

# Digitalization in Logistics: small, medium and large-sized organizations

A comparison study in the Dutch Logistics sector

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## ABSTRACT

The use of digital technologies and data in industry has become increasingly important nowadays. This research aims on the digitalization process in the Logistics sector, and mainly on the influences the size of a Logistics organization can have when it comes to successfully digitalizing processes. Large Logistics organizations are the first when speaking about digitalization and the use of data for supporting their processes, as they have the resources and the knowledge to achieve that. Small and Medium sized Enterprises(SMEs) in the Logistics sector are lagging behind these larger enterprises, however digitalization can be of great influence on their processes and thus overall efficiency as well. In fact, these SMEs are of large importance for the whole Logistics industry, since they form 99% of all organizations in the EU. Therefore, this research will address a comparison between SMEs and large organizations in the Dutch Logistics sector regarding digitalization and use of data. The first research method is a literature review to explore the structural differences between small and large organizations and to validate factors that are found during the statistical analysis of a survey. The second research method is a statistical analysis of survey data from a survey, conducted by Dutch branch associations in the Logistics sector. The qualitative data that was gathered with the survey will be tested with the Chi-Square test of Independence, to find correlations between pairs of variables. The research will contribute in the form of a conceptual model in which the differences regarding digitalization and data use between small, medium and large organizations are established.

## Keywords

Digitalization, IT, data, industry 4.0, organizations, organization size, SMEs, Logistics

## 1. INTRODUCTION

The way organizations are managing their processes is changing since the introduction of digital technologies. The first step of this process was moving from paper to digital documents, the second step was the automation of processes and now the digitalization process has landed at implementing industry 4.0 technologies. The concept digitalization can be

explained as the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business[1]. In all sectors, including the Logistics and Transportation sector, the use of digital technologies and data has become increasingly important. It must shift the Logistics sector to a higher level of integration and efficiency of processes[2]. Organizations are therefore willing to invest in these technologies to stay relevant and competitive in the corresponding domain[3]. While the third industrial revolution, the automation of single processes, is still going on, industry 4.0 is already transforming the manufacturing and connected supply chain industry[4].

Industry 4.0, or smart industry, is the concept of implementing Cyber Physical Systems(CPSs) for creating smart factories by using the Internet of Things(IoT), Big Data, Cloud Computing, Artificial Intelligence(AI) and Communication Technologies for real time information and communication[5]. These promising technologies can have a great potential impact on organization's processes, however only a selected group of large organizations can experiment with these technologies, because of the large investments that are needed for the research and development of it. Especially for SMEs it is not easy to deal with these technologies, reasons for that could be a lack of resources, deficits in strategic thinking and an individual structure which limits adaptability of the technologies[6].

According to Eurostat, 99% of all enterprises located in the EU are employing fewer than 250 persons[7]. Enterprises that employ less than 250 persons can be categorized as medium sized enterprise, where enterprises with less than 50 employees can be defined as small enterprises[8]. These definitions are slightly less strict in the US, where for instance in manufacturing and wholesale trades a SME is defined as having respectively 500 and 100 employees or less. Referring to the numbers of Eurostat, only 1% of all enterprises in the EU can be defined as 'large enterprise', whereas the rest is defined as SME. Given this information, SMEs can be considered to be the backbone of the economy[9], which makes it important to have these organizations also involved in the transformation to digital organizations.

For SMEs in the Logistics sector, this transformation consists for example of the use of IT systems and the use of relevant (real-time) data. This transformation needs time and insights on how organizations can successfully implement these digital technologies. Therefore, the branch associations TLN, Evofenedex and Beurtvaartadres conducted a nationally oriented survey in 2019[10] among Dutch Logistics organizations. The survey was meant to gather information from Logistics organizations in the Netherlands regarding their situation with digitalization and data use. The results of

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this survey will be analyzed by using descriptive statistics and performing statistical tests, such as the Chi-Square test of independence. Eventually, variables will be derived that play an important role in the differences of digitalization and data use between small, medium and large organizations. To get a clear picture of the existing research in this field, a literature review will be performed. Besides validating the usefulness of the derived variables, the differences in characteristics of small, medium and large organizations are investigated by reviewing the literature.

The structure of the paper is as follows, section 1 will be expanded with the objectives of this research, including the problem statement, research goal and concluding with the research questions. The second section of the research discusses the related work that is already done in this field. After that, section 3 will describe the research methods that are used to perform the research. The fourth section compares SMEs with large organizations, both in the Logistics industry as well as a comparison in general. Section 5 dives into the results that are coming from the survey about digitalization and data use in the Dutch Logistics sector. The sixth section will compare the results of the statistical analysis with previously performed research, to validate the variables that are found significant in this research. And finally, the last two sections discuss the findings of this research and conclusions, together with a conceptual model with factors describing the differences between small, medium and large sized organizations and their situation with digitalization and data use.

### 1.1 Problem Statement

Although research has been extensively done about the digitalization process within (Logistics) organizations, the study on relating organization size in the Dutch Logistics sector to the process of increased digitalization and data use within these organizations is lacking. As mentioned in the introduction section, SMEs are of large importance for the economy of a country, so these organizations should be involved in the process of digitalization as well to stay in a competitive position as a national economy. Therefore, the differences between these Logistics SMEs and large organizations are investigated.

### 1.2 Research Goal

The goal of the research is to produce a conceptual model with factors that play an impactful role in the digitalization process of SMEs as well as large organizations. These two groups of organizations are divided and separately approached to have the differences of these groups clearly in place. The model should contribute in a way that there is more knowledge about the differences between organization sizes regarding digitalization and data use.

### 1.3 Research Questions

Following the problem statement and the goal of the research a research question **RQ** with the corresponding sub research questions **SRQ** can be set up as below.

**RQ:** What effects does the size of a Logistics organization have on having implemented digitalized processes?

**SRQ1:** What are the differences in characteristics of (Logistics) SMEs and large organizations?

**SRQ2:** How do small and large Logistics organizations differ in the use of IT systems within their organization?

**SRQ3:** What are the differences between small and large Logistics organizations regarding the use of data for supporting their processes?

