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DESIGNING A FRAMEWORK FOR SUSTAINABLE SUPPLIER SELECTION FOR DIFFERENT PURCHASING PRODUCT GROUPS

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Designing a Framework for Sustainable Supplier Selection for Different Purchasing Product Groups

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Abstract

The research conducted in this thesis aims at filling a current research gap in the field of sustainable purchasing. Namely, the goal is to provide guidance on which sustainability criteria (Triple Bottom Line) can be used for selecting suppliers of products that require unique purchasing strategies based on the level of profit impact and risk (Kraljic Matrix).

To address this research gap, a sustainability framework was designed based on the results from a systematic literature review and other relevant studies. The framework was validated with the help of a survey questionnaire that was distributed to purchasing and sustainability practitioners. Some of the most interesting findings are as follows:

- There is a significant difference between the sustainability criteria that are relevant for different product groups;
- Cost/Price of the Product is the most mentioned criterion in literature, but based on the survey results, it seems less important for Non-critical and Bottleneck items;
- A small selection of sustainability criteria is used for Bottleneck items, but these criteria are used very often, according to the survey results;
- There are significantly fewer criteria that the respondents considered as relevant for Non-critical items than for Strategic and Leverage items, especially criteria related to the business capabilities and infrastructure of the suppliers;
- New criteria, such as Geographical Location, are gaining more importance, according to the survey results, which could be motivated by events that impact the global supply chain (e.g.: pandemic);

The research presented in this thesis also has several limitations and potential for future work, the most important of which is the small sample of responses collected for the survey. To continue the current work, and ensure the generalisability of the framework, it is recommended to focus on gathering more responses and conduct more advanced statistical analyses.

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1. Introduction to the main developments in the area of sustainable supplier selection

Over the past few decades, sustainability has become a cornerstone of societal and industrial development. The main drivers of this phenomenon are considered to be related to stricter governmental regulations, increased competition and scarcity of resources, and growing expectations and requirements from customers and stakeholders (Zimmer, Fröhling, & Schultmann, 2016). The need for sustainable development is emphasized on a global scale by the World Commission of Environment and Development (WCED) (Rajeev, Pati, Padhi, & Govindan, 2017) and also on a local level with policies being introduced by the European Union and the Member States (Testa, Iraldo, Frey, & Daddi, 2012).

In a report published in 1987, the WCED define sustainable development as the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (WCED, 1987). Therefore, institutions and organisations alike have a responsibility to assess what impact their actions will have beyond the foreseeable future. This is further emphasised by consumers expressing their demand for products that are sustainably sourced and produced (Joshi & Rahman, 2015). As a result of this, organisations that fail to adopt sustainability will see in the near future a negative impact on their revenues (Ghadimi, Dargi, & Heavey, 2017) and reputations (Awasthi, Govindan, & Gold, 2018). Furthermore, since an organisation is no more sustainable than the suppliers that it uses, it is essential that it sets up a sustainable supplier selection and purchasing strategy (Benchekroun, Benmamoun, & Hachimi, 2019).

The growing importance of sustainability increases the number of supplier selection criteria for each supplier selection decision (Pishchulov, Trautrims, Chesney, Gold, & Schwab, 2019). Thus, by taking sustainability into account, the complexity of the supplier selection process increases due to a larger number of criteria that need to be considered.

Historically, organisations only evaluated Economic criteria for their supplier selection decisions (Azadnia, Saman, & Wong, 2015). However, an increase in outsourcing activities, Environmental policies, and Social concerns motivated organisations to consider sustainability as part of their selection criteria (Memari, Dargi, Jokar, Ahmad, & Rahim, 2019). Thus, Social Justice, Environmental Quality, and Economic Prosperity were included as criteria for decision-making (Elkington & Rowlands, 1999). These aspects form what is known in literature as the Triple Bottom Line (Ağan, Kuzey, Acar, & Açıkgöz, 2016).

During the supplier selection process, organisations are trying to find the right supplier for specific goods or services. The most commonly used categorisation of product groups includes Strategic items, Leverage items, Bottleneck items, and Non-critical items (Kraljic, 1983). Each purchasing product group requires a different strategy based on the difference in power between the market (suppliers) and the organisation due to the level of availability in the market (supply risk) and the need for the organisation (profit impact). Since the strategies for each product category are different it is likely that the sustainability supplier selection criteria might also be different for each category due to the difference in relative power and total interdependence (Caniels & Gelderman, 2005).

As a result, a shift in both practice and literature can be observed. In the case of organisations and institutions, the biggest changes focus on the adoption and implementation of new sustainable and green policies applied to the process of supplier management (Rajeev et al., 2017). In the context of academia, scholars are investigating several key research areas, such as antecedents for sustainable development (Sancha, Longoni, & Giménez, 2015), sustainable supply chain management (Fahimnia, Sarkis, & Davarzani, 2015), green public procurement (Testa et al., 2012), etc.

While progress has been made in the area of sustainable development, the research field is still in its beginnings. This is also shown by the majority of current research being focused mostly on the Economic and Environmental aspects of the Triple Bottom Line (Zimmer et al., 2016). Since a multitude of Triple Bottom Line criteria has been proposed across many studies, a consolidated overview of the available criteria is necessary. Similarly, there is a lot of research available on purchasing portfolios with an emphasis on cost and risk criteria, but only a handful of papers consider integrating sustainability aspects (Benchekroun et al., 2019; Dabhilkar, Bengtsson, & Lakemond, 2016; Krause, Vachon, & Klassen, 2009; Pagell, Wu, & Wasserman, 2010).

However, there are currently no papers that investigate which sustainable supplier selection criteria should be used for different purchasing product groups. As argued by Caniels and Gelderman (2005) and Dabhilkar et al. (2016), not all Triple Bottom Line criteria would be suitable for each purchasing product group due to the inherent differences in power and dependence of the suppliers. The research presented in this paper aims to address some of the limitations of current literature by answering the following research question: ***Which Triple Bottom Line criteria are available in literature and how are they***

applied to the four purchasing product groups by Kraljic, in the context of sustainable supplier selection?

The research presented in this thesis has several contributions to both theory and practice. From a theoretical perspective, this research provides a consolidation of the available research on the Triple Bottom Line criteria that can be used for purchasing decisions. Over the years, many papers have been published on this topic and scholars have used different terminology to symbolise the same criteria. Thus, such a consolidation would provide a clear overview of where researchers have focused over the years, and where potential research still needs to be done. This research is a continuation of the work done by Zimmer et al. (2016), who provided an initial overview of the available Triple Bottom Line criteria for the supplier selection process. However, the authors chose to focus on the sustainable supplier management process as a whole which does not provide enough information about the specific step of supplier selection. Additionally, the paper was published in 2016, which means that it does not include newer research on this topic that has a higher focus on Social criteria (Vahidi, Torabi, & Ramezankhani, 2018; Zarbakhshnia & Jaghdani, 2018).

