 (Motives): Image		3.35	41.85	41.85	
Environmental employer	.912				.850
Social responsibility	.895				.816
Marketing advantage	.461				.555
Factor 2 (Motives): Economic		1.26	15.79	57.64	
Company profitability	.925				.866
Long-term competitive advantage	.785				.800
Factor 3 (Drivers): External requirements		1.00	12.51	70.15	
Authority requirements	.768				.605
Customer requirements	.698				.569
Owner requirements	.482				.551

Extraction method: Principal component analysis.
 Rotation method: Varimax with Kaiser normalisation.

Table 6 Average values for clusters of companies (* = significant differences in ANOVA tests)

Cluster	Suppliers close*	Relocate plants/ warehouses*	Transport planning*	Packaging design*	Air transportation*	Road transportation*	Transport capacity
1	2.17	2.04	3.10	2.04	1.96	2.42	2.37
2	2.30	1.95	2.98	2.23	2.29	2.26	2.66
3	2.59	2.53	3.61	2.54	2.91	2.75	2.62
Total	2.38	2.22	3.27	2.30	2.45	2.51	2.55