## 2. RELATED WORK

In order to obtain the related literature, Scopus, Web of Science, Google Scholar and IEEE Xplore are used. Search terms such as 'digitalization', 'data', 'technology', 'Logistics', 'Transportation' and 'SME' are used in the mentioned databases to find relevant papers. And with this terms, multiple documents were found with research related to these fields.

The first part of the research consists of a comparison between small, medium and large sized Logistics organizations. In the field of organizational structures and characteristics, a lot of research has already been done [19, 20, 21].

In the domain of digitalization and data use within Logistics in general, there is considerable research available. The document output on literature databases is rapidly increasing as of 2014. Studies have been done on industry 4.0 technologies and the implementation of it in Logistics organizations [2, 4, 6, 13, 14, 15]. These studies are primarily focused on the potential impact of industry 4.0 technologies in Logistics organizations, however the comparison between small and large organizations is not made. So, differences in organization size of Logistics firms are not found in these studies.

In the domain of specific digital technologies used in Logistics, such as Information Systems, RFID technology and the use of data by data analytic tools, also considerable research is performed [12, 17, 18].

Furthermore, SME-focused research regarding industry 4.0 technologies is done extensively [6, 9, 16]. These studies are concerned with maturity levels, challenges & opportunities for SMEs and requirements for implementing these industry 4.0 technologies.

## 3. RESEARCH METHODS

This study will be an explanatory research, based on two methodologies to evaluate the factors that the size of an organization has on the digitalization process of organizations.

The first research method that is used in this research is a literature review. One goal of the literature review is to find out the differences in characteristics/features between small, medium and large (Logistics) organizations. The other goal of it is to validate the variables found in this research. The variables that are found should have a significant correlation with the size of a Logistics organization. One perspective on this is the differences in usage of IT systems within Logistics organizations and the other perspective is the differences in data use within Logistics organizations. The literature review will be further elaborated in section 3.1.

Secondly, survey data is used to evaluate the research questions regarding the Dutch Logistics sector. As mentioned in the introduction, TLN, Evofenedex and Beurvaartadres have conducted a survey in the end of 2019 on Data and Digitalization in the Logistics sector[10]. The results of this survey will be analyzed by using descriptive statistics and statistical methods, such as the Chi-Square test of independence. An expanded elaboration of this methodology can be found in section 3.2.

### 3.1 Literature review

#### 3.1.1 Scoping review

The first step in this research is reviewing the literature that is available in this field, which first consists of a scoping review of the literature. This will result in knowledge about the potential size and scope of available literature, which can be used for setting search criteria and filters.

#### 3.1.2 Search techniques

Initially, the online literature database Scopus has been used to obtain previously published research papers. Based on the relevancy of the resulting papers, two appropriate search queries have been developed. One of the search queries was needed for the first sub research question, as this asks for a comparison between SMEs and large (Logistics) organizations. And the other search query was used for the remaining sub research questions. In Appendix D, table D.1 the abbreviated search log of the search process can be found of the main search query.

The final search queries, which obtained the most relevant results, are as follows:

```
(  
( "Organization size" OR "Organizational size" OR  
"Corporation size" OR "Firm size" OR "Company size"  
OR "Enterprise size" )  
AND ( structure OR characteristic OR feature OR  
properties )  
AND ( Logistics OR transportation OR "Supply Chain"  
)  
AND ( differences OR compar* )  
)
```

This is the search query, especially for obtaining results about the differences in characteristics between small, medium and large Logistics organizations. The query got 57 results in the Scopus database.

```
(  
( digitali?ation OR digiti?ation OR "industry 4.0" )  
AND ( Logistics OR tranportation OR "Supply chain" )  
AND ( sme OR small OR medium OR large )  
AND ( "IT systems" OR "ICT systems" OR ict OR  
data OR "Information systems" OR "Logistics  
Information Systems" OR lis )  
)
```

This is the main search query for obtaining relevant papers on the digitalization process within Logistics organizations. Focusing on small, medium(SMEs) and large organizations. The query got 230 results in the Scopus database.

#### 3.1.3 Selection criteria

The above-mentioned queries are used in the search process. In this section the in- and exclusion criteria for the main search query are discussed. The inclusion criteria are as follows:

1. The papers must be written in English
2. The studies must be in a final publication stage
3. The studies must be of the type Conference Paper or Journal Article

The exclusion criteria are as follows:

1. Papers that are not available are excluded
2. Studies before the year 2015 are excluded
3. Studies coming from countries that are not in the top 75 rank of the aggregated LPI, according to the World Bank[22]

The last exclusion criterion was used to only have studies coming from comparable countries, regarding their performance within the Logistics sector.

#### 3.1.4 Extraction of primary studies

The search process procedure that was used is as follows:

- (1) Enter search query and search in title, abstract, keywords
- (2) Apply filters on Scopus website; using the section criteria
- (3) Read title, abstract and keywords
- (4) Read introduction and conclusion
- (5) Select relevant studies

After step 2 there were only 162 results left for the main search query. These results are analyzed on the title, abstract and keywords. When a research seemed relevant, also the introduction and the conclusion were read. Consequently, when these parts of the research paper were relevant, the paper could be added to a list of relevant papers.

### 3.2 Survey Analysis

The e-mailed survey from 2019 was filled in by primarily key persons of Logistics organizations. The survey was answered completely by 654 (N=654) Dutch Logistics companies with varying organization sizes from small and medium to large. The survey contained 86 open and closed questions to people involved in the surveyed organizations. The main type of questions are questions based on a 5-point Likert scale, however there are also a large amount of other closed questions in it which could be only answered by true/false or options that were given by the makers of the survey. From the survey, qualitative data is collected and studied. This data is collected in a period of approximately one month at the end of the year 2019.

The analysis of the data will be done using multiple statistical methods. One of them is descriptive statistics, in which bar charts and stacked bar charts are used to visualize results of a certain question. The second one is the Chi-Square test of independence. This test can validate whether there is a correlation between two categorical values or not. This is needed, since the survey data does only have categorical data and not consist of numerical data. So, by means of this test relationships can be tested between dependent variables and the independent variable 'organization size'. The organization of the data and calculations were performed within MS Excel.

The conceptual model that has been developed for visualizing the most impactful variables that are found in this research, is based on a 10-step procedure developed by Verschuren and Doorewaard[11].