Another theoretical contribution of this thesis is the combination of different but related streams of research into one artefact. More specifically, this research combines the concepts of the Triple Bottom Line, the Kraljic Matrix, and supplier selection into one framework that presents an alternative path for research on the sustainable supplier selection process. This would not only extend the work of Zimmer et al. (2016) by adding a completely new dimension, but it would also continue the work of Cousins, Lamming, and Squire (2008), who proposed the augmentation of the Kraljic Matrix with aspects of sustainability, namely Environmental Risk and Corporate Social Responsibility (another name for Social criteria). While Cousins et al. (2008) proposed this combination of sustainability aspects with the Kraljic Matrix on a conceptual level, in this thesis, specific Triple Bottom Line criteria are related to each of the four purchasing product groups.

For practitioners, this research offers new insights into the supplier selection process. The consolidated overview of the most mentioned Triple Bottom Line criteria from literature presents a good starting point for any purchaser that would like to start using sustainability criteria for their supplier selection process. Additionally, the distinction per purchasing product group offers another perspective into which aspects are important for the different

types of suppliers that organisations might have and can give purchasers the tools to make better decisions when selecting suppliers.

The thesis follows a structure containing six chapters presenting the research performed and its main results. The first chapter outlines the main motivation of the research, together with the research questions. The second and third chapters provide an explanation of the core concepts and the systematic literature review that form the knowledge base for this thesis. The fourth chapter focuses on the design of the framework which is the main deliverable of the thesis. The fifth chapter presents the design of the survey questionnaire and its main results. The final chapter contains the main conclusions, a discussion of the results, as well as the main limitations and suggestions for future work.

2. Systematic Literature Review of Triple Bottom Line criteria

2.1. Systematic literature review to provide an extensive overview of available literature on Triple Bottom Line criteria

For this thesis, a Systematic Literature Review methodology is used. The main reason for using a Systematic Literature Review is that it is designed for gathering an extensive amount of relevant literature in an objective manner which can be used to provide an overview of existing knowledge and to identify current gaps in literature (Rouhani, Mahrin, Nikpay, Ahmad, & Nikfard, 2015). In the introduction, it was mentioned that further research is needed to gather all the Triple Bottom Line criteria available in literature and to provide a homogenous overview of them. Thus, a Systematic Literature Review seems like a good fit for this purpose.

This thesis follows the Systematic Literature Review methodology proposed by (Rouhani et al., 2015), as it contains a clear and explicit process which can be easily followed. As can be seen in Figure 1, one of the first steps of this methodology is to define the research question(s) that help guide the process. Therefore, the following research question is defined: ***Which criteria of the Triple Bottom Line are defined in literature?***

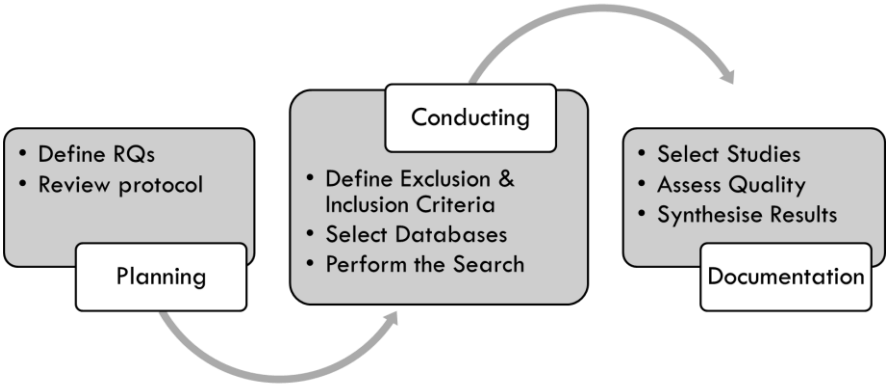

Figure 1: Systematic literature review process, adapted from Rouhani et al. (2015)

To answer this question, the focus is on finding articles that discuss specific criteria which are part of at least one of the Triple Bottom Line categories. Furthermore, scientific databases are used to search for articles as the most relevant academic results can be found in journal articles and conference proceedings. For the purpose of this thesis, the Scopus scientific database has been used. The main reasons for this are the large availability of relevant papers and the possibility to create complex search queries with the help of AND/OR logical operators which allow for the usage of inclusion and exclusion criteria.

To determine the relevant keywords to use in the search, the article of Zimmer et al. (2016) is used as inspiration. In this paper, the author has conducted a content analysis on the topic of sustainable supplier management. There are three relevant keywords groups containing similar terms that are extracted from this paper, as follows:

1. sustainable, green, environmental, ecological, social.
2. “supply chain”, supplier, partner, vendor.
3. performance, evaluation, selection, development.

Between each of the words in a keyword group, the OR logical operator is used to indicate that they are alternatives to each other, while the AND logical operator is used to indicate that a combination of at least one word from each group should be used. The PRE/ logical operator is used to make keywords as a string of words in sequential order. The order is, first a word from group 1, then group 2, and lastly group 3, like: “sustainable supplier selection” or “social partner performance”. Additionally, the asterisk symbol (*) is used to indicate that for some of the words only the stem is used. For example, the word “evaluation” can also be used by someone as “evaluating” or “evaluate”. By using the asterisk symbol at the stem of the word (evaluat*) all three versions of the word are included in the search results.

The selected keyword combinations will be used to search in the Title, Abstract and Keyword sections of each paper. This ensures that enough relevant papers will be found while keeping the results to a reasonable amount. If the keyword combinations would be used to search in all the sections of a paper, including its full text, this would result in an unreasonable number of papers, of which a large amount might not be relevant to the purpose of the thesis.

For RQ1, the following query is used in Scopus:

TITLE-ABS-KEY(("sustain*" OR "green" OR "environment*" OR "ecological" OR "social") PRE/ ("supply chain*" OR "suppl*" OR "partner*" OR "vendor") PRE/ ("perform*" OR "evaluat*" OR "select*" OR "monitor*" OR "develop*"))

In order to narrow down the results of the search, several inclusion and exclusion criteria are used. In terms of inclusion criteria, only papers written in English, published in journal and conference proceedings, and published in the past 5 years are considered (as of April 2019, when the search was conducted). The main reason for this is that papers published in journals and conference proceedings are peer-reviewed and therefore include more rigorous academic results. Furthermore, only papers published in the last 5 years are

considered since they reflect the state-of-the-art and the results of older papers are assumed to be referenced in more recent papers. This assumption is validated by checking the reference list of several recent articles that conducted a literature review relevant to the research question mentioned above.

In terms of exclusion criteria, only papers that are relevant to the RQs based on an analysis of the title and abstract are considered. Furthermore, all papers for which the full text is not accessible are removed. The final selection is made based on an analysis of the full text of the papers and their relevance to the RQs.

For assessing the quality of the papers and determining which papers are the most relevant, several criteria are used, such as:

- Specifically mentions criteria which fit in at least one of the Triple Bottom Line categories;

  Discusses one of the phases of the supplier development process in relation to sustainability.

