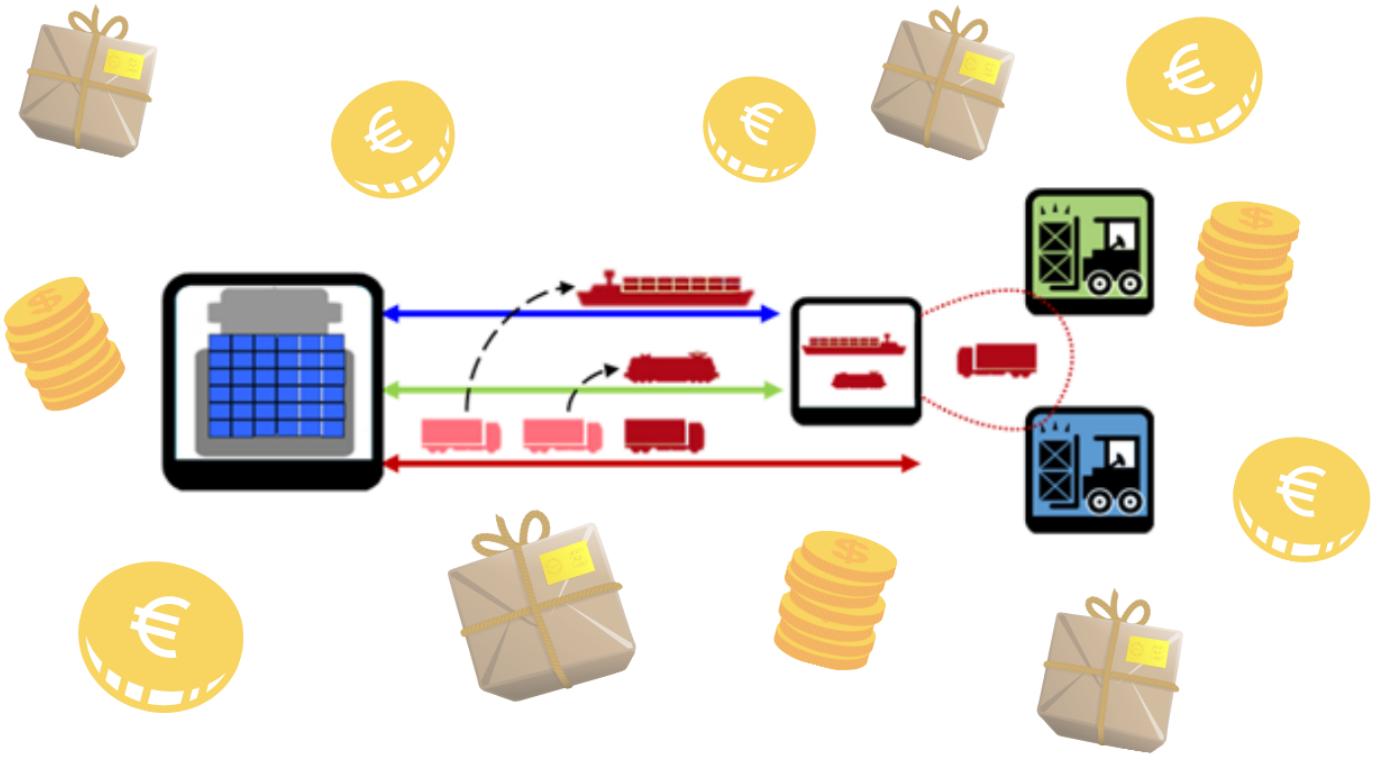
The influence of flexible transportation plans on supply chain performance of Dutch SMEs



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Abstract

Prior research in the field of supply chain management has shown that when a company organizes its transport processes flexibly, the company benefits from this, reflected in the performance of a company. Based on previous studies, flexible transportation plans have been divided into three components: A: The extent to which it is easy to change carriers on the same transport route in the short term, B: at which stage the transport plan is finalized, and C: the extent to which choices regarding the transport process are made based on available data. Studies have also shown that there are multiple key performance indicators, so companies can measure their success.

This study includes two key performance indicators that serve as dependent variables. These are the number of export shipments per year and the annual profit margin. Hence, the main purpose of this study is to prove the influence of the three mentioned components on the performance of companies. In this research, the three components are tested separately from each other and together in sense of an explainable model. This research, therefore, contains the following research question: How much does flexible transportation plans affect the supply chain performance of Small & Medium-enterprises located in The Netherlands? The analyzes in this study were based on a sample of Dutch SMEs who completed a survey. The dataset used for the analysis consists of 18 respondents. The results suggest that flexible transportation plans do not significantly contribute to the performance of the companies. However, the findings are still interesting and offer a renewed perspective on the vision within the current field of supply chain management.

Acknowledgments

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Laxmi, Lars, and Noa

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1. Introduction

In the first chapter of our thesis, the topic of flexible transportation plans will be introduced. It will be explained why flexible transportation plans are relevant, followed by a further explanation of flexible transportation plans and supply chain performance. The hypotheses and the main question are also explained in this chapter.

1.1. Relevance

Pre-pandemic, the period from 2012 to 2019, the percentage of private online purchases increased by more than fifteen percent (CBS, 2020). As we are in the middle of this pandemic, new enterprises may enter the market, file for bankruptcy, or are having the busiest time of their existence, e.g. deliveries to final destinations. At this point, we could not imagine that lives mostly depend on online services to approach (consumer) goods. We all want these goods to be delivered on time at the (final) destination but that is not always the case especially when deliveries depend on the carrier and its transportation whether its operation is intermodal or integrated synchromodal, e.g. vertical or horizontal (Behdani et al., 2016; Tavasszy et al., 2015). One of the social trends in the logistics sector is the reduction of emissions, which is also becoming gradually regulatory. Nowadays, each company wants to leave a sustainable footprint when it comes to global warming. However, not every company can afford this 'luxury contribution' or keep up with the trendy environmental issue given that companies must first be financially healthy.

Based on our interest in the classification of companies we have chosen Small and Medium-enterprises (SME) since they form the core of the Dutch economy (CBS, 2019). Financial risks are one of the critical problems for SMEs (Gozgor, Demir, Belas, & Yesilyurt, 2019). SMEs are often restricted by banks, which means that they may miss out on valuable investment opportunities. SMEs face more obstacles when applying for loans than large companies. This is due to the weaker credit position of SMEs in comparison to large companies (Luo, Wang, & Yang, 2015). Due to the disadvantageous position that SMEs have, it is of great importance that they generate a positive return on investment. In case of a negative return on investment, it can cause financial distress, which affects the company's position (Shibata & Nishihara, 2014).

Before making an investment decision, executives need to know in what way it will affect a company's supply chain performance. For optimizing a supply chain process, the management concerns clear information. Decisions of implementing flexible transportation plans, it is important for the manager to explore additional information regarding the output, as SMEs face more financial risks when making financial decisions (Wuttke, Blome, & Henke, 2013).

1.1.1. Introduction to Flexible Transportation Plans

We live in an era where innovation is the goal of the day. Today's innovations may be outdated tomorrow. Companies these days invest a lot in innovation and optimizing processes among other things to gather relevant information that can support important decisions. Because there is a lot of innovation, the world seems to be moving a lot faster. To stay connected as a company, flexibility is a key skill to survive and to continue to meet the expectations of customers. In supply chain management there are various types of flexibility. The first one is operational flexibility, this allows companies to adjust transport plans, or transport modes in a short period (Schütz & Tomasgard, 2009). Another definition of supply chain flexibility is organizational supply chain flexibility, this concerns the ability to adjust changes with product mix, volume, or design (Siddhey, & Jain, 2018). In this research,

we will further examine to what extent operational flexible transportation plans affect supply chain performance.

Flexibility makes it possible to switch production among manufacturers and suppliers which benefits management to deal with internal and external uncertainties (Chen, Egbelu, & Wu, 1994). Flexibility in the whole supply chain is meaningful when the chain consists of a supply network, production, and firms of delivering**.** Their research paper provides a framework of supply chain flexibility dimensions (product, volume, routing, delivery, trans-shipment, postponement, sourcing, response to market, launch, and access) to analyze if supply chain flexibility is positively related to firm overall performance[1] in the automotive industry (Sánchez & Pérez, 2005). Correlation between the dimensions and the firm performance of each measure shows a significant positive relationship that covers their research question. Nonetheless, each supply chain flexibility dimension is likely important in different industries.

1.1.2. Introduction to Supply Chain Performance

The current economic core is moving from individual company performance to supply chain performance. Supply chain performance contains different activities to meet the requirement of the customer in the end. Examples of these activities are on-time delivery, inventory management, or warehouse management. It can also be something that happens while meeting the customer, such as reducing emissions when using different channels. Supply Chain crosses multiple regular sections within a company, such as procurement, manufacturing, distribution, marketing, and sales to name a few. Because globalization is becoming more and more important, supply chain management needs continuous improvement. To achieve this, a company must measure performance (Hausman, 2004).

For measuring performance, using Key Performance Indicators (KPIs) is critical. This toolset measures performance or monitors a set of metrics. A KPI can be either financial or non-financial. If a company wishes to improve customer satisfaction, it will have to define a non-financial indicator and for a financial indicator, the focus is on financial key figures, such as liquidity, revenue, return on investment, or return on sales (Bongsug, 2009).

1.1.3. The connection between flexible transportation plans and supply chain performance

Flexible transportation plans are a dimension of supply chain management, there are multiple channels available for the shipment of products. A company can decide to choose only the same type of transport or to combine several transport modes. For example, a company can decide to only ship the product through a truck, but there is also an option to choose for multiple transportation modes, e.g. a ship and a truck (Sánchez & Pérez, 2005).

It is yet unclear if flexible transportation plans have a positive effect on supply chain performance. As there can be numerous measurements done and these can be separated into two types of indicators. The unknown is how flexible transportation plans affect supply chain performance and if there is a difference between the type of indicators.

[1] (return on investment (ROI), ROI growth, market share, market share growth, return on sales (ROS), and ROS growth).

1.2. Objectives and questions

The objective of the study is to further investigate if there is a positive relationship between flexible transportation plans and supply chain performance. The critical synthesis provides an overview of current knowledge, relevant scientific articles will be discussed but also mentions gaps in the available studies that are related to flexible transportation plans. Besides, critical synthesis helps to understand the topic in a better way and specify the main focus of the study. But also challenges to refute or confirm the statements made by researchers. The critical synthesis provides the opportunity to analyze their research strategies and their results which can be applied to our research, i.e. reviewing the gaps in populations and analyzing the possibilities to focus on.

As mentioned before, there are two types of key performance indicators to measure performance. Because it is unclear if a non-financial KPI is more important than a financial KPI within the Netherlands. To gain insights, it is important to examine if there is a difference between the flexible transportation plans and the influence on the type of KPI, which refers to supply chain performance.

Sánchez and Pérez's (2005), studied the Spanish automotive industry, one of their hypotheses was: "Supply chain flexibility is positively related to firm performance." Supply chain flexibility was divided into multiple flexibilities, out of these we selected those that were most relevant to flexible transportation plans (routing and trans-shipment flexibilities). Results respectively show that the effect sizes 0.301 and 0.121 are small to medium. Its effect might be moderate but it is still pointing towards a positive direction. Also, the effect may be moderate in the Spanish automotive industry, but cannot be generalized for other industries due to its empirical cross-sectional research strategy.

This thesis will elaborate on the main question:
'How much does flexible transportation plans affect the supply chain performance of Small & Medium-enterprises located in The Netherlands?'

To conduct our study there are two hypotheses formulated where the independent variable is flexible transportation plans. The dependent variable will be supply chain performance, this will be translated to a financial and non-financial key performance indicator. The focal unit of the study are SMEs based in The Netherlands, and the theoretical domain of the study includes Dutch SMEs with a supply chain process. The relationships that the study will focus on are positive and probabilistic. To achieve the objective, this thesis will elaborate on the following hypotheses:

H1: Flexible transportation plans have a positive influence on the number of export shipments of Dutch SMEs.

H2: Flexible transportation plans have a positive influence on the annual profit margin of Dutch SMEs.

In simplistic words, will the supply chain performance of companies improve, if they focus on flexible transportation plans? The performance will be measured in gross profit margin and export shipments size.

The following conceptual research model, figure 1 has been drawn up to clarify the thesis. This visualizes the different dimensions of flexible transportation plans and supply chain performance that are a part of the research.

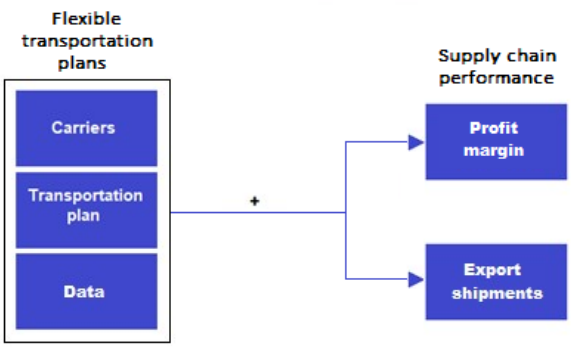


Figure 1. Conceptual Model

1.3. Overview of the structure

The thesis consists of three parts: literature research, the research findings, and finally the conclusions. Chapter two contains literature relevant to the context of the research. In chapter three the literature will be reviewed, thereafter in chapter 4, this will be evaluated. Chapter 5 contains the methodology of how the study will be conducted. After this the results are explained in chapter 6 and, chapter 7 contains the conclusion, recommendations, and limitations of the study.

2. Theory Hypotheses

Chapter two is divided into three components. Firstly, the independent variable flexible transportation plans will be linked to a definition to form its meaning and to be able to measure it in the follow-up study. Secondly, a thematic analysis has been performed to narrow down the independent variable and to evaluate the theme(s) which will be further expanded. Finally, the included studies with the corresponding themes will be discussed.

2.1. Flexible transportation plans

We treat flexible transportation plans as the ability of supply chain partners to restructure their operations, align their strategies and share the responsibility to respond rapidly to customer demand at each link of the chain, to produce a variety of products in the quantities, costs, and qualities that customers expect. This definition is adopted from the Management Research Review of Tiwari (Tiwari, 2015).

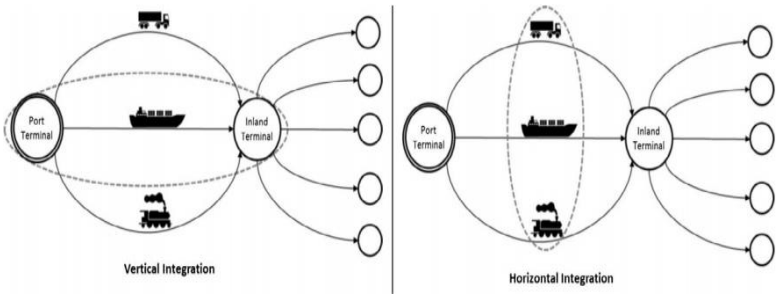


Figure 2. Vertical and horizontal integration of freight transportation planning (Behdani, Fan, Wiegmans, & Zuidwijk , 2016; Tavasszy, Behdani, & Konings, 2015)

An interesting part of this large definition is synchromodality, which is the capability to switch undisturbed (freely) between transportation modes at certain times (Verweij, 2011). Being able to switch between different transportation, the level of this flexibility depends on responsive and efficient planning of accessible transportations modes' schedules.

Synchromodality can also be characterized as "horizontal integration" of freight transportation planning in which different transportation modes are parallelized from A (origin) to B (destination) (Behdani, Fan, Wiegmans, & Zuidwijk, 2016; Tavasszy, Behdani, & Konings, 2015). In contrast to the mentioned integration, both articles describe "vertical integration" as a sequential intermodal movement (figure 2).

2.2. Themes

Every selected study for our research topic is based on related flexible transportation plans. Since there is not a 'claimed' answer to what flexible transportation plans exactly are, various amounts of published papers were collected to identify potential themes for the independent variable flexible transportation plans. These are divided into themes in table 1. Below this table, figure 3 shows a causal model where each arrow represents the causal claim between the input and output variables. As the figure depicts, it should be clarified that firm performance and supply chain performance represent the dependent variables. Other black rectangles are independent variables on their own.

2.2.1 Thematic analysis

An inductive approach has been conducted to determine our themes for our research. This means that themes can only be validated or not. Via this approach, we look for patterns in the data that possibly could support our interpretation of the independent variable and ultimately develop the framework based on what we find in the data (Braun & Clarke, 2006). As most of the papers contain cross-sectional studies, association in this research strategy is more pronounced whereas causality does not apply.