## 4. SMES VS LARGE ORGANIZATIONS

As already stated in the introduction, SMEs are defined as organizations with less than 250 employees(FTEs) or less than an annual turnover of 50 million euros. This is the definition used in the European Union, whereas countries such as the United States, Canada or China have stated that organizations with less than 500 employees are SMEs. Although these definitions are not completely similar, studies from these countries could still be useful for analyzing the differences between small and medium sized organizations and large organizations.

According to [24], small and large organizations are fundamentally different in a number of aspects. The aspects studied in this research are primarily organizational characteristics, thus organization size is one of those. Furthermore, characteristics such as the amount of technical and financial resources, the knowledge of employees and the management perspective are studied. In all of these characteristics small and large organizations differ significantly. Small businesses have in most cases limited technical and financial resources and a management perspective that is mainly based on a short time range[20].

### 4.1 Three areas of differences

Apart from these single aspects, there are three central areas in which small and large organizations are different. The first area is uncertainty, which consists of a lack of market power, the limited customer and product base and the diversity of objectives of the owners[23]. The first aspect explains that small organizations cannot set the standard in their market, such as setting the price for a product. Secondly, due to the limited capacity of production or services, the customer base is limited of smaller organizations and are thus much more dependent on a single customer. Finally, owners of small organizations are much closer to their own business than shareholders to that of a large organization. This means that the performance of a small organization is more dependent on the efforts of the owner compared with a large organization.

The second and the third important areas are innovation and evolution. These two areas are related to this research, since the digitalization of an organization has a lot to do with innovation and evolutionary change within an organization.

First of all the approach to innovation is different for small and large organizations. Small organizations are likely to commercialize innovations, but less likely to adopt innovations[25]. Other research found out that it is actually the other way around, small organizations have the ability to provide something marginally different to what a large organizations is selling to their customers[26].

Secondly, according to Storey, small organizations have a greater likelihood of evolution and change, since these organizations have most of the times not a fixed structure and management style[26]. These aspects can lead to an easier process of change, which in the case of this study could mean that smaller Logistics organizations are more likely to change their processes to digitalized ones.

Another study that is focused on comparing SMEs with large manufacturing organizations have set a list of organizational features/characteristics and the differences of these features for SMEs and MNEs[19]. Large organizations are in this research referred to as Multi-National Enterprises (MNEs), but can be considered the same as the definition of large organization as it is used in this research. The list of features

and differences between the organizational sizes are found in Appendix C, figure C.1.

## 5. IT AND DATA IN LOGISTICS

The branch associations Evofenedex, TLN and Beurtvaartadres have conducted a survey about the state of the art of digitalization and data use within Logistics organizations[10]. The survey was sent in September 2019 to 51446 addresses, which were the combined relations of the associations. However, the survey had 1948 respondents, which is in absolute sense a large amount, however relatively seen it is a low amount. Eventually, the data is further investigated and the responses were filtered talon completeness. The final number of responses that are taken into account in this research is 654, because these gave the most complete and relevant insights. The survey was organized in six different sections, each section with its own subject. There is for example a section on IT Connectivity and one on Data. Nearly all the questions have a set of answers and an open field for different answers than the provided ones. Furthermore, a large amount of questions are based on a 5-point Likert scale, which in this case means that the answers are ranging from strongly disagree to strongly agree. In total, there are 86 questions/results, including overlapping questions with different perspectives. These results are divided into the different organization sizes and analyzed by plotting the diagram that is the most clear considering the data of the question.

### 5.1 Statistical method

Since the survey has mainly categorical data, a statistical test must be chosen that fits this data. On top of that, there should be looked at two variables, and whether or not these are related to each other. For the purpose of this research, one of the variables is always organization size, because the affects of this variable, and whether these are present or not, should be tested.

A statistical test that checks if two categorical variables are related or not is the Chi-Square test of independence. The null hypothesis  $H_0$  of this test will state that the two variables are independent of each other, the alternative hypothesis  $H_a$  implies dependency, so to find a correlation between two variables the null hypothesis should be rejected. So, the hypotheses for each question with a pair of two variables; variable/factor 'x' and the variable 'organization size', that is approached by this test are:

$H_0$  is 'Organization size is independent to 'x' and

$H_a$  is 'Organization size and 'x' are correlated'.

To perform a Chi-Square  $\chi^2$  test, the two hypotheses should first be defined. The level of significance for the tests is  $\alpha = 0.05 = 5\%$ , which means that there is a 5% risk of concluding the two variables are independent when in reality they are not. From the results of a question a contingency table should be created including the observed values of each pair of categories of both variables. After that the corresponding expected values should be calculated as:

$$\hat{E}_0 N_{ij} = \frac{\text{row total} \times \text{column total}}{n}$$

The sample size should be large enough to meet the criteria that comes with this test. The first criterium is that the expected frequency for each value is at least 1 and for 80% of the values this frequency should be at least 5. The test statistic, denoted as  $\chi^2$  is computed as:

$$\chi^2 = \sum_{j=1}^c \sum_{i=1}^r \frac{(N_{ij} - \hat{E}_0 N_{ij})^2}{\hat{E}_0 N_{ij}}$$

This  $\chi^2$  value is compared with the critical value from the  $\chi^2$ -distribution table with a certain degrees of freedom. The degrees of freedom,  $df$ , is computed by multiplying the amount of rows  $r - 1$  and the amount of columns  $c - 1$ . If the test statistic  $\chi^2 >$  critical  $\chi^2$  value, then we reject the null hypothesis, implying that two variables are thus correlated.

For each question out of the survey, the constraints for the Chi-Square test are checked to ensure a reliable outcome.

## 5.2 General

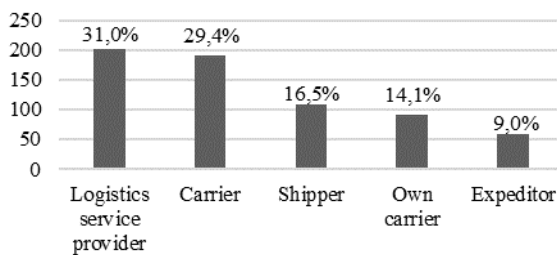
Out of the 654, most of the respondents are working for small and medium-sized organizations, but also 99 are from large organizations. The definitions for small, medium and large-sized organizations are given in the introduction section of this paper. Remarkable is the fact that more than half (57.5%) of the respondents have estimated an annual turnover of their organization between 0 and 25 million euros. The distribution of the organizations and its sizes, looking at the amount of people that are working within the organization (FTEs), are visible in table 1.