2.1.1. An increasing number of papers on Triple Bottom Line criteria with a focus on applying different supplier selection methods

After following the steps of the Systematic Literature Review explained in the previous section, a selection of relevant articles is made. For RQ1, 555 articles are found in the Scopus database after applying the search query. To get to the final selection of papers, the inclusion and exclusion criteria are used, together with an assessment of the quality of each paper. Table 1 presents the steps of the Systematic Literature Review and the resulting number of articles for RQ1.

Table 1: Selection steps for the Systematic Literature Review of RQ1

Activity	**Number of articles**
Applying the search query	555
Removing papers published before 2015	427
Removing papers based on analysis of title	396
Removing papers based on analysis of abstract	116
Removing papers that do not have a full text available	89
Removing papers based on analysis of full text	35

Of the 35 selected papers, 34 are journal articles while only one is a conference proceeding. In Figure 2, the distribution of papers per year can be seen. In the chart on the left, all the papers that are found with the help of the search query in Scopus are displayed, while on the right, all the papers that are selected are shown. It can be seen that starting with 2013 there is a significant increase in papers published on this topic, with 2018 and 2019

serving as the years with the most publications. This trend can also be seen in the papers selected to be included in this thesis. However, since the search has been performed in April 2019, not all papers from 2019 are included in the selection. This explains the lower number of selected papers in 2019.

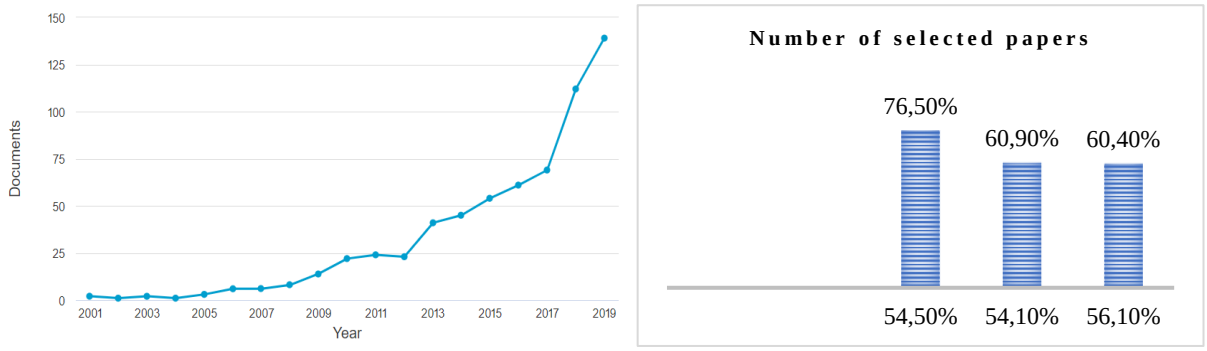

Figure 2: Number of papers found in Scopus vs. Number of selected papers, per year of publication

When considering the content of each paper, there are several similarities and differences that can be seen. All the selected papers focus on exploring or applying different supplier selection methods, such as TOPSIS (Abdel-Basset, Mohamed, & Smarandache, 2018; Li, Fang, & Song, 2019; Rashidi & Cullinane, 2019), AHP/ANP (Abdel-Basset et al., 2018; Gold & Awasthi, 2015; Tavana, Yazdani, & Di Caprio, 2017), and DEA (Ghoushchi, Milan, & Rezaee, 2018; Rashidi & Cullinane, 2019; Zarbakhshnia & Jaghdani, 2018). However, there are several papers which also provide an overview of which methods are considered in previous studies (Ghadimi et al., 2017; Gören, 2018; Liu, Eckert, Yannou-Le Bris, & Petit, 2019; F. Zhou, Wang, Lim, He, & Li, 2018) or which criteria are mentioned in other papers (Chen, Wang, Yao, Li, & Yang, 2018; Memari et al., 2019; Petrudi, Abdi, & Goh, 2018; Zarbakhshnia & Jaghdani, 2018). From the selected papers, a few mention a step-by-step methodology that can be used by organisations to select suppliers (Abdel-Basset et al., 2018; Ghadimi, Toosi, & Heavey, 2018; Kafa, Hani, & El Mhamedi, 2015; Pishchulov et al., 2019), while only the paper of Pishchulov et al. (2019) includes new criteria which are obtained from respondents.

The full list of papers selected can be found in Appendix 1 – List of selected papers. In Table 12, the authors of the paper, the year of publication, the title of the paper and the publication type can be seen. Additionally, a unique identifier is given to each paper to make it easier to refer to all the papers that are selected.

2.1.2. Six steps to group available Triple Bottom Line criteria to remove redundance and increase their usability

From the 35 selected papers, there are hundreds of unique criteria that are mentioned, for all three Triple Bottom Line categories, with a relative balance between the unique criteria mentioned between the three categories (Economic – 287 unique criteria; Environmental – 249 unique criteria; Social – 222 unique criteria). However, there is a difference between how many times certain criteria are mentioned, in favour of the Economic criteria (22), followed by Environmental (19), with Social criteria being the least mentioned of the three categories (12).

The criteria with the highest count from all three Triple Bottom Line categories are quite representative of the whole theme of the category. The Economic category has a focus on financial aspects, and therefore, it comes as no surprise that the Cost/Price is the most mentioned criterion. In the case of the Environmental category, the emphasis in on managing the pollution of the environment, which is usually monitored with an Environmental management system. This happens to correspond to the highest-mentioned Environmental criterion. Finally, in the case of the Social category, the focus lies on managing and protecting the human resources of an organisation, which is also reflected in the fact that the most mentioned Social criterion is the Health and Safety of Employees.

While identifying such a large number of criteria provides a very detailed overview of what aspects can be considered when selecting suppliers, it is not usable for the purpose of this thesis. Additionally, when analysing the criteria mentioned by each paper, it becomes clear that certain groupings can be done based on the purpose and naming of each criterion. Therefore, the number of criteria to be used in the framework and the questionnaire can be substantially reduced.

For each of the three Triple Bottom Line categories, the following procedure for grouping criteria is implemented:

1. For each paper, all the criteria mentioned are extracted in an Excel sheet, together with the names of the authors who proposed them.
2. Criteria using the same naming are grouped together. For each criterion, a count which shows how many different papers refer to it is added, together with the names of the authors who proposed them.
3. Criteria which use similar naming are grouped together. The differences between the naming used should be minimal. For example, singular and plural forms of

the words (Cost/costs), additional words which make the criterion more specific (Price/Price of product), synonyms of words (Price of product/Price of goods), etc. The name of the criterion is given based on the name of the most mentioned variant.

After analysing the remaining criteria, if there are still possibilities for grouping, the following steps are implemented:

1. Criteria which do not use similar naming but refer to the same topic. For example, Technology, Technical capability, Technology level and Production technology use different terminology, but all refer to the technology that an organisation uses. Therefore, these criteria are grouped together under the Technological capability criterion.
2. Some criteria are mentioned by different authors as being part of conflicting Triple Bottom Line categories. Therefore, the same criterion (or one with a high degree of similarity in naming or purpose) can be found in multiple Triple Bottom Line categories. An analysis of the purpose of the criteria is done to see if they should be kept separate or if they should be merged into one category. One example of this is Reputation which can be found in all the Triple Bottom Line categories in slightly different forms (Reputation – Economic category; Green Image – Environmental category; Social Reputation – Social category). However, since the three types of Reputation refer to slightly different perspectives, the choice is made to keep them separate.
3. Some criteria are mentioned as part of one Triple Bottom Line category when they would be a better fit in another category. An example of this is the Human resource practices and relations criterion mentioned in the Economic category which would be more suitable in the Social category since this aligns better with its purpose.