Themes	**Author(s), year of publication**
Internal knowledge transfer and exploitation	*Blome, Schoenherr & Eckstein, 2013* *Rojo, Stevenson, Montes, & Perez-Arostegui, 2018*
Information sharing	*Trkman, McCormack, de Oliveira, & Ladeira, 2010* *Koçoglu, Zeki, Hüseyin & Halit, 2011*
Supply chain flexibility	*Sánchez & Pérez, 2005* *Chan, Ngai & Moon, 2016*
Flexible transportation	*Dong, Boute, McKinnon & Verelst, 2016* *Hoen, Tarkan, Fransoo & Van Houtum, 2014*

Table 1. Overview Themes

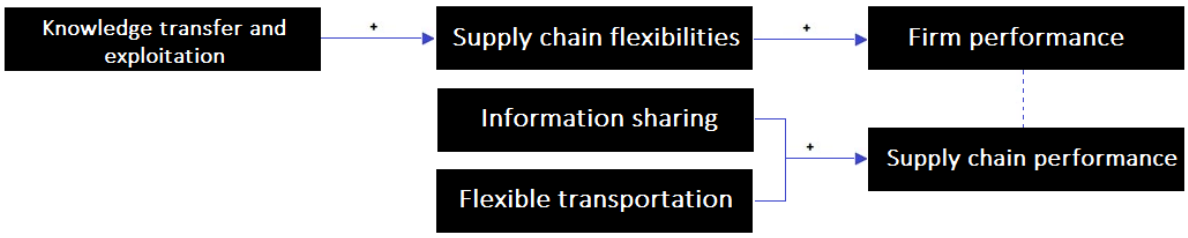


Figure 3. Causal Model

Noticeably, Blome et al. (2013) en Rojo et al. (2018) focus on knowledge transfer and its operations, assuming that it positively influences the supply chain flexibility before it exerts on firm performance, i.e. a positive causal relationship between knowledge and supply chain flexibility. We believe that knowledge is without a doubt fundamental and brings benefits if its operations are well-executed to meet the desired performance in general.

Subsequently, other studies find that supply chain flexibility was tested on firm performance (*Sánchez & Pérez, 2005; Chan, Ngai & Moon, 2016)*. However, supply chain flexibilities cover many different flexibilities. Moon et al. have taken strategic and manufacturing flexibilities to measure overall performance (2016) whereas Sánchez & Pérez have looked to many different supply chain flexibilities. For the last mentioned study, we only looked at routing and trans-shipment as relevant flexibilities which are in the scope of our research. Since strategic and manufacturing flexibilities work best in the long run, these could contradict flexible transportation plans as it most likely works in the short term.

Another theme that we have come across is information sharing which is crucial when it comes to competition between companies (Trkman, McCormack, De Oliveira & Ladeira, 2010; Koçoglu, Zeki, Hüseyin & Halit, 2011). Both studies find that decision-making based on data positively influences

supply chain performance. Sharing information makes access to operational activities between partners in the supply chain transparent. Not only transparency, but it allows both parties to obtain timely and accurate information to determine their strategies in the short term. Companies likely perform better if they support their analytical capabilities with good information systems (Trkman et al. 2010).

Ultimately, we will discuss the focus on our research topic as mentioned at the beginning of this chapter. Studies have been conducted to see what flexible transportation plans yield to the environmental issue when the financial aspect is also affected for the supply chain performance (Dong, Boute, McKinnon & Verelst, 2016; Hoen, Tarkan, Fransoo & Van Houtum, 2014). In theory, both studies indicate that the use of switching transport modes that have lower emissions will reduce costs at some point and turn in a little percentage of their profit margin. They conducted a research project for their organization on how they can deliver environmentally friendly and economic benefits by implementing flexible transportation to save 30% of emissions. Both studies have looked at switching from road to rail transportation which is different for each customer or industry. Nevertheless, the word flexibility does not always do justice in its case when transporting freight cannot bring benefits if it has to be changed during the journey. In other words, it appears that flexible transportation plans make a more positive contribution at the beginning of the supply chain process instead of during the process.

3. Critical evaluation

This chapter gives an overview description of related research which challenges our research to extend or address a gap in work in the domain. Besides, our research will only look at those articles which the common denominator between the different studies that each study focuses on performance, with each study having a different perspective of using an independent variable. These independent variables all have a link with flexible transportation plans. In the end, we will highlight the studies that we may find useful for our research.

3.1.1 Validity and reliability

Most of the (empirical) cross-sectional studies, except the studies of Dong et al. (2016) and Hoen et al. (2014), are internally valid. There are limitations on proving causal claims, as studies do not gain evidence in support of the causal direction that the hypothesis implies. If we zoom into studies of Chan et al. (2016) and Sanchez and Perez (2005), it seems that both independent and dependent variables focus on the same idea that supply chain flexibilities positively influence firm performance. Both effect sizes show small to medium effects which can be interesting for statistical generalizability. However, this can only be an indication of external validity since different flexibilities and performances are used. The observed case studies of Dong et al. (2016) and Hoen et al. (2014) are not valid enough for the whole population but may be important for decision-making for the same group.

Trkman et al. (2010) may be valid but is not reliable as it selected companies of the council list. The probability sample is missing which can lead to a fallacious picture of the population. Besides, the bootstrapped method has been used. This is not a very accurate method so that reliability cannot be guaranteed. All other studies contain reliable measurements as they are consistent with the hypotheses/research questions.

3.1.2 Research strategies and population

Based on the studied articles, there is sufficient reason to believe that flexible transportation plans have a positive influence on supply chain performance. However, the research strategies of different studies vary. It is remarkable that included (convenience) sample studies consist of multicultural firms who have a supply chain process on this topic.

The majority of studies use empirical cross-sectional research and quantitative surveys as a strategy to measure their explained variables. Each study has its definition of performance. If we zoom in on this concept, we find on closer inspection that the angle of the studies Dong et al. (2016) and Hoen et al. (2014) fit in our scope of independent variables transportation flexibilities. However, these research methods do not support enough evidence to generalize the heterogeneous population. On the other hand, it might be applicable for the homogeneous population with the same executed studies. The aforementioned case studies meet the concept of supply chain performance as the reduction of CO2 emissions. Dong et al. also look at the reduced costs of the implementation of flexible transportation. Other studies consider the performance aspect more in the context of firm performance with emphasis on abilities to perform as a firm. For this reason, further research will be conducted to substantiate and validate the hypothesis 'flexible transportation plans increase supply chain performance'.

3.1.3 Variables of studies

There are studies conducted from a transportation perspective. Dong et al. (2016) focus on the use of intermodal rail transport optimization and investigates the possibility to optimize costs and environmental performance. This is slightly similar to the study of Hoen et al. (2014) which centers on reducing emissions through transport selection and sales prices combined. Almost all research hypotheses relate to a positive influence on performance.

In addition to the performance, which is defined as a dependent variable, the independent variable is flexible transportation. This is a very broad concept and it is also reflected in the various studies that

have been included. Blome et al. (2013), Trkman et al. (2010), and Koçoglu et al. (2011), transportation flexibility is defined as the possibility to make flexible strategic choices based on information that influences the supply chain and so the transport itself. A completely different angle than in the studies of Rojo et al. (2018), Chan et al. (2016), Sánchez & Pérez (2005). There, transportation flexibility is viewed more from firms' abilities based on different supply chain flexibilities which we only looked at those flexibilities that interface with transportation. Our vision is that flexible transportation plans must be considered as the extent to which strategic adjustments can be made during the shipment's supply chain in the short term.

4. Critical synthesis

This chapter contains a qualitative review of the found effect sizes in the literature. Included studies are scrutinized to discuss its effect size how much this is convincing in the hypothesized direction. Also, the effect size is supported by the missing cases to explain the strength of its relationship between the independent and dependent variables.

4.1.1 Effect sizes

Due to some missing data, effect sizes from six out of eight studies effect could be calculated. The calculation has taken place in various ways. For example, Rojo et al. (2018) and Sánchez & Pérez (2005) use the correlation coefficient whereas t-value and sample size have been used by Blome et al. (2013), Chan et al. (2016), and Koçoglu et al. (2011) to determine the effect size. Trkman et al. (2010) have made use of the p-value and the sample size as the parameters for the effect size calculation. An estimation of the effect size was made by calculating the slope in the study of Hoen et al. (2014). Only studies of Blome et al. (2013), Rojo et al. (2018), Sánchez & Pérez (2005) standardized effect sizes are calculated.

To be able to compare the effect sizes properly, the research model of the different studies must be in line with each other. When we look at the studies that have been examined, we can conclude that the different research models of the studies do not correspond with each other as explained before. Due to the different research models, it is impossible to compare the different effect sizes. This explains why the effect sizes of the different studies vary relatively much. The calculated highest effect size is the effect size (1,11) in the Hoen et al. (2010) study. It is relatively high, but the effect size is not very reliable because it is an estimation of the slope of an exponential function. The second-highest effect size is the effect size 0,73 in the Rojo et al. (2018) study. Which is way more reliable than the effect size of the Hoen et al. (2010) study. On the other hand, there are studies with a relatively low effect size. For example, the effect size 0,0986 of Blome et al. (2013).

Although the different effect sizes cannot be compared with each other, they still can be qualitatively relevant for our study as all effects of observed studies are pointing in the same directions, i.e. all positive influences towards the dependent variable (supply chain) performance. Each research has its broad interpretation with its definitions that can contribute to our research. Most of the studies have highlighted the importance of flexibility when it comes to a certain performance.

Since various studies include flexibilities as an input variable, it is striking that these can be subdivided into both short and long term. In the short term, the competitive characteristic is seen as important when it comes to (consumer) goods (Blome, Schoenherr & Eckstein, 2013; Chan, Ngai & Moon, 2016). Goods are accompanied by manufacturing flexibilities which in turn are divided into four other flexibilities: sourcing, operating system, distribution, and information systems (Moon, Yi & Ngai, 2012). When it comes to critical success factors in a competitive market, supply chain agility cannot be ignored worldwide because it reacts quickly to changes in the market (Chan, Ngai & Moon, 2016). There, flexibility is defined as a company's ability to make adjustments in strategic choices related to internal and external factors. In short, the company's ability as flexibility affects performance in general. Studies indicate that data collection is a crucial factor in the competition that contributes positively to the entire supply chain performance (Trkman, McCormack, de Oliveira, & Ladeira, 2010; Koçoglu, Zeki, Hüseyin & Halit, 2011). However, collecting data could be placed in the short and long term because of its broad interpretation and its context in decision making.

4.1.2 Missing cases

There are missing cases (non-response) from the observed samples. Blome et al. (2013) and Chan et al. (2016) have response rates below 20 percent which means that results could have any other value than the obtained results. On the contrary, Koçoglu et al. (2011), Rojo et al. (2018), Sanchez and Perez (2005) cross the limit which does not make them a threat to the validity of their conducted studies. Conducted studies of Dong et al. (2016) and Hoen et al. (2014) are questionable as these are case studies or have undefined populations.

Since 75% of the studies are cross-sectional, causality is excluded for these studies. For the two remaining case studies, there is insufficient evidence to assume that these contain causal relationships. The empirical cross-sectional studies used respondents through a survey to gather data whereas case studies rely on informants. If we look at the trustworthiness of the sources, we can conclude that not every source in the studies can be defined as trustworthy. This is mainly due to the possibility that the respondents or informants may have an interest in providing selective information. The most reliable data is data from a database that cannot be manipulated. When respondents or informants are used to collecting information, it can always differ from reality to some extent. Each study has examined a sample instead of a census. Most studies involve a non-probability sample, except Koçoglu et al. (2011) used a probability sample. Using non-probability samples means that it is not representative enough for the whole population. On the other hand, other insights can be drawn from these results/data which can be useful for decision-makers in the supply chain.

4.1.3 Conclusion

After examining all articles, it is obvious that mostly consists of cross-sectional studies to measure the performances from a managerial perspective. Associations from different causal claims are internally validated from a heterogeneous population, but the effect sizes are still not enough to say how strong the relationships are between every two variables even though the effects point in the same positive directions. All in all, we must say that a flexible transportation plan is not easy to pin down in all studies as the research question is not giving us a full picture of a steady definition of flexible transportation plans and the effect on the supply chain performance due to the trustworthiness of studies and its criterion validity. However, it is still useful to analyze different flexibilities in the short and long terms and the relevancy of the discussed flexibilities that fit in the scope of our main hypothesis.

4.1.4 Future research

One of the definitions given in the article by Chan et al. (2016), is in our perspective a clear definition of performance. Their definition of performance describes a firm's overall performance along with the measurements of operational excellence, customer relationships, revenue growth, and financial performance such as return on investments (ROI), profit margin, and sales growth. Unlike operational excellence and customer relationship, financial performance is objective and therefore a clearer measurement. Return on Sales (ROS) indicates the sales which can fluctuate. Return on investments uses the capital, this is less likely to fluctuate. Therefore, the return on investments is a good measurement for financial performance. Based on this definition we will consider a firm's performance as the financial performance which will be measured by the company's profit the ROI of the shipment in our research. Another interesting explained variable for our research would be the export shipments as a non-financial performance which has been going on a lot in recent years and especially before the pandemic. What needs to be looked at are the gaps that have shown limitations in transportation modes of the observed case studies, a key question to what extent flexible transportation plans are. Furthermore, given flexibilities have been used different among studies as some of those are relevant

for its research questions. Also, the effect in various populations leaves us some questions marks if it would be the same in The Netherlands.

Studies matrix

(**Authors**, year) Methodology aspect	Blome, Schoenherr & Eckstein, 2013	Chan, Ngai & Moon, 2016	Trkman, McCormack, de Oliveira, & Ladeira, 2010	Koçoglu, Zeki, Hüseyin & Halit, 2011	Rojo, Stevenson, Montes & Perez-Arostegui, 2018	Dong, Boute, McKinnon & Verelst, 2016	Hoen, Tarkan, Fransoo & Van Houtum, 2014	Sánchez & Pérez, 2005
Hypothesis/research question								
Focal unit	Individuals involved in strategic procurement and supply chain management.	Asian Fashion Industry/manufacturers with major production operations in Asian countries.	Company with a supply chain process with headquarters in the USA, Europe, Canada, Brazil, and China.	Turkey companies with a supply chain process	Spanish manufacturing firms in Spain	Companies of all industries	A company that is committed to reducing emissions from outsourced transport with a self-imposed emission target for outbound transport emissions.	Automotive suppliers in Spain
Hypothesis/ Research question defined	External knowledge transfer positively influences supply chain flexibility.	H1: Strategic flexibility positively influences firm performance H2: Manufacturing flexibility positively influences firm performance	BA has a positive effect on the SCP.	Information sharing positively influences supply chain performance.	The higher the level of Operational Absorptive Capability, the higher the level of Supply Chain Flexibility.	Researchers examined synchromodality by the large shipper's relative use of intermodal rail transportation to increase supply chain performance.	How can the transport mode selection and sales prices be jointly optimized to meet an emission target efficiently for a group of customers?	Supply chain flexibility is positively related to firm performance.
Effect size								
Effect size reported	The effect size of 0.0986, the effect is zero to small. C.I.	H1: effect size of 0.347. C.I. of 95% [0.0144; 0.0.6796] H2: effect size of 0.032 C.I. of 95% [-0.2981; 0.3621]	Effect size 0.5671 C.I. of 95% confidence interval of 0.34 (LB) and 0.7942 (UB)	Effect size 0.4149, C.I. of 95% [0.0997; 0.7301]	Effect size 0.73 C.I. of 95% [0.5003; 0.9664]	Effect size 0/110=0 30/100=0,3 70/70=1 90/60=1,5	The effect size approach is 30/27 = 1,11.	Routing flexibility 0.301 C.I. of 95% [0.103; 0.499] Trans-shipment flexibility 0.121 C.I. of 95% [-0.178; 0.420]

Standardized or unstandardized	Standardized	Unstandardized	Unstandardized	Unstandardized	Standardized	Unstandardized	Unstandardized	Standardized
Research strategy								
Research Strategy	Cross-sectional	Empirical cross-sectional	Cross-sectional	Empirical cross-sectional	Cross-sectional	Case study	Case study	Empirical cross-sectional
Causal claim	causal claim	causal claim	causal claim	causal claim	causal claim	Causal claim	causal claim	causal claim
Evidence of causal claim	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence
Is the effect size parameter consistent with the research strategy?	Yes - N (sample size) - Chi-square - P-value (standardized)	Yes - N (sample size) - T-tests	Yes - N (sample size) - T-value	Yes - N (sample size) - P-value	Yes -Correlation coefficients	No	No - Slope	Yes -Correlation coefficients
Population/Sample								
Population description	1161 firms from the database German Logistics Association and the German Association for Materials Management, Purchasing, and Logistics.	725 randomly selected Asian manufacturers.	Companies in the USA, Europe, Canada, Brazil, and China. The domain is international supply chain management.	Derived from context. All companies with a supply chain process.	Manufacturing firms	Shippers who adopt a potential multimodal strategy	There is no theoretical domain given.	Focus on autonomous divisions, individual firms, and strategic business units
Characteristics	Main industries: manufacturing and logistics.	Manufacturers with major production operations in Asian countries.	The population is not exactly defined. The population is companies with an SC process.	Firms with a range of foreign and domestic industries in public and private sectors. Also, firms an organized and managed based on the Western management style.	Spanish manufacturing firms with only complete data, non-cessation of activity, and employees >10	Modal split users (intermodal rail and truck), the transportation-inventory trade-off in managing supply chains.	The population is not clearly defined.	The population is defined as Spanish automotive suppliers.
Census/Sample studied	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample
Probability/ Convenience sample	Convenience sample	Convenience sample	Convenience sample	Probability sample	Convenience sample	Convenience sample	Convenience sample	Convenience sample
Missing cases	Non-response 1020 Response rate = 12.1%	Non-response 584 Response rate= 19,4%	Unknown.	307 non-response, 35 incomplete Response rate = 31,6%	No difference will occur with the response rate	No missing data.	No missing data.	Non-response 230 firms Response rate = 35,4%

Measurement								
Informants/ respondents /others	Respondents	Respondents	Respondents	Respondents	Respondents	Informant	Informants	Respondents
Trustworthy of sources	Yes	Yes	No	Yes	No	No	No	Yes
Validity	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Reliability	Yes	Yes	No	Yes	Yes.	No	No	Yes

5. Methodology

In this chapter, the methodology is explained in more detail so that it becomes clear how our conducted study is set up. This will be explained in several sub-chapters, which are: definitions and measurement, population, and measurement protocol.