**Table 1**  
Distribution of organization sizes

Organization size	Amount	Proportion
Small	356	54,4%
Medium	199	30,4%
Large	99	15,1%

Next to the size of the organizations, the type of organization was also questioned in the survey. The survey was filled in by respondents of five types of organizations and these are distributed according to figure 1.

**Figure 1**  
Distribution of organization types



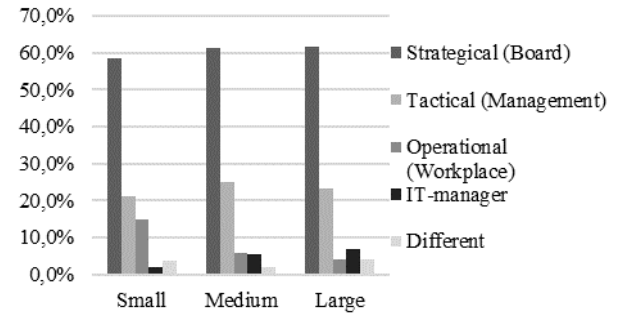
## 5.3 Management and Digitalization

Organizations are investing in digital technologies, but the decisions for these investments are coming from different organization levels. In the survey the respondents were asked in which organization level decisions are made regarding IT investments. To ask further on this topic, the next question was: Which organization level decides on specific IT systems? The levels of choice for both questions were 'Board', 'Management', 'Workplace', 'IT-manager' and 'different'. The results of the first question are visible in table 2 and figure 2.

**Table 2**  
Organization levels deciding on IT investments (N=654)

Org. size	Board	Mgmt.	Workplace	IT-Mngr.	Diff.
Small	58,4%	21,1%	14,9%	2,0%	3,7%
Medium	61,3%	25,1%	6,0%	5,5%	2,0%
Large	61,6%	23,2%	4,0%	7,1%	4,0%

**Figure 2**  
Organization levels deciding on IT investments (N=654)



The Chi-Square test statistic for this result is 24.14. The degrees of freedom is  $df = (3-1) * (5-1) = 8$ , so the critical value for  $\alpha = 0.05$  is 15.51. This means that we can reject the null hypothesis, so the organization size and the organization level deciding on IT investments are correlated.

**Table 3**  
Organization levels deciding on specific IT systems (N=654)

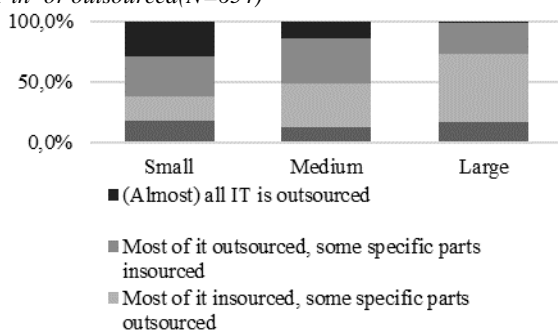
Org. size	Board	Mgmt.	Workplace	IT-Mngr.	Diff.
Small	56,7%	44,7%	52,2%	9,6%	2,2%
Medium	50,8%	73,9%	61,3%	36,7%	2,5%
Large	43,4%	76,8%	48,5%	44,4%	3,0%

The Chi-Square test statistic for this result is 66.85. Df is again 8, so the critical value for  $\alpha = 0.05$  is 15.51. This means that we can reject the null hypothesis with more evidence than the previous one, because the test statistic is far above the critical value. This means that the size of an organization and the decision-making organization level, regarding IT systems are correlated.

## 5.4 Attitude towards Digitalization

The attitude of an organization, especially its board and management, towards digitalization plays a large role in the digitalization process of an organization. This is mainly because the strategic and tactical layers of an organization decide on the investments for IT and the corresponding systems. Moreover, there is a large difference in in- and outsourcing IT management, where larger organizations are more insourcing their activities than small organizations. The stacked column chart that belongs to this question is placed below in figure 4.

**Figure 4**  
IT in- or outsourced(N=654)



From this chart we can conclude that the larger an organization is, the more IT activities are performed in-house. From the  $\chi^2$ -test the  $H_0$  is also with large certainty rejected, so these two variables are strongly associated with each other.

Another important point is the opinion of organizations on digitalization, do they see it as a high priority or is it not so important for them? Respondents are therefore asked to give the organization's opinion on digitalization, with answer options in the form of (very) (un)important and neutral. The test criteria were not met, because one of the expected frequency values is below 1, which means that the test cannot be performed. However, the data was clear and resolute, because almost all respondents said that digitalization is (very) important.

Furthermore, organizations that are of a medium or large size, sees themselves more often as a frontrunner in the field of IT, instead of a follower or laggard, when compared with the smaller organizations. Different 'frontrunners' are saying that they have a separate IT department in which developments are discussed, most of the times in collaboration with their main IT supplier. Followers are saying that they do their best to update their IT systems conform the industry standard. Lastly, laggards are saying that they are not well-informed about the possibilities and are working with old systems which cannot be well utilized.

The remainder of the questions about the position of an organization towards digitalization are not giving significant differences between small and large organizations. In fact statements such as 'Our organization is not well prepared for digitalization' are answered very divided upon small, medium and large organizations. So, for these questions there is not a proven correlation found.

## 5.5 IT Solutions

The next section of the survey was about the use of IT systems; a list of the discussed IT systems can be found in Appendix A table A.1. The answer options were 'Yes', 'No, but in the near future yes', 'No' and 'Don't know'. To compare the use of these systems within the organizations, the average percentage is taken of all systems with the answers 'Yes' and 'No, but in the near future yes'. This led to a use of 73.41%, 66.27% and 46.32%, for respectively large, medium and small sized organizations. The systems that are used the most are MS Office and a financial software package, which are probably the most available systems. From this result we can conclude that the larger an organization is, the more it makes use of IT systems. The  $\chi^2$ -test confirmed this conclusion, because the test statistic was 48.45, which was larger than the critical value of 12.59.