2.2. Results of the review on Triple Bottom Line criteria

In the following sections, more specific details are provided regarding the criteria that are found in the selected papers, their grouping, and what conclusions can be drawn. Table 2 shows the number of Triple Bottom Line criteria per category, including the number of unique criteria, the total number of reported criteria, and the highest count of times a

criterion is mentioned in the selected papers. This overview shows the results before applying the six steps described in Section 2.1.2.

Table 2: Number of Triple Bottom Line criteria per category

Category	Total unique criteria	Total reported criteria	Highest criteria count
Economic	287	457	22
Environmental	249	388	19
Social	222	324	12

2.2.1. Economic category: Cost/Price and Quality of the product are the most mentioned criteria

Economic criteria have been the backbone of supplier selection for decades (Azadnia et al., 2015; Song, Xu, & Liu, 2017), with criteria such as Cost, Service, Flexibility, and Quality often found in traditional approaches to supplier selection (Abdel-Basset et al., 2018; Tavana et al., 2017). Furthermore, the earliest research on the topic of supplier selection focused only on cost and resource-based approaches (Petrudi et al., 2018). Therefore, it is not a surprise that most papers that focus on the Triple Bottom Line, or even only on the Economic category, include the cost criterion.

From Table 2, it can be seen that there are 287 unique Economic criteria out of a total of 457 reported criteria. Following the reasoning from Section 2.1.2, most of the Economic criteria can be grouped based on some similarities. For example, one grouping that is made is the Product Quality group. Several papers mention the Quality of the Product, Product Quality Level, ISO Quality Identification, and Quality Utility Value. Even though the authors don't all use the same terms, they all refer to the Quality of the Product.

A different example of a grouping is the Cost/Price. Several papers refer to the Cost of Products while others refer to the Price. However, when checking the papers which mention these two terms, it becomes clear that they refer to the same aspect, even though the two terms are not synonymous.

In total, there are 17 criteria groups that can be made which include more than one paper referring to a specific criterion in the group. Additionally, there is one criterion which could not be grouped and is mentioned only in one paper. Furthermore, two criteria have been moved to another Triple Bottom Line category, since that would be a better fit.

Based on the number of times mentioned, it can be concluded that there are certain criteria which are considered more important than others. Traditionally, Cost was one of the most important criteria to consider for purchasing decisions, before the introduction of sustainability criteria (Ghadimi et al., 2017). This is reflected in the Cost/Price criterion

being the most mentioned criterion (35 times). Similarly, Product Quality (Azadnia et al., 2015; Luthra, Govindan, Kannan, Mangla, & Garg, 2017), Technological Capabilities (Chen et al., 2018), Flexibility (Awasthi et al., 2018), Service (Petrudi et al., 2018) are some of the most mentioned criteria which are included in both traditional approaches and sustainability-focused approaches to supplier selection.

As mentioned before, there are three criteria (Local Culture, Local Legal System, and Local Political Stability) which are found only in one paper, namely in P31. Since these criteria deal with the same aspects, they have been grouped under the Local Environment criterion, to have the same level of abstraction as the other criteria.

Finally, there are also several criteria which are mentioned as being part of more than one Triple Bottom Line category. One such example from the Economic criteria is Human Resources Practices and Labour Relations (Kannan, 2018; Pishchulov et al., 2019) which would fit better as a Social criterion. The main reason for this is that Social criteria deal with all aspects relating to human resource management, such as Employee Welfare (Fallahpour, Olugu, Musa, Wong, & Noori, 2017), Staff and Employee Training Capability (Azadnia et al., 2015), Standard Working Hours (Cheraghalipour & Farsad, 2018), Discrimination (Kannan, 2018), etc.

Another example is the Sub-tier Supplier Management (Pishchulov et al., 2019), which appears in a different form in the Environmental category as the Green Supply Chain Management criterion (Badri Ahmadi, Hashemi Petrudi, & Wang, 2017).

Therefore, the two criteria mentioned above are moved to the Triple Bottom Line category which fits them best. Appendix 2 shows where these criteria are moved and with which other criteria they are grouped.

2.2.2. Environmental category: Pollution control and the Use of an Environmental Management System are the most mentioned criteria

With the increased awareness of the Environmental impact of organisational operations, the research on supplier selection has started focusing more and more on defining and using Environmental criteria. Initially, this took the form of Green Supply Chain Management, which focused on Environmental improvements relating to the purchase of raw materials, manufacturing, transportation, disposing of products, etc. (Petrudi et al., 2018). Therefore, Environmental criteria, such as Waste Management, Environmental Certificates, Environmental Management Systems, Carbon Emissions, etc. (Amindoust, 2018; Azadnia et al., 2015; Vahidi et al., 2018) are often mentioned in literature.

For the Environmental criteria, there are 249 unique criteria from a total of 388 criteria mentioned in the papers. Therefore, similarly to the Economic criteria, a grouping of criteria is made based on the similarity in meaning and naming. For example, the category of Pollution Control is comprised of criteria, such as Pollution Production, Pollution, Pollution Control, Environmental Pollution, etc.

There are also several criteria groups for which the papers mentioning them use the same terminology, such as Environmental Costs, Biodiversity, Responsiveness, etc. However, the majority of papers refer to similar criteria by using different terminology.

There are 20 Environmental criteria groups which contain criteria that are mentioned by at least two papers, which is similar to the number of Economic criteria groups. Additionally, two criteria are moved to another Triple Bottom Line category (including the criterion mentioned only once) since they would be a better fit in another category.

As can be seen in Table 3**Error! Reference source not found.**, the Pollution Control criterion is the most mentioned criterion (Amindoust, 2018; Chen et al., 2018). However, there are conflicting opinions in literature on whether or not this criterion should be used to represent all types of pollution, including Air Emissions (Amindoust, 2018) and Waste Management (Cheraghalipour & Farsad, 2018), or if they should be considered as separate criteria (Fallahpour et al., 2017; Gold & Awasthi, 2015; Kannan, 2018; Petrudi et al., 2018). Since the criteria found from this systematic review are used to design a survey, the choice is made to keep the number of criteria as low as possible. Therefore, all of the different criteria related to pollution are grouped under the Pollution control criterion.

The Environmental Management System is the second most mentioned criterion from the selected papers (Gören, 2018; Yu, Shao, Wang, & Zhang, 2019). Several papers investigating the usefulness of Environmental criteria mention that Environmental Management System is one of the most important ones for achieving organisational sustainability goals (Luthra et al., 2017). The Environmental Management System is also considered important for managing customer requirements (Tavana et al., 2017), resource consumption, reduce, reuse and recycle (Song et al., 2017), etc.