5.1 Definitions and measurement

5.1.1 Flexible transportation plans

Flexible transportation plans are a very broad term and because of this, there are many different ways to interpret them. The abstract definition of flexible transportation plans is: 'To what extent strategic adjustments can be made in the logistics chain in the short term (month)'.

To measure the abstract definition of flexible transportation plans, the concept should be framed by dividing it into sub-concepts that are part of the main concept of flexible transportation plans. Hence, flexible transportation plans can be measured through sub-components that contribute significantly to firm performance and will be further investigated.

Based on the literature we divide flexible transportation plans into three categories:

Carriers

Carriers are an important link in the supply chain. They are the link between the different stations in the supply chain. If the cooperation between the production company and the carrier does not work properly, both, the company and the customer, can experience great hindrance. In case there is the possibility in the short-term concerning carriers, to make strategic decisions, for example by switching to another carrier. This can strengthen the position of the company in the market and thereby contribute to the performance of the company. Measuring the carrier component will be to what extent the company can switch carriers in the short term.

Transportation plan

A huge part of supply chain management is planning. A transport plan is drawn up for each shipment. When a company can draw up the plan relatively late in the shipment process, this can affect the performance of a company due to the flexibility it may give. In this study, we will investigate whether the moment of drawing up the transportation plan influences the performance of the company.

Transportation modes based on data

Almost all the big decisions within a company are taken based on (big) data. Recent years show that the decisions that are made based on data take place increasingly lower in the organization and are also taken over in the operational activities, including in the supply chain (Yu, Chaves, Jacob, & Feng, 2018). Many companies use the available data to make medium or long-term decisions. Does it give an advantage in the sense of firm performance if short-term decisions are also made based on data?

5.1.2 Export size

In this research model, export size will act as the dependent variable. This variable will be measured based on the average number of export shipments per year, over a period of five years. A high amount of export shipments can imply that the business is performing well. The exact definition of export shipment is: "Bringing Union goods outside the customs territory of the Union, by supplying products/services to companies located there" (Belastingdienst, 2016).

The variable will be measured through a Likert-scale question in the survey. The categories consist of a ranch of 300 shipments per category.

It is necessary to state that export volume is strongly related to the size of the company. As a result, export volume is not the purest form of performance. This should be taken into account when interpreting the results.

5.1.3 Gross Profit Margin

Gross profit margin assesses a company's financial health. In the case of supply chain performance, it calculates the amount of money that is left after deducting the costs incurred for transportation. As this study will be conducted in the scope of the supply chain, the gross profit margin is consciously chosen. Several companies are participating in this research. Each company has its investment policy and uses its margin differently. This must be considered. The profit margin of a company can therefore give a distorted picture of the performance of a company.

A high percentage may indicate a more efficient transport process, on the other hand, a poor pricing strategy can be the cause of a low gross profit margin. This could be due to two possible causes. The first one might be a lower efficiency in the transport process which means that a company does not transport the goods efficiently enough. Or the quantity of transport is insufficient to cover the costs.

The gross profit margin will be measured in a percentage. To find out the margin of companies, a question has been included in the survey to obtain information about the margin that the different companies maintain.

5.2 Population

The main domain of the research consists of Small and Medium-sized companies located in the Netherlands. The companies must operate with a supply chain process. Furthermore, the companies must actively transport in one of the following industries: Food and beverages, Textiles and apparel, agriculture, forestry and fishery, wood and building materials, chemicals, life sciences and health, mining, energy, and utilities, or automotive.

The population has been deliberately defined, looking at the different facets of the population.

The geographic domain is the Netherlands. This is for the practical reason that the research will be conducted in the Netherlands. This makes it easier to approach Dutch companies to participate in the study. In addition to being geographically easier for Dutch companies to participate in, the research group had access to a database of Dutch companies that have a supply chain process, through a personal connection with the owners of the consultancy company GRC Customs.

When defining the population, a conscious choice was made for SMEs. This has several reasons. First of all, SMEs are generally more accessible and therefore more willing to participate in such surveys. In addition, the Netherlands has relatively more SMEs compared to big enterprises. SMEs can be seen as the engine of the Dutch economy and thus have a lot of influence. Optimization can often be achieved within SMEs. If they can do this by focusing on the three pillars of flexible transportation plans, this research can contribute to the optimization of a large part of the SMEs in the Netherlands.

To determine the different sectors, we looked at the largest sectors in which SMEs operate.

5.3 Measurement protocol

As explained in the introduction this research consist of a research question that reads as follows: 'How much does flexible transportation plans affect the supply chain performance of Small & Medium-enterprises located in The Netherlands? To investigate this research question more specifically, two hypotheses have been formulated that frame and specify the issue. The following two hypotheses have been formulated:

H1: Flexible transportation plans have a positive influence on the number of export shipments of Dutch SMEs.

H2: Flexible transportation plans have a positive influence on the annual profit margin of Dutch SMEs.

A dataset is required to carry out the research. Thereafter, a survey was sent out to obtain the dataset. This chapter explains how the data collection came about and how the effect size is calculated.

5.3.1 Data gathering

The data will be collected through a questionnaire aimed at SMEs in the Netherlands with an internal logistics process (see appendix C). We will use our network to approach related supply chain managers who are representative of SMEs located in the Netherlands. The company is willing to share its customer base of Governance Risk and Compliance Customs (GRC Customs) to approach AEO companies. They are an Authorized Economic Operator consultancy company and have the necessary network to collect data for our research. Besides, we will target people on LinkedIn and ask our network who are active in the supply chain to participate in our research.

The information will be gathered by a survey created in Qualtrics. The results will be exported from Qualtrics and uploaded to R-Studio to run the analyses. This study relay on respondents. The respondents will be people with the required knowledge of the supply chain processes of the company he/she is working for. The position of the respondent within the company will be asked in the survey, because of this the reliability of the research can be guaranteed.
Since the research is a cross-sectional study, the research model has a relatively high external validity and a relatively low internal validity.

5.3.2 Effect size

Multiple regression analysis and its non-standardized regression coefficient will be executed to measure the effect. A t-test will be carried out per section of flexible transportation plans. The effect on the gross profit margin will therefore be examined for each component. The effect size is then calculated using the following parameters: sample size, and p-value of the t-test per section. The results of these tests will be, point estimation of Cohen's d and the 95% confidence interval scores.

6. Results

In chapter six the results of the various statistical tests are discussed and explained. Each element of flexible transportation plans has been tested separately concerning both KPIs. In addition, an explanatory model has been made for each performance indicator. The results of the statistical test will be in detail discussed in this chapter.

6.1 Sample

The final sample consists of a total of eighteen respondents. All of them work at SMEs located in the Netherlands. Ten out of the eighteen companies are based in the province of South Holland. The final sample consists of respondents who work at different organizations, varying between companies with one to ten employees up to and fifty to two hundred and fifty employees. The majority of the respondents in the final sample, eleven out of eighteen are currently working for large SMEs. They have currently 51 up to two hundred and 250 in the food and beverages sector, three from the transport service, two in the agriculture, forestry, and fishing sector, two in the chemicals industry, and four respondents have indicated that they are currently active in another sector. Based on these, there can be concluded that we are dealing with a heterogenic theoretical domain.

There might be a possibility that the sample is biased, as a sizeable part of the respondents works at companies that are AEO certified. In general, these companies have good process and protocol' management, which might not give a good reflection of the population. Due to using personal networks to approach respondents, the sample is not a probability sample as not every company has an equal opportunity to participate in the study.

6.2 Effect size

6.2.1 Export shipments per year

Y = Average number of export shipments per year (Q15)								
	X	Test	t-value	p-value	Coefficient	95% confidence interval	Effect size (Cohen's d)	95% confidence interval of the effect size
(Q10)	Carrier	Pearson's r	0.364	0.721	0.091	[-0.393, 0.534]	0.1716	[-0.754, 1.0972]
(Q11)	Transportation plan	Pearson's r	0.326	0.748	0.081	[-0.401, 0.528]	0.1537	[-0.7716, 1.079]
(Q12)	Data	Pearson's r	0.011	0.992	0.003	[-0.465, 0.469]	0.0052	[-0.9188, 0.9291]

Table 2.Matrix export shipments

The observed results of our conducted study (table 2) have shown that each p-value of decisions based on data, the ease of switching carriers, and adjusting transport plans contain more than the significance level of 0.05, which means that all explanatory variables are insignificantly correlated with the average number of export shipments per year. Besides, its coefficients show weak associations or greater uncertainty with the regressand. These standardized effect sizes reflect the estimation in a relatively wide confidence interval of 95%. The effect sizes of each regressor of flexible transportation plans are calculated based on the sample size and the corresponding t-value on the website of Campbell Collaboration (Campbell Collaboration, sd). Based on the calculated effect sizes, it can be seen that none

of the various components of flexible transportation plans have a significant effect on the number of export shipments per year.

6.2.2 Profit margin

Y = Profit margin over 2020 (Q16)								
	X	Test	t-value	p-value	Coefficient	95% confidence interval	Effect size (Cohen's d)	95% confidence interval of the effect size
(Q10)	Carrier	Pearson's r	-1.193	0.082	-0.500	[-0.824, 0.071]	-0.6618	[-1.7783, 0.4548]
(Q11)	Transportation plan	Pearson's r	-1.165	0.269	-0.332	[-0.741, 0.269]	-0.6462	[-1.7614, 0.469]
(Q12)	Data	Pearson's r	1.471	0.170	0.405	[-0.187, 0.782]	0.816	[-0.3156, 1.9475]

Table 3. Matrix profit margin

In contrast to the previous analysis, which focused on the number of export shipments per year, this analysis looks at the financial performance and something remarkable is noticed. In the hypothesis drawn up, it is assumed that flexible transportation plans have a positive influence on the performance of companies. The profit margin for 2020 is included in the table above as a (financial) KPI. Table 3 shows that two of the three x variables (which are part of flexible transportation plans) have a negative t-value and therefore also a negative effect size. Only the variable data has a positive relationship with the financial performance of companies. However, the variables are not significant to statistically validate the given relationships. Later on, the x variables will be added in an OLS multiple regression analysis, to investigate whether the variables together can form a reliable model.

6.3 Regression Analysis

In the previous section, we looked at the different parts of flexible transportation plans separately. However, this does not give a full picture of the possible strengthening between the various components of flexible transportation plans. For this reason, an Ordinary Least Squares (OLS) regression analysis has been performed in which the variable carriers, data, and transportation plan serve as independent variables that influence the dependent variable performance in the sense of the average number of export shipments per year and in a separate analysis the performance will be expressed in profit margin per year.

Results of the explanatory variables

Export shipments per year

Carrier

When looking at the results of the regression analysis, it shows that the score of carrier influences the score given for the average number of export shipments per year with 0.010 on a scale. In concrete terms, this means that if the company - according to the Likert-scale set up in the survey - were to indicate one scale higher in terms of the ease of switching carriers, the company would score 0.010 Likert-scale categories higher on the question of how many export shipments the company on average transmits. So, the theory that can be derived from this is: the more flexibly an organization can switch carriers, the more

export shipments the company will send. This theory can be established with 81% certainty when only looking at the p-value. However, an 19% margin of error remains. This margin is too large to assume that the variable contributes significantly to the model.

Transportation plan

The transportation plan is the variable with the greatest absolute impact on export shipments per year. Namely, one scale higher on the demand for flexibility in transportation plan would mean that the company would score 0.084 scales higher on the question of how many export shipments the company sends on average. So, the easier an organization can change its transportation plan later on in the process, the more export shipments the company will ship. However, the reliability of this variable measured in p-value is not sufficient to validate this theory. This variable has a p-value of 0.848, which equals reliability of 85%, meaning that a margin of error of 15%. As a result, it can be concluded that the variable transportation plan is not significant in the model.

Data

The outcome of the data is also a striking outcome given the hypothesis that has been formulated. It was indicated that flexible transport would have a positive influence on the performance measured in the average number of export shipments per year. Theoretically, concerning our research question, data is part of the overarching variable flexible transport and should in turn positively impact performance. The results of the performed regression analysis show that the variable data has the smallest effect on the average number of export shipments per year compared to the other variables. So the more companies make logistical choices based on data, the more export shipments are shipped per year, this variable does not apply. If we look at the results of the regression analysis, it is striking that when the score given to the question: 'to what extent the company makes choices based on data, a scale is scored higher on the given Likert-scale, the expected score on demand related to export shipments will increase by 0.038 scales on the Likert-scale. This absolute impact can be described as very small. However, the variable is also not significant in the model with a confidence percentage of 90%, which means that the margin error is 10%. This margin of error is well outside the given 5% significance range.

Reliability of the model export shipments

Assumptions

Four assumptions are hidden behind this model. These assumptions must be validated for a usable model.

Assumption 1 (Normality)

The error ε must be normally distributed. In the performed regression analysis, it appears that the assumption concerning normality has been violated.

Assumption 2

The mean of ε must be 0, i.e., E ε = 0. The regression analysis performed shows that the error mean assumption has been violated.

Assumption 3

The error ε must have the same variance $\sigma 2$ for any value of x. In the graph below it can be seen that the assumption is violated as well.

Assumption 4

The value of ε associated with any particular value of y must be independent of ε associated with any other value of y. In the graph below it can be seen that the red line is not "flat", so the conclusion is that assumption four is violated.

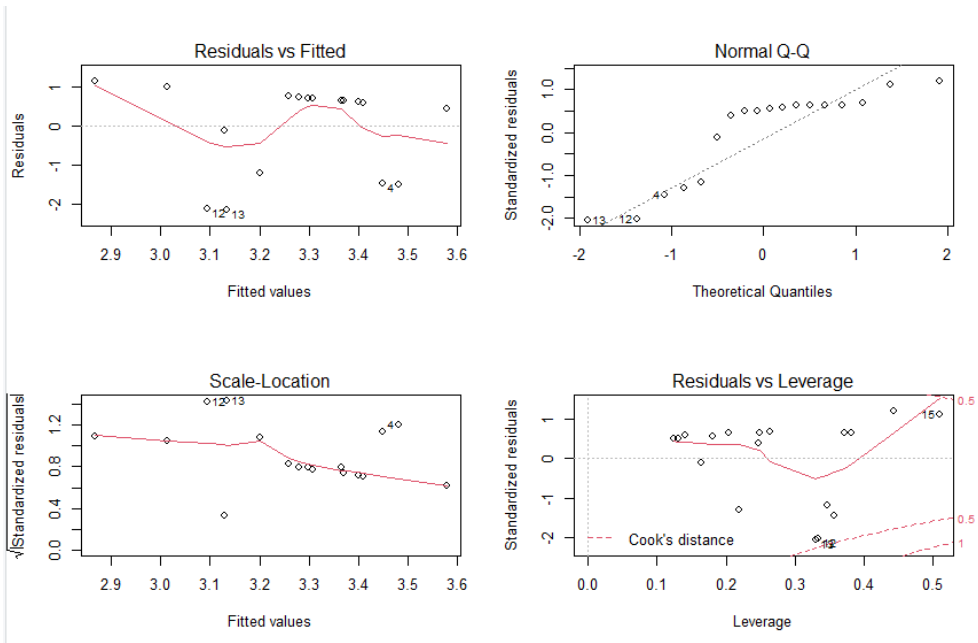


Figure 4. Regression analysis, export shipments

Conclusion Based on assumptions

Based on the assumptions behind the ordinary least squares multiple regression models, it can be concluded that the theory with the model created cannot be used to validate the theory.

Coefficient of determination

To investigate the reliability of the complete model, the adjusted coefficient of determination (R^2) was examined. This coefficient indicates the explainability of the total model. The adjusted coefficient of determination of the multiple regression analysis performed is negative, namely -0.200. As a result, the model drawn up has a negative explanation. The theory formed based on the hypothesis has not been validated with this model.

Profit margin

Carrier

The variable carrier in this model deviates most from the hypothesis based on the estimation in this model. In concrete terms, this means that if the company - according to the Likert-scale set up in the survey - were to indicate one scale higher in terms of the ease of switching carriers, the company would score 1.630 Likert-scale categories lower on the question of how much profit margin the company achieved in 2020. However, the p-value of this variable is very low, namely 0.332, which is far beyond the acceptable limit of 0.95. As a result, this variable is not significant and therefore no statistical statement can be made about the influence that this variable has on a company's performance.