The shipping document is an important document in the Logistics industry, since it ensures that a shipment can successfully travel according to the rules of different countries. In the past years new technologies have been introduced on the market, such as the sign on glass system, which makes sure that shipments can be confirmed by a signature on a handheld. On top of that a new system called E-CMR is introduced, which is a completely digital shipping document, which makes it possible to track, adjust and sign a shipment. The results of the survey shows that primarily large organizations are using these newer technologies and this is again confirmed by the statistical test used in this research. The p-value, which is the likeliness of the null hypothesis being true is in this case 0.23%, and that is lower than the level of significance that is set ( $\alpha = 5\%$ ).

## 5.6 IT Connectivity

Most of the organizations, also in Logistics, have existing IT systems that are in use within the business processes. To further digitalize an organization, systems should be integrated with each other, instead of a stand-alone system for every purpose. This is needed, because of a lack of efficiency for an organization if that is not the case, since data available in one system is then not available in another one. So, respondents were asked to estimate the state of integration of IT systems right now. Out of the 99 large organizations, 73% said that at least many of their systems are integrated. For the medium and small-sized organizations this was respectively only 58.7% and 35.9%. The test statistic for the question is 63.10, which is much larger than the critical value of 15.51, so there is enough evidence to state that the size of an organization and the state of integrated IT systems are correlated.

Moreover, respondents were asked if integrating IT systems is desirable or not, this resulted in an increase of desirability as the organization size also increased. The difficulty of this integration is mostly seen as 'very difficult' by the larger organizations, probably because of the larger amount of systems and data that these systems use.

## 5.7 Data

Data is becoming increasingly important in industry, because useful insights can be gathered by analyzing data coming from various processes within an organization. Therefore, the survey asked for the use of data for different purposes. The purposes were 'Revenue per customer', 'Costs of vehicles', 'Costs of personnel', 'Driver's data', 'Return' and 'Absenteeism of personnel'. To test these purposes a combined test table is created with the average of all six factors together. From this table it becomes clear that approximately 88% of medium and large sized organizations are using data for these purposes and ~74% of the small organizations is doing that.

The data section consisted of more questions, primarily about the quality of data and the frequency of data collection and if it is similar to what is seen in reality. However, for all these questions there was not investigated a significant difference between the variables 'organization size' and 'variable  $x$  for data', because nearly all test statistics were lower than their critical values.

Nevertheless, the last question of this section showed a clear difference between small, medium and large organizations. There was asked for the expectations of real-time data for the coming years. The options with their statistics and the bar chart for this question can be found in Appendix A table A.2



and figure A.3. The  $\chi^2$ - test statistic of 34.82 is also much larger than the critical value of 21.03, because of the degrees of freedom of 12.

## 5.8 Business Innovations

### 5.8.1 Collection and Organization of Data

IT systems produce a large amount of data, which can give useful insights for an organization. These data need to be processed by an IT system that can collect the data and organize it. One of the questions respondents have gotten was: *'Is the organization familiarized with IT systems that can collect data and organize it?'*. The results from the corresponding question conclude that mainly large organizations are familiar with these systems and make use of it or will use it in the future. The test statistic  $\chi^2$  is 65.43 and is much larger than the critical value of 12.59, so the size of an organization have an evident effect on being familiarized with these systems and the use of it.

### 5.8.2 Process Optimization

IT systems can help organizations with the optimization of their business processes, by for example eliminating repetitive actions, automating billing processes and the use of an ERP for organizing internal processes. The question that respondents on this subject have gotten was: *'Is the organization familiarized with IT systems that can optimize processes?'*. The results from the corresponding question conclude that again mainly large organizations are familiar with these systems and make use of it or will use it in the future. The test statistic  $\chi^2$  is 46.33 and is much larger than the critical value of 12.59, so the size of an organization have an evident effect on being familiarized with these systems and the use of it.

### 5.8.3 Analytics

IT systems can also help organizations with their analytics. One of the questions respondents have gotten was: *'Is the organization familiarized with IT systems that can support Analytics of the organization?'*. The results from the corresponding question conclude that mainly medium- and large sized organizations are familiar with these systems and make use of it or will use it in the future. The test statistic  $\chi^2$  is 25.96 and is much larger than the critical value of 12.59, so the size of an organization have an evident effect on being familiarized with these systems and the use of it.

## 5.9 Bottlenecks

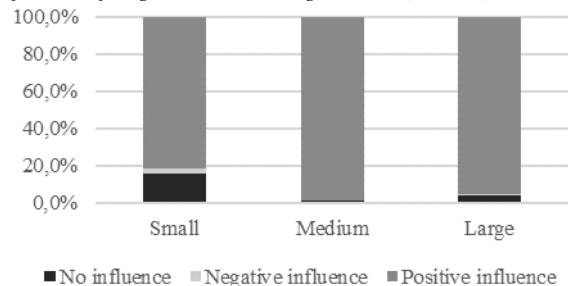
To improve the state of digitalization and data use within Logistics organizations, it is relevant to identify potential causes for organizations that are staying behind. The bottlenecks that were spoken about in the survey are *'Financial problems'*, *'Time limitations'*, *'Implementation complexity'*, *'Connectivity problems'*, *'Lack of skills, knowledge and attitude of staff'* and *'Management does not see it as priority'*. Remarkable from the result is that medium- and large sized organizations are stating more frequently the bottlenecks than small organizations. It is likely to assume that these organizations are therefore giving more priority to digitalization and data use, because they are aware of the potential causes of lack of digitalization and data use.

## 5.10 Concluding results

At the end of the survey there were some final questions that had the purpose to round up the survey and to ask for a general conclusion about the state of digitalization and data use in the organizations.

First of all there was asked what sort of influence digitalization has on the organization, with answer options from 'no influence', to 'negative influence' and 'positive influence'. Most of the respondents answered 'positive influence' on this question, however 15.7% of the small organizations answered with 'no influence'. The results of this question in total are visible in figure 5.