The Environmental Management System criterion is defined by several papers as focusing on evaluating the Environmental Performance of an Organisation (X. Zhou & Xu, 2018) and detailing Environmental Implementation Policies and Certificates (Liu et al., 2019; Luthra et al., 2017; Pishchulov et al., 2019; Sen, Datta, & Mahapatra, 2018; Yu et al., 2019). Therefore, this suggests that the Environmental Management System could include

criteria, such as Environmental-related Certificates and Environmental Protection Plans/Policies. Thus, these criteria are grouped under the Environmental Management System criterion.

After all the criteria are grouped by following the six steps mentioned in Section 2.1.2, there is only one criterion that is mentioned by one paper, namely, Warehouse management (Fallahpour et al., 2017). For the rest, the criteria that are mentioned the least are Green transportation, Green production, and Responsiveness, which are mentioned in two papers.

Similarly to the Economic category, some of the criteria can also be found in other Triple Bottom Line categories. One example of this is Responsiveness (Ghadimi et al., 2018), which can also be found in the Economic category, namely Responsiveness and Ease of Communication (Gören, 2018). Appendix 2 shows where these criteria are moved and with which other criteria they are grouped.

2.2.3. Social category: Health and safety, and the interest and rights of the employees are the most mentioned criteria

Recently, there has been a trend in studies to include Social criteria as part of the sustainable supplier selection approaches (Vahidi et al., 2018; Zarbakhshnia & Jaghdani, 2018). This has been motivated by increased pressure from the government and other stakeholders to include Corporate Social Responsibility aspects as part of the supplier selection decision-making process (Petrudi et al., 2018). As a result, Social criteria, such as the Health and Safety of Employees, Rights of Stakeholders, Information Disclosure, etc. (Rabbani, Foroozesh, Mousavi, & Farrokhi-Asl, 2019; Yu et al., 2019; Zarbakhshnia & Jaghdani, 2018) are often mentioned by studies.

There are a total of 324 Social criteria mentioned in the selected papers, of which 222 use unique terminology. Therefore, similarly to the previous two Triple Bottom Line categories, groupings of criteria are made based on the purpose and naming of each criterion. An example of this is the Health and Safety of Employees group which contains criteria, such as Work Safety and Labour Health, Occupational Health and Safety, Occupational Health and Safety Management, Standardized Health and Safety Conditions, Health and Safety Practices, Work Safety, etc.

There are also several papers which mention criteria using the same terminology, such as Labour Practices and Decent Work, Disciplinary and Security Practices, Society,

etc. However, as is the case for the previous two Triple Bottom Line categories, a majority of papers that are grouped used slightly different terminology.

There are 22 Social criteria groups that are mentioned in more than one paper. Additionally, two criteria are moved to another Triple Bottom Line category since they would be a better fit in another category. This is similar to the numbers from the first two Triple Bottom Line categories.

The main focus of the Social criteria is on the human resources of an organisation. Therefore, it comes as no surprise that the most mentioned criterion in the selected papers is the Health and safety of employees (28 times). It refers to minimizing health and safety incidents and implementing security practices and regulations (Kafa et al., 2015; Song et al., 2017).

Many of the other Social criteria have some kind of logical relation to the Health and Safety criterion. For example, the Interest and Rights of Employees (Luthra et al., 2017), Job Opportunities (Azadnia et al., 2015) and Employee Welfare (Chen et al., 2018) are considered part of the Employment Practices of an organisation (Ghadimi et al., 2017). While some papers consider that Employment Practices are a different criterion than Health and Safety (Chen et al., 2018; Song et al., 2017), a few have chosen to group these together (Awasthi et al., 2018; Mohammed, Filip, Setchi, & Li). For the purpose of this thesis, all the previously mentioned criteria are included separately since this would allow for more granularity in defining the elements of the framework and the questionnaire.

Most Social criteria mentioned by the selected papers focus on the employee, while there are only a few which focus on the external environment of the organisations such as the Rights of Stakeholders (Badri Ahmadi et al., 2017; Rabbani et al., 2019; Sen et al., 2018) and Local Community Influence (Ghoushchi et al., 2018; Liu et al., 2019; Petrudi et al., 2018). X. Zhou and Xu (2018) argue that the external criteria are equally important to the internal ones in revealing the level of Social Responsibility and sustainability of suppliers.

Similarly to the previous two Triple Bottom Line categories, there are several criteria which can be found in more than one category. One example of this is Energy and Resource Efficiency (Tavana et al., 2017) which could be considered as part of the Resource Consumption (Kafa et al., 2015) Environmental Triple Bottom Line category. Appendix 2 shows where these criteria are moved and with which other criteria they are grouped.

When considering the number of metrics defined in literature for the three categories, several studies conclude that there is a severe lack of Social metrics being mentioned in

literature, when compared to the Economic and Environmental metrics (Luthra et al., 2017; Zimmer et al., 2016). This can be motivated by the relatively recent focus on Social criteria when compared to Economic and even Environmental criteria.

2.2.4. Synthesis of the results: Economic criteria are most mentioned in literature

Based on the previously discussed results, **Error! Reference source not found.** includes an overview of the top 10 most mentioned Triple Bottom Line criteria per category after they have been grouped based on the six steps mentioned in Section 2.1.2.

Table 3: Top 10 most mentioned Triple Bottom Line per category

Top 10 Economic Criteria	**#**	**Top 10 Environmental Criteria**	**#**	**Top 10 Social Criteria**	**#**
Cost or Price of the Product	35	Pollution Control	27	Health and Safety of the Employees	29
Quality of the Product	30	Use of an Environmental Management System	24	The Interest and Rights of the Employees	22
Delivery of the Product	27	Reduction of Resource Consumption	21	Local Community Influence	12
Technological Capability	18	Environmental Competencies	15	The Rights of the Stakeholders	11
Service Capability	16	Eco-design	14	Information Disclosure Capability	11
Flexibility	15	Recycling Capability	13	Social Responsibility	11
Financial Capability	14	Green Packaging	13	Ethical Issues and Legal Compliance	10
Responsiveness and Ease of Communication	11	Green Research and Development	10	Labour Practices and Decent Work	9
Production Facilities and Capacity	11	Green Supply Chain Management	10	Staff and Employee Training Capability	9
Relationship with the Supplier	10	Green Image	10	Career Opportunities for the Employees	8

Red highlight - significant drop-off in the number of papers mentioning this criterion

As can be seen in Table 3, the results for the most mentioned criteria for the three Triple Bottom Line categories are in line with a lower focus on Environmental and especially Social criteria, as argued by Luthra et al. (2017) and Zimmer et al. (2016). A significant drop-off in the number of times mentioned can be observed for the third Social criterion (Local Community Influence), which is mentioned less than half the times as the third Economic criterion (Delivery of the Product). However, for the last few criteria, the gap between the number of times the criteria for each of the categories is mentioned becomes less significant.