Transportation plan

The transportation plan is the other variable with a negative estimation score, namely -0.773. The outcome of this variable is also at odds with the hypothesis. One scale higher on the demand for flexibility in transportation plans would mean that the company would score 0.773 scales lower on the question about the profit margin in 2020. As with the previous variable, this variable based on the p-value is not significant and for this reason, does not contribute to the statistical/explanatory model. The p-value of this variable is 0.618, which means that there is a margin of error of 38.2%. The statistically allowed margin of error is 5%. As a result, no statistical conclusions can be drawn for this variable either.

Data

Data is the only variable in this model which has a positive relationship with the y variable performance in the sense of profit margin over 2020. The estimation score of this variable is 0.6003. This value should be interpreted as follows. One scale higher on the question about to what extent the company makes choices based on data will result in a 0.6003 scale higher on the question about the profit margin in 2020. However, this variable is also not significant based on the p-value, which is 0.602.

Reliability of the model profit margin

Assumptions

Four assumptions are hidden under this model. These assumptions must be validated for a usable model.

Assumption 1 (Normality)

The error ε must be normally distributed. The performed regression analysis shows that the assumption concerning normality has been violated since the dots are not on the diagonal line.

Assumption 2

The mean of ε must be 0, i.e., E ε = 0. The regression analysis performed shows that the error mean assumption has been violated because the red line is not horizontally plotted from zero.

Assumption 3

The error ε must have the same variance $\sigma 2$ for any value of x. In the graph below it can be seen that the assumption is violated as well since the red line is not horizontally plotted.

Assumption 4

The value of ε associated with any particular value of y must be independent of ε associated with any other value of y. In the graph below it can be seen that the red line is not "flat" but is going downwards, so also this assumption is violated.

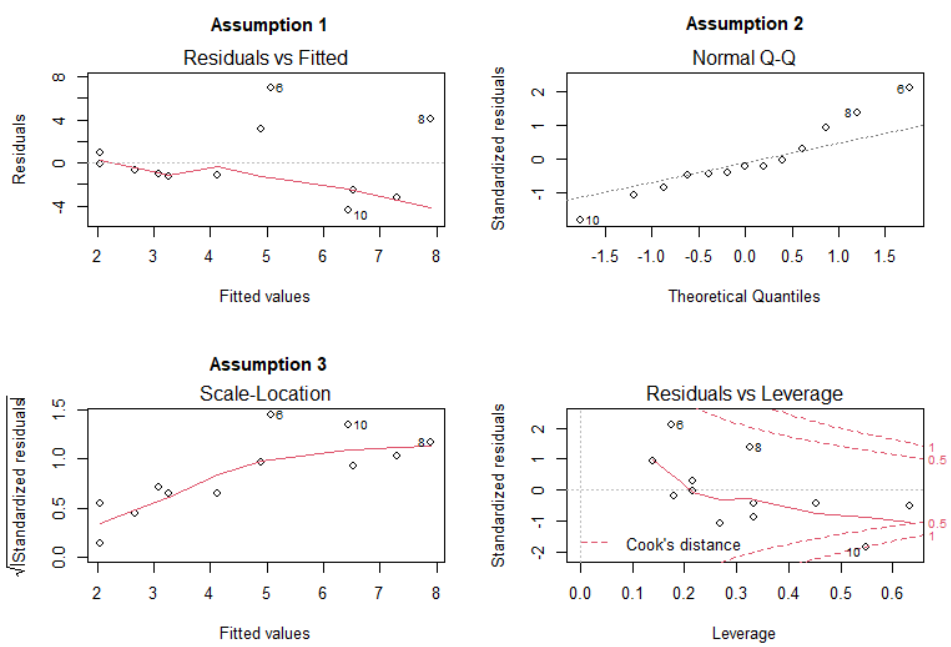


Figure 5. Regression analysis, Profit margin

Conclusion Based on assumptions
Based on the assumptions behind the ordinary least squares multiple regression models, it can be concluded that also this theory cannot be validated based on the model.

Coefficient of determination
The overall explanatory percentage of the model is measured by the adjusted coefficient of determination (R2). The model has an adjusted coefficient of determination (R2) of 0.065. This means that the explanatory power of this model is 6.5%, which is low in an absolute percentage. However, compared to the model in which export shipments per year were the dependent variable, this model performs better. The model of export shipments per year has a negative adjusted coefficient of determination. So in that sense, the model where the profit margin is the dependent variable is better than the model where export shipments per year are the dependent variable.

6.4 Missing data and non-response

Of course, this research also has a part non-response. However, it is difficult to find out what the percentage of the non-response is, as the survey was shared on Linked-In and in the network of GRC Customs. In this study, it is impossible to find out how the respondents arrived at the survey. Whether this is through Linked-In or the GRC Customs network is unknown because no different links were used.

In addition to the non-response, the respondents did not fill in every question, as a result of which missing values are present in the data set. The minimum set of questions to be able to carry out the research was made mandatory by the research team so that at least sufficient data was available to carry out an analysis. The optional questions were question 1 about the company the respondent works for. The other optional questions were the questions about the financial performance of the companies because this information can be sensitive so that not every respondent would want to share this data. As a result, the analysis in which the average number of export shipments per year has more data, namely 18 respondents, and the analysis in which profit margin per year (2020) is the dependent variable, has 13 respondents. So there are five missing values from the profit margin perspective.

6.5 Critical evaluation

When taking a critical look at the research, several things must be taken into account. These matters will be explained pointwise.

This research and the accompanying analyzes with results were made based on a sample that represents the entire population. The population consists of all SMEs in the Netherlands with a supply chain process. This is a considerably large population. The sample used to investigate the hypothesis and the research question is not proportional to the total population. This affects the reliability of the study and should be taken into account when reading the study.

The sample ensures that only a statement about SMEs established in The Netherlands can be made, as the research is about companies located in The Netherlands. A few of the companies are indeed located there but do not meet the requirements to qualify as an SME. These respondents are not removed from the final sample as the only way to track down this fact is through the company name, which was optional for the respondent to fill in. The anonymous respondents choose to not fill in the companies' names, which means there might be a possibility that they also don’t qualify as an SME, and this could only be

found out through the companies' names. If these will not be deleted, the results may appear biased through outliers.

As explained in 6.1 Sample, there is a possible bias in the sample. Because the GRC Customs network was used to approach respondents, a large part of the respondents are logically companies that are AEO certified. The ratio of AEO certified companies and non-AEO certified companies in the sample is therefore not representative of the entire population and must be taken into account.

The research with its results and conclusion is based on answers obtained through a survey. In the survey, each variable was questioned by one question. To increase the reliability and validity of this study, it would have been better if the variable was measured using several questions to reduce possible interpretation differences and thereby reduce the margin of error.

As this study is a cross-sectional study, no causal relationship can be established. In this research, it is assumed that the independent variables, that make up the concept of flexible transportation plans, influence the dependent variable performance of companies. However, this cannot be said with certainty. It could also be that the relationship is the other way around. Namely, that the performance of the dependent variable affects the independents' variables of flexible transport. In addition, there is another scenario. In this scenario, an unknown z variable can affect both variables.

6.6 Lessons learned

This thesis aims to investigate to what extent flexible transportation plans affect the performance of companies. The tricky thing about this hypothesis is that it encompasses abstract and broad concepts. These concepts had to be further specified. This was difficult because no one of the group members had any prior knowledge of supply chain and transport. This resulted in an intensive literature search.

6.6.1 Literature

The literature review was challenging. This phase was used to gain more knowledge about supply chain and transport. During this process, it became clear what the substantive meaning of the acquired variables in the supply chain field was and in which frameworks these concepts are used. The next step was to define the concepts of flexible transportation plans and performance further and linking this to the concepts. As the definitions hold a different meaning in the logistics industry. Summarizing relevant scientific articles, clarified which definitions would be used for the study that was conducted. This resulted in, revised articles and, the elimination of several studies.

When carrying out the desk research, the direction of the thesis had to be determined. There was an opportunity to interpret the variables in different ways. A focus was chosen at an early stage concerning the interpretation of the variables. As a result, the articles had to be chosen carefully as a specific direction already was chosen. This made the literature research more difficult than expected. The lesson to be learned from this experience is to keep the subject broad in the beginning and to concretize the research at a later stage.

However, keeping the subject broad may impact the insignificant results we obtain from our research. As beforementioned effect sizes from the observed studies have already shown that the effect of the association was small to medium. By using the inductive approach in the literature to identify themes that frequently appear in our collection of papers. Though, as we find that the influence of the themes on the

performance does not apply to all industry and implicitly to all countries, we generalized to further develop our research questions since a grounded theory about flexible transportation plans is not within reach and thus need to be parsed to meet the definitions in broadly speaking. Also, if we look back to the missing cases that were present in the observed studies most of them consist of non-probably samples which does what it does namely, not being representative for the population. Generating, reviewing, defining, and naming themes from there also reflects in our results. Not only does our research have missing cases, ideally, but we should also have looked at themes where probability samples are used in combination with no missing cases at all in recent studies. Our results should undergo a re-interpretation of our conclusions to make them more solid.

6.6.2 Research method

When selecting the research method, a choice had to be made between two types of research. The first option was conducting a quantitative survey. The other option was to research a qualitative research method. The discussion going on between the members was using a database of collecting data by ourselves. Using a database had as an advantage that there was a lot of data available, but the data was not specific enough to measure what was needed to answer the research question. The other possibility was collecting data through a survey. After discussing the pros and cons we chose to continue by setting out a survey as by this way we would acquire exactly the data we needed to conduct the study. The survey was to be distributed to SMEs with a supply chain process. Personal networks have been used to collect the data and gained the necessary data. This process pointed out that before deciding upon something to take a look at how it is going to affect the study and attain the results. Furthermore, the experience thought that having a great personal network can be very useful.

The supply chain performance served as a dependent variable in this study. This variable was defined as financial performance in the form of profit margin per year. There was no guarantee that companies would share these details as it can be sensitive information to SMEs. However, the backup plan was to include a question in the survey about the export shipments to ensure that when companies did not want to provide financial details, the research would not come to a standstill. Results of the surveys showed that many companies did not wish to share their financial information. As a result, plan b had to be used and the interpretation of the dependent variable (supply chain performance) had to be adjusted to a non-financial KPI, export shipments per year. After conducting the survey, it became clear that there must always be a plan b if respondents do not want to share the requested information. The results of the survey made us realize that it is important to come up with a backup plan in case you are not sure if a company is willing to share information that might be confidential or sensitive.

Creating the probability sample was also not very easy to execute. One of the ways how respondents were approached, was through using the customer base of a consultancy company and sending an e-mail out to active clients. Many respondents indeed filled out the survey after receiving the e-mail, because this bias may have arisen. As all of these companies are AEO certified, the sample does not represent the total field. This experience increased the awareness of the fact that it is difficult to create a non-bias dataset using a probability sample.

6.6.3 Research results

The survey was open for 16 days and was filled out by 18 respondents. The survey was supposed to be anonymous, as it contained questions that asked to share sensitive details about the company. There were a few questions such as the company name, that could conflict with the anonymity of the respondents. Therefore, the question was kept optional to be filled out. This causes the reliability of the survey, since the respondents cannot be traced, and information cannot be validated at a later stage. Furthermore, there was chosen to include a backup KPI in case the survey would not provide the necessary data. This alternative KPI was export shipments per year. To foresee the study of the required data, we performed a complete analysis for both KPIs. In retrospect, it was a good move to include several KPIs instead of relying on one.

7. Discussion

In the last chapter, firstly the conclusions are drawn and the main question will be answered. Then recommendations for future studies will be given and thereafter limitations of the study will be discussed.

7.1 Conclusions

Prior research has shown that the impact of flexible transportation plans can influence supply chain performance. This can be deduced from the critical synthesis elaborated in chapter 4. Many studies have a significant effect size, namely the article by Dong, Boute, McKinnon & Verelst, 2016 and Hoen, Tarkan, Fransoo & Van Houtum, 2014. Their studies have respective effect sizes of 1.5 and 1.11. These are high effect sizes and indicate that flexible transportation plans have a significant effect on the performance of companies. However, there are several reasons why it is difficult to compare the different studies. Each study has its population and definitions of the concepts. Nevertheless, it has given the critical synthesis enough indications that, realistically, there is a connection between flexible transportation plans and performance.

To measure performance in research, you need to define a key performance indicator, which can be either financial or non-financial. In this study, the financial KPI was the gross profit margin of a company per year and the non-financial KPI was the export shipments per year per company. The results imply that there is no significant meaning between the independent variables which include flexible transportation plans and the dependent variable supply chain performance measured in export shipments per year and gross profit margin per year.

The variables: carrier, transportation plan, and data, which includes the concept of flexible transportation plans are all individually tested against both export shipments per year and gross profit margin. This is done through a Pearson' r test. No significant effects could be derived from these tests.

In addition to the individual tests, explanatory models have also been made based on an OLS multiple linear regression analysis. Two models have been made. Carrier, transportation plan, and data were included as independent variables in both models. For the first time, export shipments served as a dependent variable. In the second model, the variable was gross profit margin.

In the first model, the variable export shipment served as a dependent variable. The model had a coefficient of determination of -0.200. This indicates that the model can be considered as poorly reliable and therefore the model has a negative explanatory power. In addition, the underlying assumptions of the OLS multiple linear regression were violated, which makes the reliability of the model even more questionable. However, the model concluded that none of the independent variables had a significant effect on the dependent variable export shipments.

In the second model, gross profit margin served as the dependent variable. This model had a coefficient of determination of 0.065 which is better than the first one but still very unreliable. The model only explains 6.5% of the value of the dependent variable gross profit margin. The underlying assumptions of the OLS multiple linear regression are violated in this model as well. As a result, this model is also not reliable enough to interpret the results statistically. Nevertheless, when we look at the results none of the variables in the model is significant.

Biased that the financial KPI is gross margin profit or the non-financial KPI export shipments per year. The results of the study could contain valuable information and provide companies with advice to invest in flexible transportation plans to improve their business.

Based on the findings there can be concluded that H1: Flexible transportation plans have a positive influence on the number of export shipments of dutch SME's and H2: Flexible transportation plans have a positive influence on the annual profit margin of dutch SME's, are rejected. The individual statistical scores can be seen in table 3 of chapter 6. The scores of the OLS multiple linear regression can be found in chapter 6 pages 25-30. The underlying cause of the rejection can be explained by the size of the sample. This was so small, it cannot represent all the SMEs based in the Netherlands with a supply chain process. Furthermore, the reliability can be discussed, because the statistical tests are based on just one survey question for each variable.

Another look at the described results, the research that has been carried out is not in line with the earlier and previous studies that have been carried out within the existing paradigm, where the degree of flexibility would influence the performance of companies. The contribution of this research is, therefore, a critical input within the existing paradigm, which encourages re-examination.

7.2 Limitations

The generalizability of the results is limited because it is not a probability sample. Because of this, the study does not give a clear picture of how the connection between flexible transportation plans and the (non-) financial supply chain performance is by SMEs based in The Netherlands. Besides, not all the industries were included in the questionnaire. Four of the respondents had chosen another industry. Hereby, it was not possible to get a clear view of the industries or the ones that did not belong to one of the options.

Further, the profit margin may be reliable information for some SMEs and it is preferable not to share it. This is partly because SME companies are often more sensitive to competition. To make companies willing to share their margin, we gave options varying from zero to a hundred percent with jumps from ten percent. That is why it is not clear what the actual profit margin is from all the companies.

In addition, export volume was chosen as the non-financial KPI to measure supply chain performance. But a company can be able to ship a high volume but still run inefficiently. A more suitable non-financial KPI would have been customer satisfaction as this also proved to be an important factor. This would mean that we had to get access to the customer base of the companies. This again can be sensitive to share with other parties as the customers are the core of SMEs.

The results do not give a complete picture of the effect of flexible transportation plans on supply chain performance. Also, the research's fundament is based on sensitive details. This makes it hard to get specific information. Therefore there is a limit on the KPIs that can be interpreted as a (non-)financial KPI.

7.3 Recommendations

Further research is needed to establish if flexible transportation plans have a positive influence on supply chain performance. First of all, the sample should be a probability sample, because in this case, every SME has the same chance to be part of the research. It should also be taken into account that multiple KPIs could be used, these could be tested individually. The best way to conduct a future study is by separating companies by size based on the number of employees or annual revenue because SMEs include small and medium enterprises. Due to the company size, export shipments can highly vary. Even though a company can yearly export a large number of shipments, the supply chain process can still be inefficient and inflexible.

Finally, future studies could experiment with synchromodality, from what level it will be profitable for a company to implement it. It should be clear if companies get financial (dis)advantages or non-financial (dis)advantages. Also, future studies should show how big the positive impact is for a business and how it affects a company and its employees.