**Figure 5**  
Influence of Digitalization on organization(N=654)



The Chi-Square test statistic for this result is 40.70 > critical value of 9.49, so there is evidence that the size of an organization is related to the influence digitalization has on it. This result is in line with the expectations of digitalization for the future of organizations and their efficiency. An average of 70.9% across all organization sizes believes that digitalization will contribute (very) much to the efficiency of their organization in the future. The Chi-Square test statistic was 50.15 > critical value of 18.31, so enough evidence to assume that this pair of variables is also dependent on each other, which means in this case that large organizations are more believing in an increase of efficiency through digitalization than smaller organizations. Lastly, there was asked in which area digitalization is the most important. The differences between organization sizes are not large, because the tests' p-value is 0.8%. Nevertheless the results, visualized in a bar chart, can be found in Appendix A, figure A.4.

## 5.11 Influencing variables

As can be seen in table 4 below, the variables are listed that shows the most significant differences between small, medium and large sized organizations. Together with the name of the factor, the Chi-Square test statistic and the critical value statistic are listed. The variables that are stated in this list form the fundament to construct the conceptual model.

**Table 4**

List of most influencing variables regarding the organization size – ordered by the largest to smallest ratio of  $\chi^2 / cv$

Variable	$\chi^2$	cv
IT in- or outsourced	80.16	12.59
Familiarization with IT systems for the collection/organization of Data	65.43	12.59
Organization levels deciding on specific IT systems	66.85	15.51
Overall influence of Digitalization	40.70	9.49
The state of integration of IT systems	63.10	15.51
Importance of IT in general	60.10	15.51
Use of several IT solutions(combined avg.)	48.45	12.59
Familiarization with IT systems for process optimization	46.33	12.59
Future contribution of Digitalization on the organization's efficiency	50.15	18.31
Recognition of Bottlenecks	56.66	23.68
Familiarization with IT systems for analytics	25.96	12.59
Frontrunner, follower or laggard	23.01	12.59
Expectations for the potential of (real-time) data in the future	34.82	21.03
Organization levels deciding on IT investments	24.14	15.51
Effect of Digitalization on several areas within the organization	32.95	26.30
Current contribution of Digitalization on the organization's efficiency	25.83	21.03

According to the list of variables that came up after analyzing the results of the survey, it becomes clear that the variable in- or outsourcing of IT activities has the strongest relationship with the variable organization size. This result actually means that the larger a Logistics organization is, the more IT activities it has insourced. The question on whether digitalization has contributed a lot to the efficiency of a Logistics organization, has shown the less significant differences between small and large organizations.

## 6. CONCEPTUAL MODEL

In order to develop the conceptual model related to this study, the 10-step procedure of Verschuren and Doorewaard is used[11]. The 10 steps that will result in a final conceptual model are followed to get to a convenient result. Some of these steps are taken together to customize the procedure to this research. Consequently, the findings of this research are implemented in the procedure:

The main dependent variable Y that is subject to change.

Y = 'Digitalized Logistics organization supported by (real-time) Data'

Researched independent variables X, P, Q, etc. that have a strong influence on Y.

The independent variables influencing the state of digitalization and data use within Logistics organizations are found in this research by performing the survey analysis. The most significant variables are chosen for the final model

The independent variable U that has a significant effect between the variable Y and the remaining variables X, P, Q, etc.

U = 'Organization size'

In appendix B, figure B.1 the conceptual model can be found. Some variables are not incorporated, because of inconvenience of the model phrasing. Furthermore, the benefits of a digitalized Logistics organization are phrased, which are coming from several studies[4, 6, 13].

The variables that arose from the research and are included in the model are aligned with findings in the literature. First of all, outsourcing important activities, such as IT-related ones are primarily done by SMEs[19], which is also the case in our dataset. This will however cause a negative effect on becoming a digitalized organization. Furthermore, the experience and expertise with IT systems for the several purposes that are mentioned are often lacking at SMEs. Thirdly, the approach and attitude towards digitalization in general is an important factor for the readiness of a company. This attitude needs to be positive towards digitalization and data use, otherwise the organization will not be likely to change. And lastly, the recognition of bottlenecks and the forecasting of problems must be in order to evolve into a digitalized Logistics organization[9], having this not as a priority will lead to a negative effect towards the main dependent variable.

## DISCUSSION

First of all, the results of this study are based on the Dutch Logistics industry. This means that studies based on countries other than the Netherlands can have divergent conclusions, which is of course dependent on the type and location of the country. In this research there is chosen to include research papers that are published in countries that are in the top 75 of the aggregated LPI rank, according to the World Bank. This exclusion criterion for certain countries could be inconvenient.

Apart from where the data is coming from, the statistical analysis of this survey data is a contribution to the body of knowledge of this field. This is because useful insights are gathered about the differences between small and larger organizations. These insights consists of e.g. the difference in attitude towards digitalization and data use, the difference in use of available IT solutions, the difference in priority of IT implementation and the different expectations for real-time data with its corresponding advantages in the future. All these variables are coming back in the

Besides of the contributions of this study, there also conclusions that can not be made. One of the perspectives that is not taken into account is the type of Logistics organization, together with the size of it. As can be read in the report that Evofenedex published about the survey, the type of organization is also having a significant effect on the different questions. This type of research should therefore be a relevant follow-up on this research.

Furthermore, the Logistics sector is not compared with all sectors where digitalization and data use play a role. So, to validate the findings of this research a comparison could be made with another sector, for example the manufacturing sector or services sector.

And finally, even with a relatively large sample size, as the survey has, the reality could be slightly different and therefore it would be relevant to have another survey with a higher participation rate.



## CONCLUSION

To conclude this research paper, a conceptual model is established with the most significant factors describing the differences between small, medium and large sized organizations regarding digitalization and data use.

The research question was split into three sub research questions. The first sub research question is: 'What are the differences in characteristics of (Logistics) SMEs and large organizations?'. To answer this question a literature review is performed to establish a list of differences between the two groups of sizes. The list and the corresponding findings can be found in respectively Appendix C table C.1 and section 4.

The second sub research question is: 'How do small and large Logistics organizations differ in the use of IT systems within their organization?'. This question is answered by conducting a statistical analysis on the survey data that was provided by the branch organization Evofenedex. From this analysis there can be concluded that the larger a Logistics organization is, the more it makes use of available IT systems. As can be read in section 5.5, where the use percentages of several IT systems are combined, 73.41% of the large organizations are using these IT systems, whereas merely 66.27% and 46.32% of the medium- and small sized organizations is using these systems.