3. Designing the sustainability framework by augmenting the Kraljic Matrix with Triple Bottom Line criteria

In order for organisations to take full advantage of the Triple Bottom Line, they need to have access to frameworks and approaches that can help them with selecting and integrating sustainable suppliers in their network (Ghadimi et al., 2017). This can be done by having a good understanding of what the supplier selection process is, having a comprehensive overview of available criteria for three Triple Bottom Line categories, and understanding the core differences and similarities between the purchasing strategies for different product groups. Therefore, the following sections focus on providing a better understanding of these aspects.

3.1. Sustainable supplier selection requires more research to determine which criteria should be used

Supplier management can be defined as a set of activities that can be performed by an organisation to identify and improve the performance of its suppliers (Rashidi & Saen, 2018). This can include a range of activities, such as training supplier employees, auditing suppliers, introducing reward systems, investment in supplier capacity building, requiring ISO 14000 certification, etc. (Bai & Sarkis, 2010).

As defined by Zimmer et al. (2016), the three stages of the supplier management process are supplier selection, monitoring and development. Even though all three stages of supplier management are important, the selection of suppliers is key for the management of a sustainable supply chain and can lead to an increase in business performance (Luthra et al., 2017). Furthermore, outsourcing and globalisation have made the selection of suppliers more crucial for the competitiveness of an organisation (Badri Ahmadi et al., 2017), and more complex due to the many aspects that need to be taken into consideration (Gold & Awasthi, 2015), such as supplier profiles, types of purchased items, and criteria related to the process (Kafa et al., 2015).

Seeing the importance of selecting appropriate suppliers, having a better understanding of the supplier selection process is crucial. Zimmer et al. (2016) define the sustainable supplier selection process as consisting of several tasks, namely, identifying the needs and specifications of the suppliers, defining the criteria that will be used for the assessment of suppliers (in the selection as well as the monitoring and development process),

using these criteria for both initial evaluation and qualification, and the detailed assessment and final selection steps.

Thus, the supplier selection process considers the aspects regarding the supplier characteristics, as well as the products and services they offer. As a result, the paradigm of the Triple Bottom Line would affect both the identifying of supplier specifications and the criteria that are used for assessing them. Furthermore, as argued by Zimmer et al. (2016), the same sustainability criteria can be used for selecting new suppliers, and for monitoring and developing existing suppliers, to ensure a higher sustainability profile for the supply chain. Thus, it is important to have a good understanding of the available sustainability criteria that can be used.

From the many studies on the topic of supplier selection, there are only a limited number of papers that focus on sustainable supplier selection (Tavana et al., 2017), and even fewer that incorporate social aspects in the decision-making process (Song et al., 2017). Furthermore, research on how certain aspects, such as product types (Krause et al., 2009), developed/developing country (Luthra et al., 2017), principal supplier/third -party supplier (Luthra et al., 2017), etc. affect the supplier selection process is lacking. Moreover, since suppliers are increasingly more scattered on a global scale, aspects such as resilience should be considered as part of the supplier selection process (Amindoust, 2018).

As can be seen, several potential directions for research would help fill the current research gaps. For the purpose of this thesis, the focus will be on identifying which Triple Bottom Line criteria are the most relevant for selecting suppliers based on the different product groups that they offer. Therefore, in the next section, a more detailed explanation of product groups and the current research that relates them to sustainability is presented.

3.2. The Kraljic Portfolio Matrix is the most popular technique used by purchasers to make decisions about product categories

Purchasing portfolio models are tools that combine two or more dimensions for categorising products which use different purchasing strategies (Benchekroun et al., 2019). In 1983, Kraljic proposed the Kraljic Portfolio Matrix, which has become one of the most popular templates for purchasing management (Gelderman & Van Weele, 2003, 2005; Pagell et al., 2010). It has helped integrate purchasing portfolios into the supply chain management practices of organisations, which has led to improved business performance and competitive advantage (Jaenglom & Tariq, 2013).

In their research, Gelderman and Van Weele (2005) showed the effectiveness of the Kraljic Portfolio Matrix in the context of managing a complex supplier base. Other studies have shown that organisations use the Kraljic Portfolio Matrix for formulating long-term sourcing strategies by looking at the power position and dependence relationship and using this for their supplier development (Gelderman & Van Weele, 2003, 2005). Additionally, the Kraljic Portfolio Matrix has been used by organisations to change their purchasing strategies in response to changes in customer requirements (Pagell et al., 2010).

The Kraljic Portfolio Matrix is divided into four distinct quadrants along two axes, namely the Profit impact and Risk factor. Each quadrant has a specific group of products and a unique strategy related to purchasing these products. **Error! Reference source not found.** shows the four quadrants of the Kraljic Portfolio Matrix.

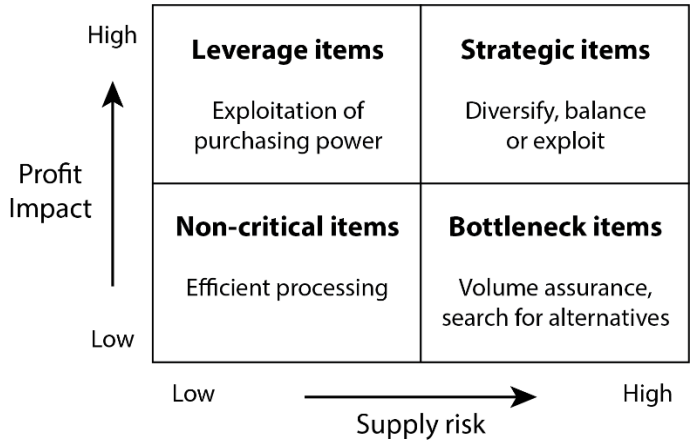

Figure 3: Kraljic's Portfolio Matrix and recommendations, adapted from Benchekroun et al. (2019)

The Profit Impact (vertical axis) represents how much the purchase of a specific item impacts the profits of an organisation. This can be measured in terms of the Cost of Materials, Total Cost, Profitability Profile, etc. (Jaenglom & Tariq, 2013). If the Profit Impact is low, then the product is categorized as either a Non-critical or a Bottleneck item while if the Profit Impact is high, then the product can be either a Leverage or a Strategic item.

The horizontal axis, which is the Risk Factor, refers to the complexity of the supply market and the risk that this presents. Some aspects that are considered when assessing the Risk Factor are whether there is a monopoly or oligopoly in the market, the pace of technological advancement, entry barriers etc. (Jaenglom & Tariq, 2013). If the Supply Risk is low, then the product is categorised as either a Leverage item or a Non-critical item while if the Supply Risk is high, then the product is either a Bottleneck or a Strategic item.

The first product group contains Leverage items that have a high Profit Impact for the buying organisation and a relatively low Supply Risk. In these cases, the purchasing

organisations dominate the market in terms of relative power since they consider suppliers to be homogenous and interchangeable, which usually can get them better deals (Dabhilkar et al., 2016). These items should be purchased based on price and availability from multiple suppliers with which the purchasing organisation doesn't cultivate long-term relationships (Pagell et al., 2010). Therefore, the dependence of the purchasing organisation is low while the supplier's dependence is high. The strategy for this category is to achieve economies of scale by purchasing large volumes of items (Dabhilkar et al., 2016).