Appendix

A. Literature

1. The impact of knowledge transfer and complexity on supply chain flexibility: A knowledge-based view (Blome, Schoenherr, & Eckstein, 2013)

As globalization increases the complexity of the Supply Chains, therewith the expectations from shorter product lifecycles, competition, and rising customers also increase. Because of the demand customers put on companies nowadays, the supply chains have more environmental complexity which raises the importance of supply chain flexibility. A possible definition of Supply Chain flexibility can be the potential to react to and compensate for changes in the environment. This can refer to the speed with which it is possible to alter production processes, capacities, stock turnovers, and cycle time. To remain competitive, a company needs to remain flexible. Supply Chain flexibility focuses on the dimensions of products.
Knowledge is an essential block to build forward with for organizations. Knowledge allows companies to develop core competencies and tackle possible problems. Transferring knowledge into activities can be defined as "a process through which a unit is affected by the experience of another's". The study combines literature research with practical data. The cross-sectional study's hypotheses suggest that the knowledge transfer processes can be distinguished as internal and external and their influence on the Supply Chain. H1: Internal knowledge transfer positively influences supply chain flexibility. H2: External knowledge transfer positively influences supply chain flexibility

The used data was collected through an electronic survey, which was filled out by individuals involved in procurement and supply chain management as key informants. The questions were firm- and relation-specific. Chain flexibility was assessed on a 5-point Likert scale anchored at not at all sufficient and fully sufficient. Out of all the respondents, 66,1% indicated as belonging to top management, 26,1% to middle management, and 7,8% to lower management.

The hypotheses were tested via regression analysis, involving three different models as the dependent variable. The results show that internal and external knowledge transfer has a significant effect on supply chain flexibility (see table 1). The results show that internal (H1: β=0.27; p < 0.01) and external knowledge transfer (H2: β=0.24; p < 0.01) have a significant effect on supply chain flexibility. The analysis of the two hypotheses has been statistically validated. With the provided Chi-square, 1.37, and the sample size (N=141), the calculated effect size (0.0986) of the transfer of knowledge and the influence on supply chain flexibility with a confidence interval of -0.0678 (LB) and 0.2597 (UB). This shows zero to a small effect.

	Determinants of supply chain flexibility		
	M1	M2	M3
Knowledge transfer			
Internal knowledge transfer (IKT)		0.27**	0.22**
External knowledge transfer (EKT)		0.24**	0.27**
Complexity contingencies			
Product complexity (PC)		0.21**	0.23**
Supply complexity (SC)		−0.22**	−0.29***
Moderating effects			
IKT × PC			0.33***
IKT × SC			−0.28**
EKT × PC			−0.17*
EKT × SC			0.27**
Control variables			
Industry	−0.02	−0.01	0.03
Firm size	−0.04	−0.07	0.04
N	141	141	141
R^2	−0.01	0.27	0.37
Model F	1.13	8.96***	8.71***
Delta R^2		0.28	0.10
Delta model F		13.35***	6.13***

***Significant at $p \leq 0.001$; **significant at $p \leq 0.01$; * significant at $p \leq 0.05$.
Chi-Square = 1.37

Table 4. Results of hierarchical analysis

The effect size cannot be interpreted as a causal relationship because not all other external factors are excluded.

2. **The effects of strategic and manufacturing flexibilities and supply chain agility on firm performance in the fashion industry (Chan, Ngai, & Moon, 2016)**

Fashion items are unique consumer products, they characterize short life cycles, high demand volatility, low sales predictability, and impulsive purchases. The demand for such products is unstable and also affected by external factors as weather and trends. To keep up with the fluctuations in the competitive market, supply chain agility is widely considered a critical success factor. An agile supply chain can be defined as a supply chain that responds rapidly to changes in the market. Another definition is the capability of a supply chain to rapidly realign the network and its operations to meet the highly dynamic customer demands and needs. Flexibility is an important factor influencing a firm's agility and overall performance.

Supply chain agility depends on different elements that apply to firm performance. The elements can be, delivery speed, centralized and collaborative planning, vendor management, quick response, cost minimization, and organizational flexibility. Therefore flexibility is defined in the research as the ability of a firm to adjust its strategic decisions in response to changing internal or external factors.

To research the flexibility factors on firm performance, five hypotheses have been formulated. The first two hypotheses provide insight into the relationship between strategic flexibility and manufacturing flexibility and supply chain agility. H1 is, Strategic flexibility positively influences supply chain agility and H2 is manufacturing flexibility positively influences supply chain agility. The third and fourth hypotheses provide insight into the relationship between strategic flexibility/manufacturing flexibility and firm performance. H3 is, strategic flexibility positively influences firm performance and H4 is, manufacturing flexibility positively influences firm performance. The fifth and last hypothesis researches the relationship between supply chain agility and firm performance. H5 is, supply chain agility positively influences firm performance.

To perform the research and test the five hypotheses empirically, an electronic questionnaire survey was conducted among manufacturers in the fashion industry in the emerging Asian market. For better control of the measurement process, the only focus was only the fashion industry during one time period and included only manufacturers. The sought manufacturers were ones with major production operations in only Asian countries. Random sampling was employed. The list counted 725 randomly selected manufacturers, 141 responses were finally received. This is a response of 19.4%, this is acceptable for an online survey and close to the recommended minimum of 20% for empirical studies.

To statistically analyze the research model and test the hypotheses, Partial Least-Squares (PLS) -based Structural Equation Modeling (SEM) technique was used to analyze the data. The overall model explains that there is a substantial amount of variance in firm performance. All the hypotheses were calculated with one sample size (N=141) and per hypotheses, the t-value is given. H1 (t-value = 2.06) shows that there is a medium to small effect with an effect size of 0.3099 of strategic flexibility influencing supply chain agility positively, with a confidence interval of 95% of -0.0222 (LB) and 0.642 (UB). H2 (t-value = 5.86) shows there is a large effect that manufacturing flexibility positively influences supply chain agility with an effect size of 0.987. With a 95% confidence interval of 0.6374 (LB) and 0.13366 (UB). H3 (t-value = 3.53) shows that there is a small to medium effect of strategic flexibility positively influencing firm performance with an effect size of 0.347. With a 95% confidence interval of 0.0144 (LB and 0.6796 (UB).

H4 (t-value = 1.84) proves there is zero to small effect of manufacturing flexibility positively influencing firm performance with an effect size of 0.032. With a 95% confidence interval of -0.2981 (LB) 0.3621 (UB). The last, H5 (t-value = 3.72) shows there is medium effect supply chain agility positively influencing firm performance with an effect size of 0.4817. With a 95% confidence interval of 0.1468 (LB) and 0.8166 (UB).

3. The impact of business analytics on supply chain performance (Trkman, McCormack, de Oliveira, & Ladeira, 2010)

The supply chain is an important factor these days when it comes to competition between companies. As a company, it is important to have insight into which factors influence supply chain performance. Optimizing the supply chain based on business analytics and in particular the "analytics of plan" is about making flexible decisions in the supply chain based on data to improve performance. This article examines the relationship between business analytics and supply chain performance where system support and business process orientation are moderators. This is done by a cross-sectional research strategy.

The hypotheses assumed in this research are: a) Business analytics has a positive influence on supply chain performance; b) Process orientation and information systems influence the correlation between business analytics and supply chain performance. Figure 3 shows the conceptual research model. It visually depicts the relationships between business analytics in supply chain management and performance in the SCOR areas (Plan, Supply, Make and Deliver).

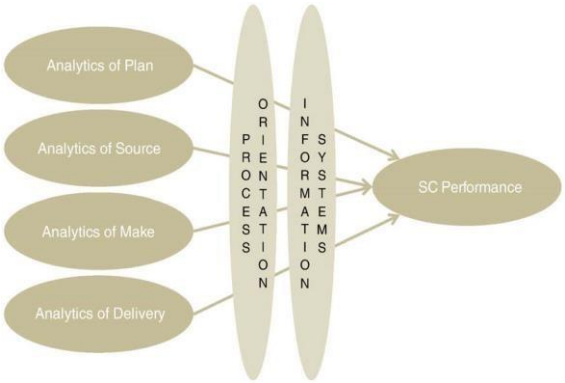


Figure 6. Conceptual research model

The data in this research was obtained by distributing a survey among 310 companies from different industries and countries/continents (USA, Europe, Canada, Brazil, and China). The survey consisted of 5-point Likert scale questions. The questions focused on decision-making in the main supply chain management decision categories for each of the four SCOR decision areas. Structural equation modeling (Partial Least Squares; PLS) was used to test the model and calculate the influence of the variables.

The research results show that the use of business analytics in critical process areas can influence the performance of a supply chain. The results underline the importance of using explanatory and predictive models. Based on this, management can make the right decisions. In addition, companies that support their analytical capabilities with good information systems are more likely to be able to perform better. Interestingly, the results provide limited support for the impact of delivery analytics and the moderating effect of orientation on business processes. The most interesting part of this research (from a flexible transportation plan perspective) is "analytics of plan". In this study, the sample size (N=310) and the p-value (7.847E−05) of the "analytics plan" were given. Based on these key figures the effect size of 0.5671 with a 95% confidence interval of 0.34 (LB) and 0.7942 (UB) was calculated. This indicates a medium effect. However, reliability can be discussed because the statistical test is carried out with data that has been bootstrapped. It may be a logical theory that "analytics of plan" causes supply chain performance. However, this is cross-sectional research and therefore a causal relation cannot be validated.

4. **The effect of supply chain integration on information sharing: Enhancing the supply chain performance (Koçoglu, Zeki, Hüseyin & Halit, 2011)**

It is a big advantage when companies can make decisions based on information. Information gathering is crucial in the competition. Information will be the key factor in decision-making. This research focuses on the influence of supply chain integration by sharing information that influences supply chain performance. The conceptual model consists of three main elements: supply chain integration, information sharing, and supply chain performance.

Supply chain integration improves customer engagement in supply chain activities and increases the effort of supply chain partners. Supply chain integration stands for the adoption and use of collaborative structures, processes, and technologies between supply chain partners to build and maintain a seamless conduit for the accurate and timely flow of information, materials, and finished goods. The first hypothesis is H1: Supply chain integration positively influences information sharing.

Supply chain integration improves supply chain performance by transferring real-time, reliable, and accurate information both to external partners in the supply chain and within the functions of the individual organization. This leads to the following hypothesis: H2 Supply chain integration positively influences supply chain performance.

By sharing information between partners in the supply chain, parties in the chain get access to operational activities of their customers and suppliers, such as point of sale data, stock level, and process visibility. This allows the parties to obtain timely and accurate information to determine their strategies flexibly. Also, results turn in greater flexibility and responsiveness in the supply chain, which positively influences the whole supply chain performance. From this follows the hypothesis: H3: Information sharing positively influences supply chain performance.

The hypotheses are tested by an empirical cross-sectional study. The data was collected through a survey conducted by 158 manufacturing companies in Turkey. The sample data consisted of a range of industries, including telecommunications, computer, and electronics, communications, software, manufacturing and machinery, chemical industry, service technologies, food, and materials industries. The organizations participating in the study have both national and international operational domains. In this study, 158 useful surveys were collected for analysis. The survey consisted of a 5-point Likert scale ('completely disagree' (1) to 'completely agree' (5).

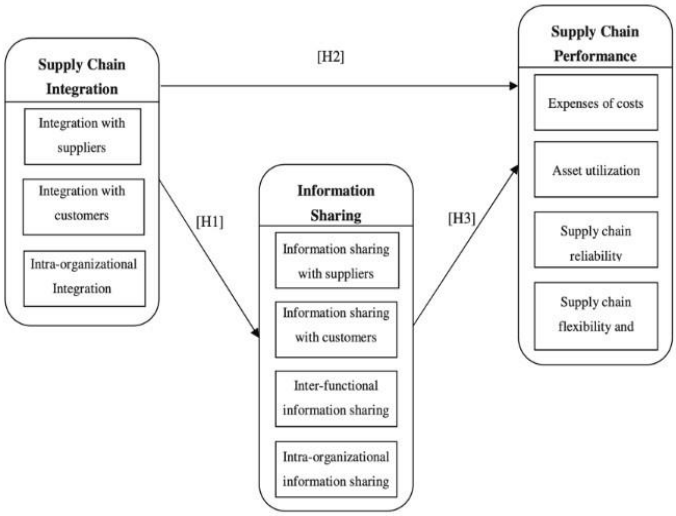


Figure 7. Conceptual research model

To statistically analyze the research model and test the hypotheses, Partial Least-Squares (PLS) -based Structural Equation Modeling (SEM) technique was used. The analysis shows that all three hypotheses have been statistically validated. The most interesting part of this research (from a flexible transportation plan perspective) is H3, which includes the flexibility of the supply chain and transportation plan, which is an important part of the research we will carry out during the bachelor thesis. Due to this reason the effect size of H3 is calculated based on the given key figures. This is done by the given t-value (t-value = 3.92), p-value (p = 0,01) and the sample size (N=158). The effect size of the influence of information sharing on supply chain performance is 0.4149, with a 95% confidence interval of 0.0997 (LB) and 0.7301 (UB). This shows a small to medium effect. By the cross-sectional study, a causal relation cannot be validated.

5. Supply Chain Flexibility in dynamic environments (Rojo, Stevenson, Montes, & Perez-Arostegui, 2018)

In the supply chain management and operations literature, flexibility used to put more emphasis on the firm level which is manufacturing flexibility (Slack, 1983; Slack, 1987) where flexibility is generally accepted as an important strategic ability (Krajewski, Wei, & Tang, 2005; Eisenhardt, Furr, & Bingham, 2010). Lately, the focus on flexibility in studies extends in the context of the supply chain (Spring & Stevenson, 2007; Blome, Schoenherr, & Rexhausen, 2013). Definitions of Supply Chain Flexibility (SCF) often refer to react to the environment (Llorens-Montes, Perez-Arostegui, & Rojo, 2016).

Rojo et al. (Rojo, Stevenson, Montes, & Perez-Arostegui, 2018) partly aim at the alignment between supply chain strategy and the environment by analyzing the relationship between SCF and environmental dynamism. 'Alignment' has been treated as "alignment implies that the firm must have the potential to learn, unlearn, or relearn" (Fiol & Lyles, 1985). Environmental dynamism has two main characteristics (Kovach, Hora, Manikas, & Patel, 2015), these are unpredictability and instability. According to Miller et al. (Miller, Ogilvie, & Glick, 2006)**,** these terms are defined as follows:

Unpredictability: "the lack of regularity in the pattern of change in the environment"
Instability: "the extent to which an environment exhibits change"

Since empirical research on the environment and dynamic capabilities are scarce to be found, Montes et al. propose the possibility to ease SCF through related learning and knowledge processes (dynamic capabilities), which include operational absorptive capacity (OAC) and organizational learning (OL). These two specific dynamic capabilities are based on theoretical support in the literature. OAC was adopted in their research which was defined by Cohen and Levinthal (Cohen & Levinthal, 1990) as "the ability of a firm's operational units to acquire, assimilate, transform and exploit knowledge from the operations' management". The term OL was followed by Moreno et al. (Ruiz-Moreno, Llorens-Montes, & García-Morales, 2007) as "the knowledge created by individuals is increased in an organized fashion and is transformed into part of the knowledge system of the organization". Rojo et al. follow the SCF construct of the dimensions proposed by Moon et al. (Moon, Yi, & Ngai, 2012) which solve the distinction problem in manufacturing flexibility and SCF, and the lack of its measurement scale that should operationalize the concept (Spring & Stevenson, 2007):

- Sourcing flexibility: "the availability of materials and services and the ability to purchase them according to changing needs".
- Operating system flexibility: "the capability to provide products with a wide variety of characteristics, combinations, and volumes to satisfy multiple customer specifications".
- Distribution flexibility: "a firm's ability to manage its distributors, warehouses, loading capabilities, and other distribution installations effectively and efficiently".
- Information systems flexibility: "the ability of a firm's information systems to adapt to changing market circumstances, especially in situations of unexpected misfit".

Thus, the second aim of their research paper is to find out how to approach SCF through OAC and OL. Looking at the mentioned objectives, their research question is formulated as follows:
"What is the relationship between SCF and environmental dynamism? And what role do dynamic capabilities (OAC and OL) play in developing SCF?".

Furthermore, a variety of hypotheses regarding discussions in the literature and Montes et al.'s research paper. We will only look at the scope of our research question, in this context of study 'supply chain flexibility. Since operational knowledge has a stronger effect than other types of knowledge on the operational level (Loufrani-Fedida and Saglietto, 2016). This effect is due to the formalized rules and procedures. OAC refers to a specific type of knowledge that is particularly related to SCF. So, the most relevant hypothesis is that OAC has a greater effect on SCF than OL. The focused hypothesis where we look at is H3: "AOC has a greater effect on SCF than OL".