Furthermore, there is a large difference found between small and larger organizations concerning the level of integration of these IT systems. As stated in section 5.6, the Chi-Square test statistic for current IT systems integration is 63.10, which means that a relationship between the size of an organization and the level of integration is evident. So, the larger a Logistics organization is, the higher the level of integration is between IT systems within that organization.

The third and last sub research question is: 'What are the differences between small and large Logistics organizations regarding the use of data for supporting their processes?'. Also for the last sub research question the statistical analysis is used to answer it. In sections 5.7 and 5.8.1 the findings for this question are discussed regarding Data use and IT systems that are collecting and organizing data.

The research question is answered by means of the conceptual model. This model describes the differences between small and larger organizations regarding digitalization and data use within these organizations. The factors that play an important role in this relationship are listed in section 5.11. The development and final model are explained in section 6. The model itself can be found in Appendix B figure B.1.

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## APPENDIX

### Appendix A

**Table A.1**

List of IT systems(N=654)

Name of system	Current average use
MS Office: Word, Excel, Outlook	96.3%
Transport Management System (TMS)	67.8%
Route- and Planning software	43.4%
Warehouse Management System (WMS)	40.1%
Enterprise Resource Planning (ERP)	28.2%
Fleet Management System (FMS or On-board computers)	65.7%
Navigation systems	75.2%
Control Towers	20.2%
Financial Package	91.3%
HR Package	73.3%
Business Reporting	51.0%

**Table A.2**

Expectations for real-time data use for the coming years(N=654)

	E1	S1	C1	D1	T1	N1	D2
Small	70%	24%	43%	29%	17%	15%	3%
Medium	83%	26%	61%	52%	38%	3%	1%
Large	85%	32%	67%	59%	62%	2%	4%

E1: Increase in Efficiency

S1: Better Safety

C1: Better Collaboration with partners

D1: Increase in Data-driven decision-making

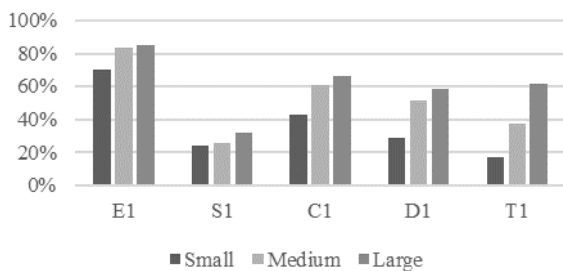
T1: More Transparency in the Supply Chain

N1: Nothing

D2: Different

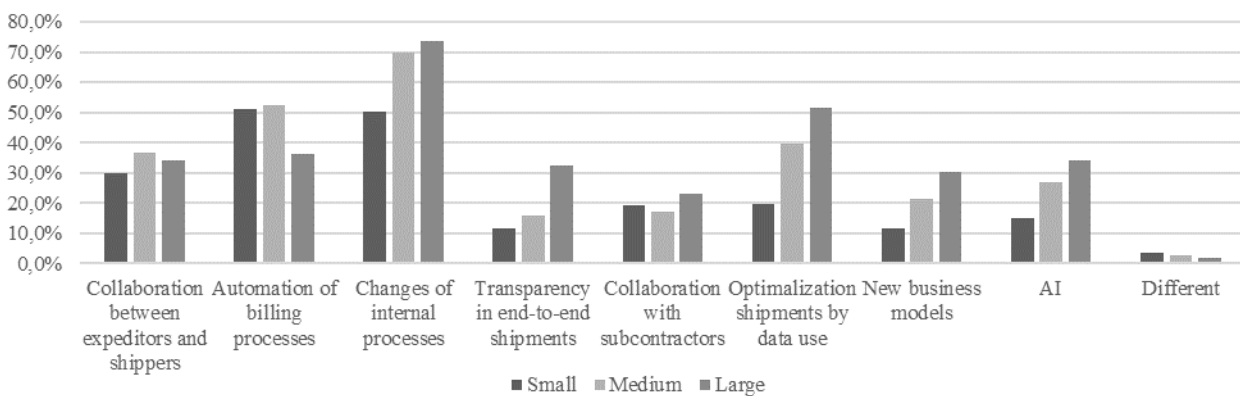
**Figure A.3**

Expectations for real-time data use for the coming years(N=654)



**Figure A.4**

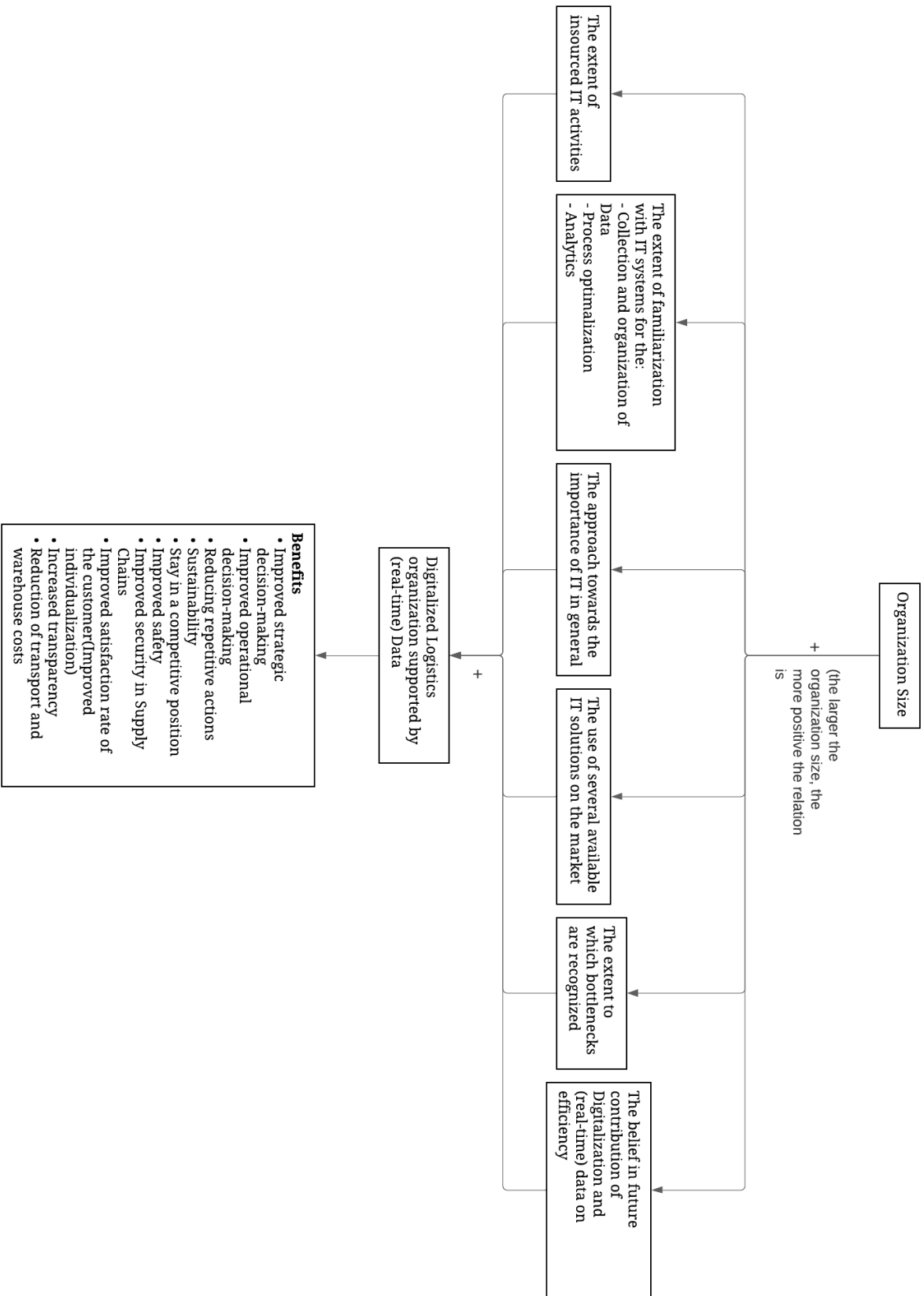
Importance of Digitalization in different organization areas(N=654)