The second product group contains Strategic items that have a high Profit Impact on the purchasing organisation and a high Supply Risk. Therefore, the items in this category should be purchased from a small number of suppliers, preferably only one, with which the purchasing organisation has a close long-term relationship (Pagell et al., 2010). Therefore, in this case, the strategy is to develop a balanced relationship in terms of relative power where there is total interdependence between the parties involved, which would allow for the implementation of sustainability practices in a mutually beneficial manner (Dabhilkar et al., 2016).

The third product group contains Non-critical items that have a low Profit Impact on the purchasing organisation and a low Supply Risk. These types of items are usually purchased from multiple suppliers based on price (Pagell et al., 2010). Therefore, the strategy, in this case, is to enhance purchasing power by standardising and bundling purchasing requirements (Dabhilkar et al., 2016). The main goal is efficiency and low transaction costs (Pagell et al., 2010).

The fourth product group contains Bottleneck items that have a low Profit Impact on the purchasing organisation and a high Supply Risk. They are similar to Strategic items in the sense that they are available from a limited number of suppliers, often only one (Pagell et al., 2010). Since suppliers dominate the market, the purchasing strategy focuses on single-sourcing long-term contracts to maintain the continuity of suppliers, while searching for suitable alternatives when possible (Dabhilkar et al., 2016).

3.3. Not all purchasing product groups based on the Kraljic Portfolio Matrix are suitable for sustainable supplier selection

Since an organisation is no more sustainable than its supply chain, it is becoming increasingly important for purchasing organisations to become accountable for the products they buy (Dabhilkar et al., 2016). Based on a review of literature, it can be seen that there

are conflicting opinions regarding whether sustainability practices can be implemented when purchasing certain product groups.

As suggested by Cousins et al. (2008), one option to augment the Kraljic Matrix with aspects of sustainability would be to consider an additional dimension reflecting the Environmental Risk. However, since Social aspects play an equally important role in the sustainability profile of organizations, as argued by Cousins et al. (2008) (under the umbrella of Corporate Social Responsibility), this perspective should also be added to the Kraljic Matrix. Thus, the approach used in this thesis would be to integrate the Triple Bottom Line criteria in all four of the Kraljic purchasing product groups.

Table 4: Overview of literature combining sustainability practices and the Kraljic Matrix

Kraljic Product Group	**Argument**	**Article**
Leverage items	Sustainability should become a strategic goal for leverage items	Pagell et al. (2010)
	Purchasers should stimulate the implementation of strategic practices (reduction of material used and introduce recyclable materials	Krause et al. (2009)
Strategic items	Can improve sustainability performance	Pagell et al. (2010)
	Mutually beneficial implementation of sustainability practices	Dabhilkar et al. (2016)
	Emphasize innovation in the product development process with a focus on sustainability	Benchekroun et al. (2019)
	Stop sourcing from suppliers who refuse to implement sustainability practices	Krause et al. (2009)
Non-critical items	No barriers to switching suppliers, so stricter sustainability requirements can be used	Krause et al. (2009)
	A significant trade-off between cost and environmental and sustainable supplier compliance	Dabhilkar et al. (2016)
Bottleneck items	High dependence on suppliers can make it difficult to request the implementation of sustainability	Benchekroun et al. (2019)
	Not possible to influence the sustainability profile of suppliers for this product category	Dabhilkar et al. (2016)
	Purchasing organizations should promote and devise industry-wide sustainability standards	Krause et al. (2009)

Pagell et al. (2010) argue that the original classification of Kraljic for Leverage items is no longer applicable in the case of sustainability. Therefore, they propose that it should be divided into three categories, such as Strategic commodity, Transitional commodity, and True commodity. The True commodities reflect the Kraljic understanding of Leverage items.

The Transitional commodity represents the leverage items that are gaining a temporary strategic status due to the need of the customers, which will gradually reduce. The final category, Strategic commodities, represents the items provided by suppliers that slowly improve their Triple Bottom Line performance due to a beneficial long-term relationship with the purchasing organisation. In line with this, Krause et al. (2009) propose that for Leverage items, purchasing organisations should stimulate the implementation of sustainability-focused practices across the supply chain relating to a reduction of material usage or the introduction of recyclable materials.

In the case of Strategic items, organisations should emphasize innovation in the process of new product development focused on improving sustainability, by having close collaborations and knowledge sharing with suppliers (Benchekroun et al., 2019). For example, reducing the usage of non-recyclable items, remanufacturing unused/unsold products, and better waste management (Jaenglom & Tariq, 2013). In case suppliers refuse to adopt the same sustainability priorities as the purchasing organisation, the decision to source items from these suppliers should be reconsidered (Krause et al., 2009).

For non-critical items, purchasing organisations can use stricter sustainability requirements, such as specific certification of the supplier's operations and practices, since there are many alternative suppliers available and there are usually no barriers to switching (Krause et al., 2009).

For Bottleneck items, the purchasing organisation is in a dependent situation which can make it difficult for them to request the implementation of sustainability aspects from their suppliers (Benchekroun et al., 2019). Therefore, one option in this situation is for purchasing organisations to develop or promote industry-wide standards and norms that help promote sustainability (Krause et al., 2009).

In their study, Dabhilkar et al. (2016) show that sustainability programs have an impact on all Kraljic categories, except for Bottleneck items. One explanation for this would be the weak bargaining position of the purchasing organisation, which is not able to influence the sustainability agenda of its suppliers. Additionally, in the same study, the authors argue that there are significant trade-offs between achieving lower costs and higher Environmental and Social supplier compliance in the case of non-critical items (Dabhilkar et al., 2016). This could be explained by the fact that current prices for non-critical items do not reflect the costs that the suppliers would have to make to implement sustainable operations. Therefore,

the interdependence between the purchasing organisation and the suppliers would have to increase to ensure supplier compliance.

As can be seen from the previous discussion of literature, the initial focus of the Kraljic Portfolio Matrix on reducing cost and risk cannot be fully aligned with a pursuit of sustainable purchasing. This is due to the investments that both the purchasing organisation and their suppliers need to make when implementing sustainability-focused practices, which are not usually financially efficient in the short-term (Benchekroun et al., 2019).

In conclusion, significant differences can be observed for all four product groups in terms of purchasing power, dependence between purchasing organisations and suppliers, purchasing strategies, and ability of the purchasing organisations to request the implementation of sustainability practices. Therefore, there could be a significant difference between which Triple Bottom Line criteria are considered most relevant for each of the four Kraljic product groups.

3.4. Framework for sustainable supplier selection based on the Kraljic product groups and the Triple Bottom Line categories

In the previous chapters and sections, the motivation for this research has been explained and argued, and the most important concepts and theories have been presented, together with a detailed overview of the Triple Bottom Line criteria found in literature. All this information can be used to shape the main result of this thesis, namely the framework.

A framework is chosen as the main result of this thesis because it is a tool for classifying items and therefore, it aligns best to the type of knowledge that is available, namely to the categorisation of criteria and product groups. Additionally, frameworks are very visual and easy-to-understand tools that can be used by practitioners, which is one of the goals of this research.