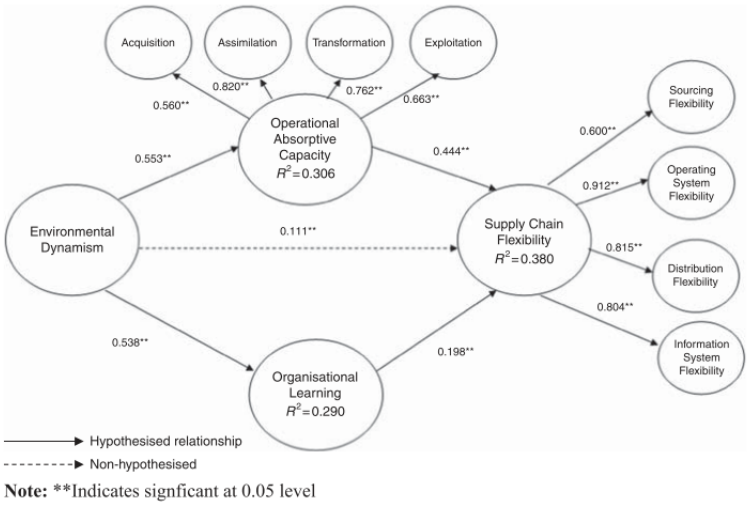


Figure 8. Structural equation modeling results with standardized parameter estimated.

Also, OAC (β=0.444; t=6.372; $p < 0.05$) shows a positive impact on the level of SCF. This provides empirical evidence to confirm the statement "The higher the level of OAC, the higher the level of SCF". If we look at the effect size (0.73) and its corresponding interval [0.5003; 0.9664], we can say that there is a large effect on the high-level relation between AOC and SCF. Its standardized coefficients show that OAC is stronger on SCF than OL. Montes et al. also used f^2 statistic to test each relationship and obtained the values of f^2 = 0.372 for OAC on SCF and f^2 =0.151 for OL on SCF. The effect size of OAC on SCF is larger than the effect size of OL on SCF, i.e., OAC has a greater effect on SCF than OL (which confirms H3).

The mentioned hypothesis does entail a causal claim. The formulated statements covary in the prediction direction and refer more to associations. Data of Montes et al. are cross-sectional, which means that testing causality is empirically difficult. Evaluating SCF with cross-sectional data can be a risk when analyzing short-term situations in the firm and not its flexibility as capability over time. In their research paper and its variety of hypotheses, the effect size parameters consist of correlation coefficients and standardized regression coefficients. Thus, it is consistent with the cross-sectional study.

The population encompasses manufacturing firms which can be treated as a part of the theoretical domain since manufacturing flexibility is more placed in a wider context of the supply chain context. Spanish manufacturing firms were the focus of their study. Manufacturing firms with only complete data (correct phone number), non-cessation of activity, and more than ten workers were included in the study. Eventually, a sample was studied. The sample is a non-probability sample that refers to a convenience sample. 302 valid responses were obtained. They evaluated non-response bias according to Fawcett et al. (2014) Mean values of size variables for all firms and mean values of the responded firms were similar

(p > 0.05). Also, ten different manufacturing industries were assessed in insignificant differences (p > 0.05).

6. Investigating synchromodality from a supply chain perspective (Dong, Boute, McKinnon, & Verelst, 2016)

According to the calculations carried out by the Intergovernmental Panel on Climate Change (IPCC), annual greenhouse gas (GHG) needs to be reduced by 40%-70% between 2010 and 2050. The expectation is that the freight share of total transportation emissions is expected to increase from 42% to 60% in 2050, making explicitly this sector one of the hardest sectors to decarbonize.

Combining several modes for any mode of transportation at a strategic, tactical, or operational level is generally characterized as 'multimodal transportation'.

Different types of commodities, distances, or products require different modes of services and conditions.

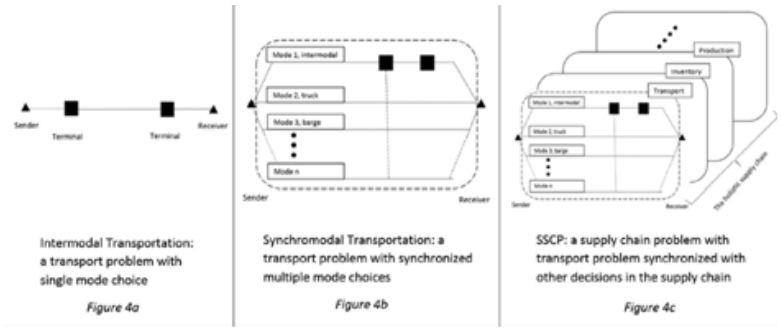


Figure 9. Figure 6. Comparison between intermodality, synchromodality and SSCP (Dong, Boute, McKinnon, & Verelst, 2016)

Intermodal transportation is a reference to the use of different transportation modes used on a single route. Synchromodal transportation expands the pathway of the one-dimensional freight of the pathway of intermodal transportation. Synchromodality from a Supply Chain Perspective (SSCP) is seen as a strategy that per definition is multimodal, therefore the flexible choice of freight transportation modes into shippers' management of the supply chain processes (figure 3).

From the perspective of a firm, the inventory does not consist only of handling costs of a warehouse, but also the cost of capital (CCP) linked to the inventory. The CCP is approximately 10% and the average inventory is holding costs of 25% of its value. The average value of the cargo is affected to be 100,000 EUR. The average CCP per day is calculated as follows, CCP divided by 365 (days) times the average value of the cargo.

Intermodal rail transportation always delivers a constant quantity to the distribution center. A problem-solving model is built through simulation, this obtains solutions. There is searched for different combinations of Q, S over a simulation of time horizon T. S and T are integer and the ratio of Q shows the share of intermodal rail transportation. C changes when Q varies from an intermodal rail share of 0% to higher percentages [1].

If chosen for the option of Road Transportation, there will be an average of 75 g CO_2 per tonne-kilometer discharged (TKM). Using SSCP this will be 24 tons. With a distance of 500 km using road transportation, there can be obtained 0,9 CO_2 emission per period. This is proximately for SSCP an average of 0,342. By using SSCP the effect of the carbon tax on CO_2 emission reduction is relatively small. The application of SSCP can reduce the emission of CO_2, through internal optimization of a firm's supply chain. The absence

of flexibility prevents models from obtaining higher reductions cost and emission wise. Furthermore, a company's freight volume volatility, unit of transportation, inventories vice versa may be different.

7. Switching Transport Modes to Meet Voluntary Carbon Emission Targets (Hoen, Tarkan, Fransoo & Van Houtum, 2014)

The transport sector is the second largest sector responsible for CO2 emissions in Europe and its share is still increasing. 66% of these emissions are attributable to road transport. The article there will be focused on changing the transport method within existing networks to reduce CO2 emissions. This article does not have a digit hypothesis, but a research question has been formulated as follows: How can the transport mode selection and sales prices be jointly optimized to meet an emission target efficiently for a group of customers? To elaborate on this research question: Organizations want to reduce the CO2 emissions that they generate to get the goods to the customers by switching to other transport modes that have lower emissions. This can be done by looking at each customer individually, the transport costs, the weight, the distance, and the lead time of the different transport methods. The selling price of a product must at least cover the transport costs. Therefore, the selling price can vary from customer to customer. So, this article is not about transportation flexibility during the transport process, but it defines transportation flexibility as the flexibility of making transportations mode choice at the beginning of the process.

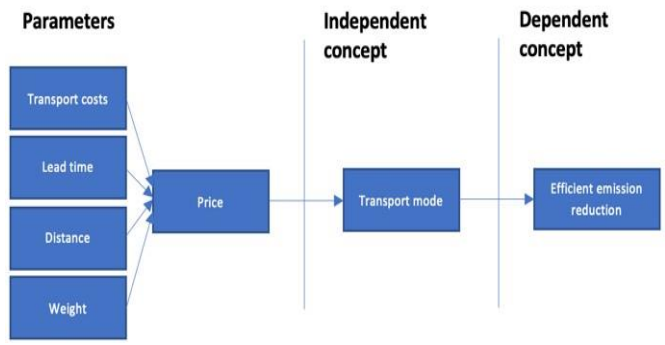


Figure 7. Conceptial research

Within the designed model several parameters determine which type of transport is most suitable, weighed with both cost and profit. This model is passed through for each delivery. The relationship that can be established is: if the model is based on your right transport choice, the reduction of emissions will decrease efficiently.

The case study was carried out at the company Cargill. In the case study, the cost-minimization model was first carried out, because this model suited Cargill's situation best. In order not to limit the findings to Cargill's design, the profit-maximization model was also applied to investigate the impact of demand sensitivity. The model observed that a 10% emission reduction can be achieved with only a 0.7% cost increase. If the minimum-cost solution is considered, it is possible to reduce emissions by 27% overall. In the case of profit maximization, the researchers concluded that emissions can be reduced by 30% with a profit loss of 1.2%. The effects apply only to routes shorter than 3,300 km. These effects can be deduced from the conclusion of the article. In addition, the results are also shown in the graph (Figures 5 and 6).

The slope of linear regression is the definition of effect size. Since, in this article, the relation between CO2 reduction and total cost and the relation between CO2 and total profit is defined as exponential relations, the necessary input is not given. With the given information it is not possible to calculate the effect size. Nevertheless, it is possible to calculate the effect size based on the maximum CO2 reduction and maximum cost increase. This can be done by dividing the value by the x value. So, 30/27 = 1,11. For the relation between profit and CO2 reduction, it is not possible to calculate the effect size, because the

maximum reduction led to zero profit. The estimated effect size cannot be interpreted as a causal effect size.

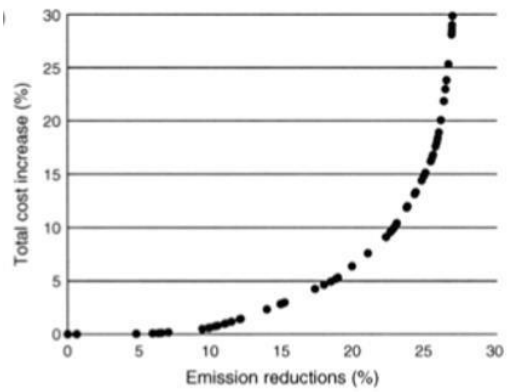


Figure 5. Emission reduction versus profit

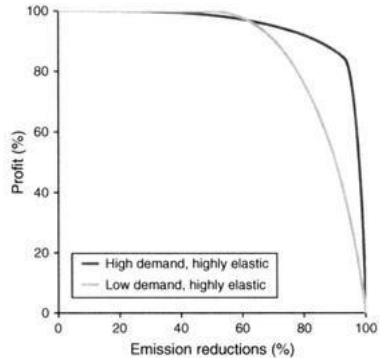


Figure 6. Emission reduction vs total cost increasing

8. Supply chain flexibility and firm performance (Sánchez & Pérez, 2005)

The purpose of Sanchez and Perez's paper is to make an inferential on the determinants of supply chain flexibility and its impact on the firm performance (tested on 126 Spanish automotive suppliers). Flexibility can be defined as a capability to respond/to change without being 'punished' in the performance (Upton, 1994). Supply Chain flexibility considers two main factors: process flexibility and logistics flexibility (related to logistics strategies).

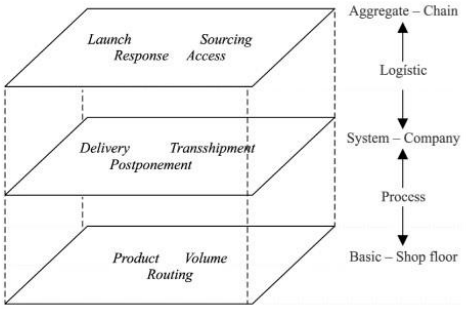


Figure 10. Supply chain flexibility dimensions

Their research paper provides a framework of supply chain flexibility dimensions to propose the paper's research hypotheses *(Sanchez and Perez, 2005)*. One of the hypotheses is:

H1: Supply chain flexibility is positively related to firm performance

Flexibility can be split into long-run (the organization's ability to adapt to the change) and short-run survival (organization's competitive attitude). A firm's overall performance refers to the six indicators of the performance: ROI, ROI growth, market share, market share growth, ROS, and ROS growth.

In the scope of the theme's hypothesis two relevant dimensions have been taken a closer look at with the following cited definitions:

Routing flexibility: "It is the capability of processing a part through varying routes by using alternative machines, flexible material handling, and the flexible transporting network. This flexibility reduces the negative impact of environmental uncertainty and unforeseen inefficiencies in the production process" (Gupta & Buzacott, 1986).

Trans-shipment flexibility: "Involves movement of stock between locations at the same echelon level where physical distances between the demand locations and the supply locations are small" (Barad & Sapir, 2003).

Martinez and Perez's results suggest that each single flexibility dimension does not equally relate to each firm performance measure in their research paper. Each dimension is likely important in different industries. According to the mean performance rating and the standard deviations, respondents considered routing flexibility as one of the top performances. Furthermore, the correlation between the relevant flexibility dimensions (regarding its average) and the firm performance of each measure show a significant positive relationship that covers the research question.

Based on the ROI as firm performance, the unstandardized effect size of routing flexibility on the firm performance is 0.301 and its corresponding confidence interval of 95% [0.103; 0.499] and the unstandardized effect size of trans-shipment on the firm performance is 0.121, and the corresponding confidence of 95% [-0.178; 0.420]. In other words, firm performance increases by one point when routing flexibility increases by a factor of 0.301. The firm performance also increases by one point when trans-shipment increases by a factor of 0.121. This means that routing flexibility has a much larger effect than trans-shipment flexibility on firm performance.

The hypothesis is not intended as a causal one but more as an association between supply chain flexibility and firm performance. Data in their cross-sectional study is quite limited to explain causal relationships. They also did not use secondary data, e.g., financial reports, to crosscheck the firm performance. Correlation coefficients of the parameters are implicitly given (by calculating its mean and standard deviation) which is consistent regarding the hypothesis in this study.

Flexibility dimension	Mean	SD	Percentage of answering 6 or 7
Delivery flexibility	5.94	1.33	69.9
Volume flexibility	5.64	1.14	60.3
Routing flexibility	5.60	1.12	54.7
Response to market flexibility	5.45	1.21	52.8
Product flexibility	5.30	1.40	50.9
Access flexibility	5.04	1.59	41.5
Transshipment flexibility	5.00	1.70	45.2
Postponement flexibility	4.74	1.76	39.6
Launch flexibility	4.64	1.58	41.5
Sourcing flexibility	4.49	1.47	22.6

Notes: Seven-point Likert scale. Higher values indicate better capacities related to competitors

Figure 9. Scores of the seven-point Likert scale per dimension

Flexibility dimension	ROI	ROI growth	Market share	Market share growth	ROS	ROS growth
Product flexibility	0.494**	0.359**	0.390**	0.341**	0.259**	0.236*
Volume flexibility	0.266**	0.151	0.239*	0.290**	0.209*	0.226*
Routing flexibility	0.301**	0.226*	0.264**	0.274**	0.154	0.148
Delivery flexibility	0.211*	0.266**	0.134	0.260**	0.060	0.150
Transshipment flexibility	0.121	0.243*	0.211*	0.254**	0.045	0.255**
Postponement flexibility	0.055	0.164***	0.270**	0.187***	0.136	0.154
Access flexibility	0.425**	0.322**	0.405**	0.457**	0.310**	0.320**
Sourcing flexibility	0.125	0.103	0.297**	0.335**	0.091	0.140
Launch flexibility	0.321**	0.360**	0.585**	0.597**	0.315**	0.455**
Response to market flexibility	0.352**	0.357**	0.393**	0.350**	0.209*	0.192*
Flexibility (construct)	0.384**	0.418**	0.330**	0.393**	0.195*	0.254**
Basic flexibility (construct)	0.318**	0.301**	0.434**	0.300**	0.223*	0.167***
System flexibility (construct)	0.215*	0.209*	0.143	0.259**	0.066	0.175***
Aggregate flexibility (construct)	0.439**	0.475**	0.336**	0.401**	0.238*	0.258**

Notes: ***$p < 0.1$; **$p < 0.01$; *$p < 0.05$ – Spearman correlation coefficients

Figure 10. The correlations between performance and the several dimensions

B. Data measurement and R format

Comp_name	Function	Location	Segment	Revenue	Employee	Industry	Tr_modes	Tr_Strategy	Carrier	Tr_plan	Data	Fin_ind
Metadata	Metadata	Nominal	Nominal	Ordinal	Ordinal	Nominal	Ordinal	Nominal	Interval	Interval	Interval	Interval

Nonfin_ind	Export_Ship	Profit	Profit_Incr	Profit_Decr
Interval	interval	Interval	Interval	Interval

Explanation of the variables

Q1 -> `Compname` = The full name of the company the respondent is working for.
Q2 -> `Position` = The position of the respondent within the company
Q3 -> `Location` = Location of the company (regions in the Netherlands)
Q4 -> `Segment` = Business-to-consumer/Business-to-Business
Q5 -> `Revenue` = Annual revenue of the company in 2020
Q6 -> `Employee` = Number of workers employed

1 = 1 – 10
2 = 11 – 50
3 = 51 – 250

Q7 -> `Industry` = The industry which is the company active in
Q8 -> `Tr_modes` = How many transport modes are used

1 = 1
2 = 2
3 = 3
4 = 4 or more

Q9 -> `Tr_Strategy` = Intermodal/Multimodal
Q10 -> `Carrier` = How easily can the carried be switched
Q11 -> `Tr_Plan` = How easily can the transport plan be adjusted
Q12 -> `Data` = Extent of data-driven decisions
Q13 -> `Fin_ind` = The importance of financial indicators
- 13_1 -> `Likelihood_profit`
- 13_2 -> `Likelihood_ROI`
- 13_3 -> `Likelihood_revenue`
- 13_4 -> `Likelihood_liquidity`
- 13_5 -> `Likelihood_shipmargin` = Profit margin per shipment
- 13_6 -> `Likelihood_shipyear` = Shipments per year

Q14 = `Nonfin_ind` = The importance of non-financial indicators
- 14_1 -> `Likelihood_leadtime`
- 14_2 -> `Likelihood_emission` = Emission reduction
- 14_3 -> `Likelihood_loyalty` = Customer satisfaction

Q15 = `Export_Ship` = Average number of export shipments per year

Answers:
- 1 = 0 – 300
- 2 = 301 – 600
- 3 = 601 – 900
- 4 = 901 or more

Q16 = `Profit` = The profit margin in 2020 (see table 1)
Q17 = `Profit_Incr` = Percentage of profit increase in 2020
Q18 = `Profit_Decr` = Percentage of profit decrease in 2020

As numeric	
1	0% <
2	0% - 10%
3	11% - 20%
4	21% - 30%
5	31% - 40%
6	41% - 50%
7	51% - 60%
8	61% - 70%
9	71% - 80%
10	81% - 90%
11	91% - 100%
12	>100%

Table 1. *Q16_Profit margin categories.*

C. Questionnaire format

Thesis SCM (NL versie)

Beste meneer/mevrouw,

Wij zijn Noa, Laxmi en Lars en benaderen u naar aanleiding van onze scriptie aan de Rotterdam School of Management, Erasmus Universiteit. Onze scriptie betreft een onderzoek naar het eventuele verband dat gelegd zou kunnen worden tussen de mate van flexibiliteit in het transportproces en de financiële prestaties van Midden en Klein-bedrijven. Middels verschillende respondenten, werkzaam binnen Supply Chain management, proberen wij dit verband nader te onderzoeken.