# Appendix B

Figure B.1

Conceptual model of the most influencing variables



## Appendix C

Figure C.1

*Comparison of SMEs and large organizations based on the defined features/characteristics*

#	Features	SMEs	MNEs
1	Financial resources	Low	High
2	Use of Advanced Manufacturing Technologies (AMTs)	Low	Very High
3	Software Umbrella (incl. Data Analytics)	Low (Tailored solutions)	High (Standardized solutions)
4	Research & Development	Low	High
5	Nature of Product Specialization	High	Low
6	Standards consideration	Low	High
7	Organization culture/ Leadership flexibility	Low	High
8	Company Strategy	Dictated by Owner	Market Research and accurate Analyses
9	Decision Making	Restricted to Owner	Board of Consultants
10	Organizational Structure	Less Complex and Informal	Complex and Formal
11	Human Resources Engagement	Multiple domains	Specialized domains
12	Exposure to Human Resource Development	High in the industry/low outside the industry	Low within the industry/high outside the industry
13	Knowledge and Experience Industry	Focused in a specific area	Spread around different areas
14	Alliances with Universities/ Research Institutions	Low	High
15	Important Activities	Outsourced	Inourced
16	Dependence on Collaborative Network	High	Low
17	Customer/Supplier Relations	High(strong)	Low(not so strong)



## Appendix D

The abbreviated search log can be found in table D.1. This search log was created during the literature review on digitalization and data use in Logistics organizations. During the search process the following set of rules are taken into account:

- The online literature database Scopus has been used for the development of the search query.
- Each (set of) term(s) was queried in the Title, Abstract and Key words of the research papers.
- The results were sorted on relevancy.
- The initial search query was created to obtain the broadest result in literature, and consequently was tailored to actually relevant results.
- Wildcard symbol '?' was used to find both words in British English as well as in American English.
- The following filters are applied:
  - Year of publication: > 2014
  - Type: Journal Article or Conference paper
  - Country: Countries with an aggregated LPI rank of 75 and above, according to The World Bank[22]
  - Publication stage: Final
  - Language: English

**Table D.1**

<p>(( Digitali?ation OR Digiti?ation OR "industry 4.0" OR technology)  AND (Logistics OR Transportation)  AND (SME OR small OR medium OR large)  AND ("IT systems" OR "ICT systems" OR ICT OR Data OR "Information systems" OR "Logistics Information Systems" OR LIS)  )  <i>2415 results</i>  The amount of results is large and the researches are mainly focused on Logistics Information Systems. To limit the results the term 'technology' will be removed.</p>
<p>(( Digitali?ation OR Digiti?ation OR "industry 4.0")  AND (Logistics OR Transportation)  AND (SME OR small OR medium OR large)  AND ("IT systems" OR "ICT systems" OR ICT OR Data OR "Information systems" OR "Logistics Information Systems" OR LIS)  )  <i>134 results</i>  The amount of results decreased a lot. The term 'Supply chain' will be added to have a broader focus.</p>
<p>(( Digitali?ation OR Digiti?ation OR "industry 4.0")  AND (Logistics OR Transportation OR "Supply chain")  AND (SME OR small OR medium OR large)  AND ("IT systems" OR "ICT systems" OR ICT OR Data OR "Information systems" OR "Logistics Information Systems" OR LIS)  )  <i>230 results</i>  The results seem to be relevant when looking at the first twenty papers. To further exclude irrelevant papers most of the selection criteria will be used. This can be done by using the filters on the</p>

<p>website of Scopus.  (( digitali?ation OR digiti?ation OR "industry 4.0" )  AND ( Logistics OR tranportation OR "Supply chain" )  AND ( sme OR small OR medium OR large )  AND ( "IT systems" OR "ICT systems" OR ict OR data OR "Information systems" OR "Logistics Information Systems" OR lis ) )  AND ( LIMIT-TO ( PUBSTAGE , "final" ) )  AND ( LIMIT-TO ( PUBYEAR , 2015-2021 ) )  AND ( LIMIT-TO ( DOCTYPE , "cp" ) OR LIMIT-TO ( DOCTYPE , "ar" ) )  AND ( LIMIT-TO ( LANGUAGE , "English" ) )  )  <i>162 results</i>  The amount of results is feasible and can be further investigated and filtered, by reading the abstract and/or introduction of the papers. This amount is also already filtered with regards to the country of the research.</p>
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