Uw hulp kunnen wij goed gebruiken en vragen u vriendelijk om de onderstaande enquête in te vullen. Om de vragen optimaal te beantwoorden, raden wij aan om gebruik te maken van
een computer/laptop. Deze enquête zal ongeveer vijf minuten van uw tijd in beslag nemen en uw antwoorden zijn anoniem. Mocht u zich niet comfortabel voelen bij het noemen van het bedrijf waar u werkzaam bent dan hoeft dit niet, deze vraag is optioneel.

Bij voorbaat hartelijk dank voor uw moeite en tijd. Indien u vragen heeft over de enquête of geïnteresseerd bent in het verloop van ons onderzoek kunt u ons bereiken via 557149nn@eur.nl

Met vriendelijke groet,

Noa Nguyen, Laxmi Sardjoe Mishre en Lars Bruurmijn

Q1 Bedrijfsnaam (optioneel)

_____

Q2 Wat is uw functie binnen het bedrijf?

_____

Q3 In welke provincie is het bedrijf gevestigd?

▼ Friesland (1) ... Flevoland (12)

Q4 In welk segment focust uw bedrijf op?

- ○ Business-to-business (1)
- ○ Business-to-consumer (2)
- ○ Beide (3)

Q5 Wat is de gemiddelde jaaromzet van het bedrijf?

- ○ ≤ €2.000.000 (1)
- ○ ≤ €10.000.000 (2)
- ○ ≤ €50.000.000 (3)

Q6 Hoeveel werknemers zijn er in het bedrijf?

- ○ 1-10 (1)
- ○ 11-50 (2)
- ○ 51-250 (3)

Q7 In welke sector is het bedrijf actief?

▼ Voeding en genotsmiddelen (1) ... Anders (10)

Q8 Hoeveel transportmogelijkheden worden gemiddeld ingezet om goederen van punt A naar punt B te vervoeren? (De verschillende transportmodaliteiten zijn lucht-, binnenwater-, zee- en off-road transport)

- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 of meer (4)

Uitleg transport De volgende vraag gaat over het gebruik van transport.
Hieronder is een korte uitleg van de definities gegeven.

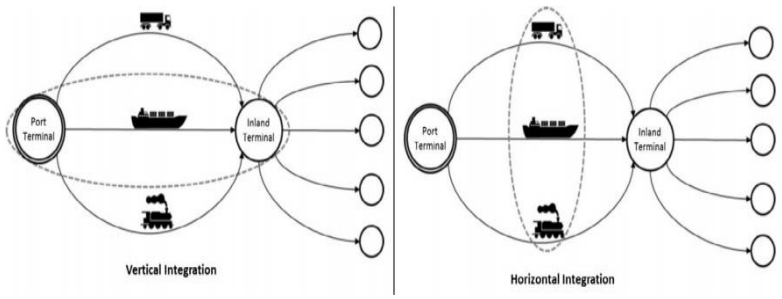


Figure 11. Vertical and horizontal integration of freight transportation planning (Behdani, Fan, Wiegmans, & Zuidwijk , 2016) (Tavasszy, Behdani, & Konings, 2015)

Intermodaal transport (verticale integratie):
Verwijst naar een reeks verschillende transportmodaliteiten die tijdens een enkele reis worden gebruikt.

Synchromodaal transport (horizontale integratie):

Verwijst naar het parallel gebruik van verschillende transportmodaliteiten die de vracht van punt A naar punt B vervoert.

Q9 Ons vrachtvervoer opereert via:

- ○ Intermodaal transport (1)
- ○ Synchromodaal transport (2)

Q10 Hoe eenvoudig kunt u (op korte termijn) van vervoerder op dezelfde vervoersverbinding wisselen?

	1. Heel moeilijk (1)	2. Moeilijk (2)	3. Neutraal (3)	4. Eenvoudig (4)	5. Heel eenvoudig (5)
Wisseling van vervoerder (1)	○	○	○	○	○

Q11 Hoe eenvoudig kunt u de vervoersplannen op (korte termijn) van tevoren aanpassen?

	1. Heel moeilijk (1)	2. Moeilijk (2)	3. Neutraal (3)	4. Eenvoudig (4)	5. Heel eenvoudig (5)
Aanpassing vervoersplan (1)	○	○	○	○	○

Q12 In hoeverre worden keuzes gemaakt op basis van data binnen de supply chain (SC)?

	1. Nooit (1)	2. Zelden (2)	3. Soms (3)	4. Vaak (4)	5. Altijd (5)
Keuzes o.b.v. SC data (1)	○	○	○	○	○

Q13 Hoe waarschijnlijk zal u de volgende (financiële) indicatoren gebruiken om de prestaties van de toeleveringsketen te meten?

	1. Zeer onwaarschijnlijk (1)	2. Onwaarschijnlijk (2)	3. Noch onwaarschijnlijk, noch waarschijnlijk (3)	4. Waarschijnlijk (4)	5. Zeer waarschijnlijk (5)
Bedrijfswinst (1)	○	○	○	○	○
Return on investment (2)	○	○	○	○	○
Jaaromzet (3)	○	○	○	○	○
Liquiditeit (4)	○	○	○	○	○
Winstmarge per zending (5)	○	○	○	○	○
Aantal zendingen per jaar (6)	○	○	○	○	○

Q14 Hoe waarschijnlijk zal u de overige indicatoren gebruiken om de prestaties van de toeleveringsketen te meten?

	1. Zeer onwaarschijnlijk (1)	2. Onwaarschijnlijk (2)	3. Noch onwaarschijnlijk, noch waarschijnlijk (3)	4. Waarschijnlijk (4)	5. Zeer waarschijnlijk (5)
Levertijd bestelling (1)	○	○	○	○	○
Reductie van emissie (2)	○	○	○	○	○
Klanttevredenheid (loyaliteit) (3)	○	○	○	○	○

Q15 Wat was het gemiddelde aantal (export) zendingen per jaar vanaf 2015?

○ 0 - 300 (1)

○ 301 - 600 (2)

○ 601 - 900 (3)

○ 901 - of meer (4)

Q16 Wat was de winstmarge van uw bedrijf waarvoor u werkzaam bent in 2020?

▼ 0% (1) ... >100% (12)

Q17 Met hoeveel procent is de winst ongeveer toegenomen in 2020 ten opzichte van 2019?

▼ Niet van toepassing (1) ... >100% (12)

Q18 Met hoeveel procent is de winst ongeveer afgenomen in 2020 ten opzichte van 2019?

▼ Niet van toepassing (1) ... >100% (12)

End of Block: Default Question Block

Thesis SCM (EN version)

Dear Sir / Madam,

We are Noa, Laxmi, and Lars and we approach you for our research that we carry out as students at the Rotterdam School of Management, Erasmus University. Our thesis concerns an investigation of the possible relation between flexibility in the transport process and the financial performance of Small and Medium-enterprises. We are attempting to further investigate this relationship through various respondents working within the Supply Chain Management.

With your valuable help, we kindly ask you to complete the survey below. To answer the questions optimally, we recommend that you complete them on your computer/laptop. This survey will take approximately five minutes and your answers will be anonymous. If you do not feel comfortable mentioning the company, you can leave this question blank.

Thank you in advance for your effort and time. If you have any questions about the survey / are interested in the progress of our research, you can reach us at 557149nn@eur.nl

Kind regards,

Noa Nguyen, Laxmi Sardjoe Mishre and Lars Bruurmijn.

Q1 Company name:

_____

Q2 What is your position within the company?

_____

Q3 Where is the company located in the Netherlands?

▼ Friesland (1) ... Flevoland (12)

Q4 Which segment does the company focus on?

- ○ Business-to-Business (1)
- ○ Business-to-Consumer (2)
- ○ Both (3)

Q5 How many employees do the company have?

- ○ 1 - 10 (1)
- ○ 11- 50 (2)
- ○ 51 - 250 (3)

Q6 What is the company's average annual revenue?

- ○ ≤ €2.000.000 (1)
- ○ ≤ €10.000.000 (2)
- ○ ≤ €50.000.000 (3)

Q7 In which industry is the company active?

▼ Food and Beverages (1) ... Other (10)

Q8 How many transportation modes are used on average to bring goods from A to B? *Information about transportation modes:*
The different modes of transport are air, inland water, sea, and off-road transport

▼ 1 (1) ... 4 or more (4)

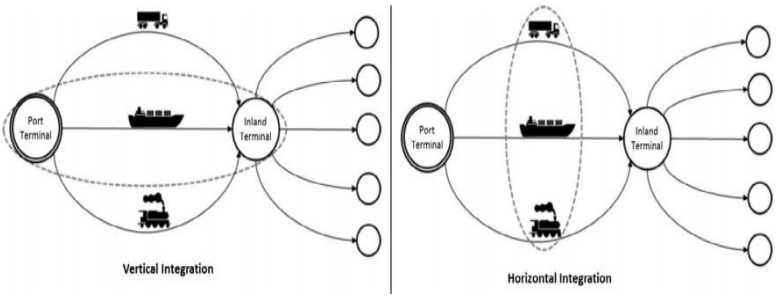


Figure 12. Vertical and horizontal integration of freight transportation planning (Behdani, Fan, Wiegmans, & Zuidwijk , 2016) (Tavasszy, Behdani, & Konings, 2015)

Transport usage The next question is about the usage of transportation. Down below you read a short explanation of the definitions.

Intermodal transportation (vertical integration, see figure 1 on the left): Refers to a sequence of different transportation modes used on a single journey.

Synchromodal transportation (horizontal integration, see figure 1 on the right): Allows parallel for the usage of different transportation modes from the origin to the destination.

Q9 Our freight transportation often goes by:

- ○ Intermodal transportation (1)
- ○ Synchromodal transportation (2)

Q10 How easily can you change carriers on the same transport connection in the short term?

	1. Very difficult (1)	2. Difficult (2)	3. Neutral (3)	4. Easy (4)	5. Very easy (5)
Switching carriers (1)	○	○	○	○	○

Q11 How easily can you adjust the transport plans in advance (in the short term)?

	1. Very difficult (1)	2. Difficult (2)	3. Neutral (3)	4. Easy (4)	5. Very easy (5)
Adjusting transportation plans (1)	○	○	○	○	○

Q12 To what extent are choices made based on data within the supply chain?

	1. Never (1)	2. Rarely (2)	3. Occasionally (3)	4. Almost every time (4)	5. Every time (5)
Data-driven (1)	○	○	○	○	○

Q13 How likely will you use the next (financial) indicators to measure supply chain performance?

	1. Extremely unlikely (1)	2. Somewhat unlikely (2)	3. Neither unlikely nor likely (3)	4. Somewhat likely (4)	5. Extremely likely (5)
Profit (1)	○	○	○	○	○
Return on investment (2)	○	○	○	○	○
Revenue (3)	○	○	○	○	○
Liquidity (4)	○	○	○	○	○
Profit margin per shipment (5)	○	○	○	○	○
Freight cost per unit (6)	○	○	○	○	○
Shipments per year (7)	○	○	○	○	○

Q14 How likely will you use other indicators to measure supply chain performance?

	1. Extremely unlikely (1)	2. Somewhat unlikely (2)	3. Neither unlikely nor likely (3)	4. Somewhat likely (4)	5. Extremely likely (5)
Lead time delivery (1)	○	○	○	○	○
Emission reduction (2)	○	○	○	○	○
Customer satisfaction (loyalty) (3)	○	○	○	○	○

Q15 What was the average number of (export) shipments per year from 2015?

▼ 0 - 300 (1) ... 901 or more (4)

Q16 What was the profit margin approximately over 2020?

▼ 0% (1) ... > 100% (12)

Q17 How much has the company's profit increased in 2020 compared to 2019?

▼ Does not apply (1) ... > 100% (12)

Q18 How much has the company's profit decreased in 2020 compared to 2019?

▼ Does not apply (1) ... > 100% (12)

End of Block: Default Question Block

D. Output R

1. Export volume as performance

```
database <- Flextrans_complete
```

Transportation modes

```
        Pearson's product-moment correlation

data:  database$Q8_Tr_modes and database$Q15_Export_Ship
t = 0.47953, df = 16, p-value = 0.638
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3683068  0.5550553
sample estimates:
       cor
0.1190307
```

Carrier

```
cor.test(database$Q10_Carrier, database$Q15_Export_Ship)
```

```
        Pearson's product-moment correlation

data:  database$Q10_Carrier and database$Q15_Export_Ship
t = 0.36365, df = 16, p-value = 0.7209
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3929416  0.5348022
sample estimates:
       cor
0.09053794
```

Transportation plan

```
cor.test(database$Q11_Tr_plan, database$Q15_Export_Ship)
```

```
        Pearson's product-moment correlation

data:  database$Q11_Tr_plan and database$Q15_Export_Ship
t = 0.32649, df = 16, p-value = 0.7483
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.4007383  0.5281621
sample estimates:
       cor
0.08135214
```

Data

```
cor.test(database$Q12_Data, database$Q15_Export_Ship)
```

```
        Pearson's product-moment correlation

data:  database$Q12_Data and database$Q15_Export_Ship
t = 0.010615, df = 16, p-value = 0.9917
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.4647921  0.4689429
sample estimates:
        cor
0.002653865
```

Location (Regression)

```
> RsltAov <-lm(Q15_Export_Ship~Q3_Location, database)
> anova(RsltAov)
Analysis of Variance Table

Response: Q15_Export_Ship
            Df  Sum Sq Mean Sq F value Pr(>F)
Q3_Location  5  6.5444  1.3089  1.0425  0.437
Residuals   12 15.0667  1.2556
```

Segment (Regression)

```
> RsltAov <-lm(Q15_Export_Ship~Q4_Segment, database)
> anova(RsltAov)
Analysis of Variance Table

Response: Q15_Export_Ship
           Df  Sum Sq Mean Sq F value Pr(>F)
Q4_Segment  3  3.3889  1.1296  0.8679 0.4808
Residuals  14 18.2222  1.3016
```

Industry (Regression)

```
> RsltAov <-lm(Q15_Export_Ship~Q7_Industry, database)
> anova(RsltAov)
Analysis of Variance Table

Response: Q15_Export_Ship
            Df  Sum Sq Mean Sq F value Pr(>F)
Q7_Industry  6  6.6111  1.1018   0.808 0.5845
Residuals   11 15.0000  1.3636
```

Transportation Strategy (Regression)

```
> t.test(Q15_Export_Ship~Q9_Tr_strategy, database)

        Welch Two Sample t-test

data:  Q15_Export_Ship by Q9_Tr_strategy
t = 1.0483, df = 13.938, p-value = 0.3123
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.5815824  1.6926935
sample estimates:
  mean in group Intermodaal transport mean in group Synchromodaal transport
                             3.555556                              3.000000
```

Linear regression

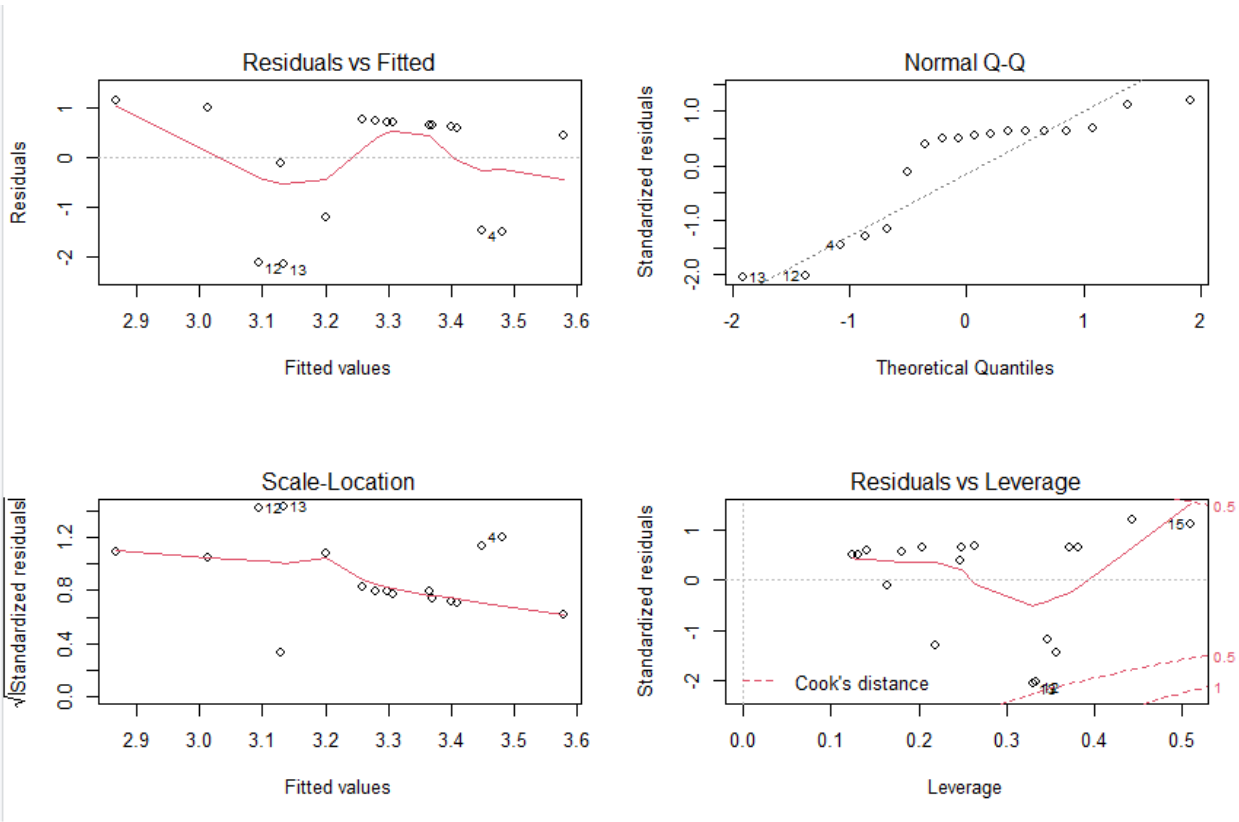
```
> RA<-lm(Q15_Export_Ship~Q10_Carrier+Q11_Tr_plan+Q12_Data, database)
> summary(RA)

Call:
lm(formula = Q15_Export_Ship ~ Q10_Carrier + Q11_Tr_plan + Q12_Data,
    data = database)

Residuals:
    Min      1Q  Median      3Q     Max
-2.2274 -0.9749  0.6107  0.7572  0.9787

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.54089    2.08514   1.219    0.243
Q10_Carrier  0.09966    0.40536   0.246    0.809
Q11_Tr_plan  0.08433    0.43315   0.195    0.848
Q12_Data     0.03748    0.28777   0.130    0.898

Residual standard error: 1.235 on 14 degrees of freedom
Multiple R-squared:  0.01153,	Adjusted R-squared:  -0.2003
F-statistic: 0.05442 on 3 and 14 DF,  p-value: 0.9826
```

#Moderator on each IV

```
> RA<-lm(Q15_Export_Ship~Q10_Carrier*Q4_Segment+Q11_Tr_plan*Q4_Segment+Q12_Data*Q4_Segment, database)
> summary(RA)

Call:
lm(formula = Q15_Export_Ship ~ Q10_Carrier * Q4_Segment + Q11_Tr_plan *
    Q4_Segment + Q12_Data * Q4_Segment, data = database)

Residuals:
    Min      1Q  Median      3Q     Max
-1.7432 -0.7530  0.2022  0.7070  1.2683

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)             4.7170     4.5905   1.028    0.328
Q10_Carrier            -1.7128     1.2595  -1.360    0.204
Q4_Segment             -1.3869     2.5446  -0.545    0.598
Q11_Tr_plan             1.2408     1.2747   0.973    0.353
Q12_Data               -0.2080     0.7636  -0.272    0.791
Q10_Carrier:Q4_Segment  0.8139     0.4945   1.646    0.131
Q4_Segment:Q11_Tr_plan -0.4764     0.5260  -0.906    0.386
Q4_Segment:Q12_Data     0.1929     0.3840   0.502    0.626

Residual standard error: 1.244 on 10 degrees of freedom
Multiple R-squared:  0.284,	Adjusted R-squared:  -0.2172
F-statistic: 0.5667 on 7 and 10 DF,  p-value: 0.7679
```

Assumptions

- RA<-lm(Q15_Export_Ship~Q10_Carrier+Q11_Tr_plan+Q12_Data, database)
- plot(RA)
- par(mfrow = c(2, 2))
- plot(RA)



#Linear regression, performance indicators on Q15_profit as performance

```
RA<-
lm(Q15_Export_Ship~Q13_1Likelihood_profit+Q13_2Likelihood_ROI+Q13_3L
ikelihood_revenue+Q13_4Likelihood_liquidity+Q13_5Likelihood_shipmarg
in+Q13_6Likelihood_shipyear+Q14_1Likelihood_leadtime+Q14_2Likelihood
_emission+Q14_3Likelihood_loyalty, Flextrans_complete2)
```

```
> summary(RA)

Call:
lm(formula = Q15_Export_Ship ~ Q13_1Likelihood_profit + Q13_2Likelihood_ROI +
    Q13_3Likelihood_revenue + Q13_4Likelihood_liquidity + Q13_5Likelihood_shipmargin +
    Q13_6Likelihood_shipyear + Q14_1Likelihood_leadtime + Q14_2Likelihood_emission +
    Q14_3Likelihood_loyalty, data = Flextrans_complete2)

Residuals:
     Min       1Q   Median       3Q      Max
-1.43300 -0.42697  0.00392  0.48294  1.70932

Coefficients:
                           Estimate Std. Error t value Pr(>|t|)
(Intercept)                  5.1727     3.8465   1.345   0.2156
Q13_1Likelihood_profit       0.2450     0.5811   0.422   0.6844
Q13_2Likelihood_ROI         -0.4668     0.4308  -1.083   0.3102
Q13_3Likelihood_revenue      0.5628     0.6143   0.916   0.3864
Q13_4Likelihood_liquidity   -0.3301     0.4256  -0.776   0.4603
Q13_5Likelihood_shipmargin  -1.0866     0.6231  -1.744   0.1193
Q13_6Likelihood_shipyear     1.3116     0.5751   2.280   0.0520 .
Q14_1Likelihood_leadtime    -1.8094     0.9518  -1.901   0.0938 .
Q14_2Likelihood_emission     0.4513     0.4944   0.913   0.3881
Q14_3Likelihood_loyalty      0.6929     0.5219   1.328   0.2210
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.219 on 8 degrees of freedom
Multiple R-squared:   0.45,     Adjusted R-squared:  -0.1688
F-statistic: 0.7272 on 9 and 8 DF,  p-value: 0.6788
```

2. **Profit margin as Performance**

```
#Profit margin as Performance
database <- Flextrans_complete2
database <- database[-c(2, 4, 8, 17, 18), ]
```

Carrier

```
cor.test(database$Q10_Carrier, database$Q16_Profit2020)
```

```
        Pearson's product-moment correlation

data:  database$Q10_Carrier and database$Q16_Profit2020
t = -1.9134, df = 11, p-value = 0.08206
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.82386366  0.07074466
sample estimates:
       cor
-0.4997193
```

Transportation plan

```
cor.test(database$Q11_Tr_plan, database$Q16_Profit2020)
```

```
        Pearson's product-moment correlation

data:  database$Q11_Tr_plan and database$Q16_Profit2020
t = -1.1654, df = 11, p-value = 0.2685
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.7461972  0.2685227
sample estimates:
       cor
-0.3315102
```

Data

```
cor.test(database$Q12_Data, database$Q16_Profit2020)
```

```
        Pearson's product-moment correlation

data:  database$Q12_Data and database$Q16_Profit2020
t = 1.4714, df = 11, p-value = 0.1692
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.1873097  0.7818229
sample estimates:
      cor
0.4055281
```

Location (Regression)

```
> RsltAov<-aov(Q16_Profit2020~Q3_Location, database)
> anova(RsltAov)
Analysis of Variance Table

Response: Q16_Profit2020
            Df  Sum Sq Mean Sq F value Pr(>F)
Q3_Location  4  31.231  7.8077  0.4593 0.7642
Residuals    8 136.000 17.0000
```

Segment (Regression)

```
> RsltAov<-aov(Q16_Profit2020~Q4_Segment, database)
> anova(RsltAov)
Analysis of Variance Table

Response: Q16_Profit2020
           Df  Sum Sq Mean Sq F value  Pr(>F)
Q4_Segment  1  41.552  41.552  3.6369 0.08295 .
Residuals  11 125.679  11.425
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Industry (Regression)

```
> RsltAov<-aov(Q16_Profit2020~Q7_Industry, database)
> anova(RsltAov)
Analysis of Variance Table

Response: Q16_Profit2020
            Df  Sum Sq Mean Sq F value Pr(>F)
Q7_Industry  5  33.731  6.7462  0.3537 0.8648
Residuals    7 133.500 19.0714
```

Transportation Strategy (Regression)

```
> var.test(Q16_Profit2020~Q9_Tr_strategy, database)

        F test to compare two variances

data:  Q16_Profit2020 by Q9_Tr_strategy
F = 1.387, num df = 5, denom df = 6, p-value = 0.6946
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.2316449 9.6779947
sample estimates:
ratio of variances
          1.386989
```

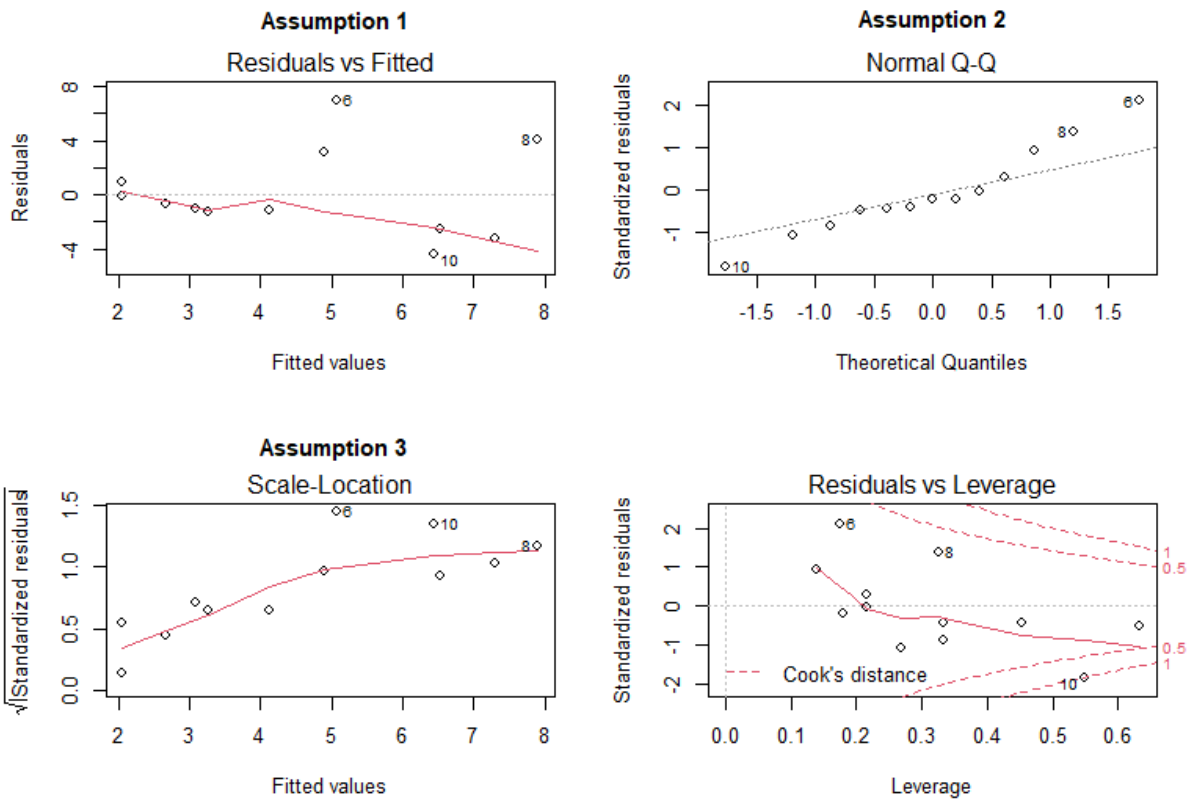
```
> t.test(Q16_Profit2020~Q9_Tr_strategy, database)

        Welch Two Sample t-test

data:  Q16_Profit2020 by Q9_Tr_strategy
t = 0.31545, df = 9.9293, p-value = 0.7589
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -4.191283  5.572236
sample estimates:
  mean in group Intermodaal transport mean in group Synchromodaal transport
                             4.833333                              4.142857
```

Linear regression

```
> summary(lm(Q16_Profit2020~Q10_Carrier+Q11_Tr_plan+Q12_Data,database))

Call:
lm(formula = Q16_Profit2020 ~ Q10_Carrier + Q11_Tr_plan + Q12_Data,
    data = database)

Residuals:
    Min      1Q  Median      3Q     Max
-4.4355 -1.2610 -0.6606  0.9397  6.9376

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  10.4668     8.8022   1.189    0.265
Q10_Carrier  -1.6290     1.5884  -1.026    0.332
Q11_Tr_plan  -0.7727     1.4978  -0.516    0.618
Q12_Data      0.6003     1.1119   0.540    0.602

Residual standard error: 3.61 on 9 degrees of freedom
Multiple R-squared:  0.2985,    Adjusted R-squared:  0.06464
F-statistic: 1.276 on 3 and 9 DF,  p-value: 0.3401
```

Assumptions

- RA<-lm(Q16_Profit2020~Q10_Carrier+Q11_Tr_plan+Q12_Data, database)
- plot(RA)



<u>Performance indicators measurements (Regression)</u>

#Linear regression, performance indicators on Q16_profit as performance

```
database <- Flextrans_complete

Q16 <- database$Q16_Profit2020
Q13 <- database[, c(13:18)]
Q14 <- database[, c(19:21)]

database <- data.frame(Q13, Q14, Q16)
View(database)

database1 <- database[-c(2, 4, 8, 17, 18),]
View(database1)

RA<-
lm(Q16~Q13_1Likelihood_profit+Q13_2Likelihood_ROI+Q13_3Likelihood_re
venue+Q13_4Likelihood_liquidity+Q13_5Likelihood_shipmargin+Q13_6Like
lihood_shipyear+Q14_1Likelihood_leadtime+Q14_2Likelihood_emission+Q1
4_3Likelihood_loyalty, database1)
```

```
> summary(RA)

Call:
lm(formula = Q16 ~ Q13_1Likelihood_profit + Q13_2Likelihood_ROI +
    Q13_3Likelihood_revenue + Q13_4Likelihood_liquidity + Q13_5Likelihood_shipmargin +
    Q13_6Likelihood_shipyear + Q14_1Likelihood_leadtime + Q14_2Likelihood_emission +
    Q14_3Likelihood_loyalty, data = database1)

Residuals:
      3       5       6       7       9      10      11      12      13      14      15      16
 1.6728 -0.7298  1.9893 -2.1701  3.1648 -1.4661  1.8149  0.2196 -3.0679 -3.2552 -2.3639  4.1917

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)                10.0233    25.7154   0.390    0.734
Q13_1Likelihood_profit     10.3457     7.5583   1.369    0.305
Q13_2Likelihood_ROI        -5.7977     5.4172  -1.070    0.397
Q13_3Likelihood_revenue    -7.2194     7.0450  -1.025    0.413
Q13_4Likelihood_liquidity  -0.3117     2.5542  -0.122    0.914
Q13_5Likelihood_shipmargin -1.8634     4.0449  -0.461    0.690
Q13_6Likelihood_shipyear    0.9241     3.3207   0.278    0.807
Q14_1Likelihood_leadtime    0.2675     6.1805   0.043    0.969
Q14_2Likelihood_emission    1.1091     3.1491   0.352    0.758
Q14_3Likelihood_loyalty     0.9920     3.4773   0.285    0.802

Residual standard error: 5.944 on 2 degrees of freedom
Multiple R-squared:  0.5715,    Adjusted R-squared:  -1.357
F-statistic: 0.2964 on 9 and 2 DF,  p-value: 0.9194
```

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