The core aspect of a framework is that it contains a number of categories which are classified based on two axes. Therefore, the first step of designing the framework is deciding what aspects should be classified. Since the main purpose of the thesis is to provide a tool for combining Triple Bottom Line criteria with the four product groups, then these two aspects should be included in the framework.

The second step is to consider how to combine the purchasing product categories with the Triple Bottom Line criteria. One approach would be to use the Kraljic Matrix as the basis for designing the sustainability framework and extend it with sustainability aspects, as Cousins et al. (2008) suggest. While the authors argue to add additional dimensions to the

Kraljic Matrix, the readability and usability of the framework would decrease due to the high complexity of having 4 dimensions – the initial two dimensions which are related to Economic aspects, and two additional ones representing the Environmental and Social criteria.

Thus, instead of adding extra dimensions, for each of the Kraljic Matrix quadrants we incorporate the Triple Bottom Line criteria. Figure 4 illustrates the design of the sustainability framework.

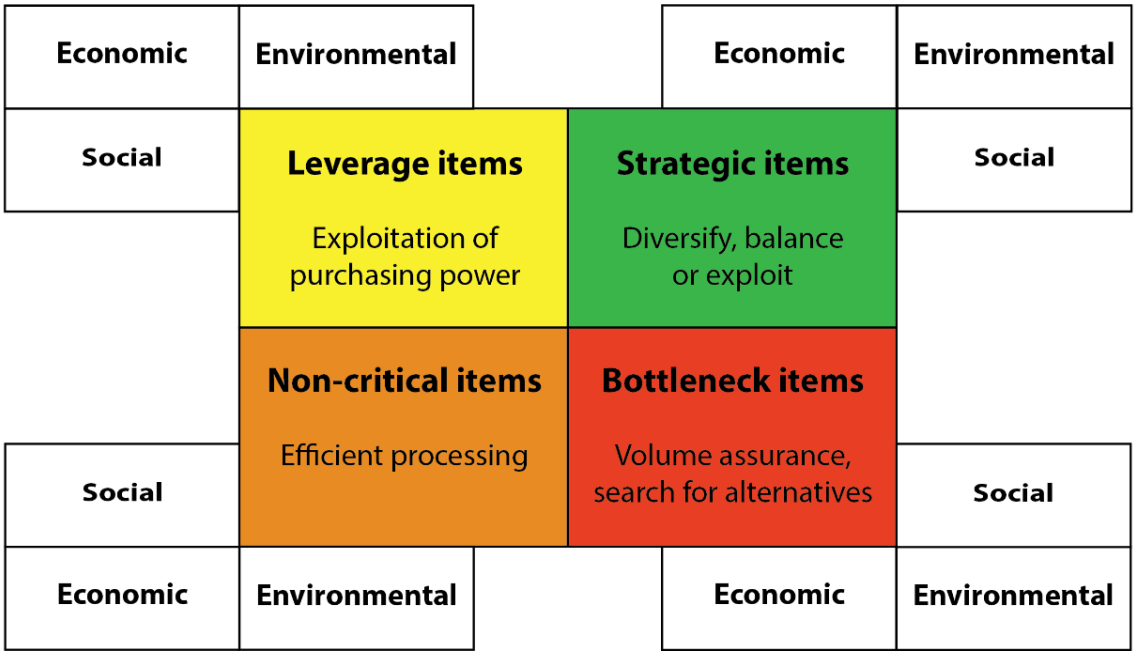

Figure 4: The framework for sustainable supplier selection based on the Kraljic product groups

Figure Legend

Colour	Explanation of frequency
Red	Rarely use Triple Bottom Line criteria for this product group
Orange	Sometimes use Triple Bottom Line criteria for this product group
Yellow	Frequently use Triple Bottom Line criteria for this product group
Green	Always use Triple Bottom Line criteria for this product group

In Figure 4, four colours are used to represent the frequency with which the Triple Bottom Line criteria would be used for the four product groups defined by Kraljic. The reasoning for why these frequencies of use are selected is explained in the following paragraphs. While an assumption regarding the whole product group can be made based on the available literature, it is not possible to distinguish between the different categories of sustainability criteria. The main reason for this is that, based on the performed literature review, no available papers have been found that discuss the connection between the four product groups and the Triple Bottom Line criteria specifically.

The study by Dabhilkar et al. (2016) shows that, for example, in the case of Bottleneck items, the bargaining power of the purchasing organisation is quite weak, since there are only a few suppliers of those specific products. Thus, organisations would find it difficult to request the implementation of sustainability practices from their suppliers (Benchekroun et al., 2019). This can lead to suppliers with a poor sustainability profile being selected due to the scarcity of the product (Dabhilkar et al., 2016). To reflect this, in Figure 4, the Bottleneck items are coloured in red to represent the low sustainability profile.

In contrast, for Strategic items organisations establish long and mutually beneficial relationships with suppliers, which present opportunities for implementing sustainability practices (Benchekroun et al., 2019). Since both the organisation and its suppliers of Strategic items have a balanced relationship with equal power, this product category has the highest likelihood for a high sustainability profile (as represented in Figure 4 with the green colour).

Similarly, a supplier for Leverage products might need to comply with the sustainability demands of the organisation in order to be able to win the contract (Krause et al., 2009). Since the organisation considers the suppliers of Leverage items as homogenous and interchangeable (Dabhilkar et al., 2016), it can have high demands in terms of its sustainability profile. However, since the organisation does not develop long-term relationships with these suppliers (Pagell et al., 2010), the likelihood of the suppliers complying with the desired sustainability profile of the organisation is lower than in the case of suppliers providing Strategic items. This is represented in Figure 4 with a yellow colour.

In the case of Non-critical items, organisations need to balance a trade-off between cost and sustainability profile (Dabhilkar et al., 2016). As a result, the suppliers for this category of items have a lower likelihood to have a high sustainability profile than those for Leverage items, since implementing sustainability practices (especially Environmental and Social criteria) might conflict with their focus on efficient processing. Thus, the Non-critical items are represented in orange in Figure 4.

Based on the design of the sustainability framework, in Chapter 4 the survey questionnaire is designed. The results of the questionnaire will help refine the design of the framework with the help of empirical data. Based on this, several recommendations can be made regarding which Triple Bottom Line criteria organisations can use for selecting suppliers for each of the four product groups.

4. Quantitative research to evaluate the sustainability framework

4.1. A quantitative survey questionnaire is chosen as the research method

This research uses a quantitative research method for evaluating the main deliverable, namely the sustainability framework. One of the most used quantitative research methods is the survey questionnaire. It is very useful for collecting opinions, attitudes, intentions, etc. of respondents from a large population in a less time-consuming manner (Blumberg, Donald, & Schindler, 2008). With questionnaires, one of the main aspects to pay attention to is sample bias which can influence the generalisability of the results. This can be diminished by having a high response rate.

Typically, questionnaires contain a series of questions or other types of items that respondents can interact with and provide relevant information to the researcher (Babbie, 2020). There are two main types of questionnaires, namely self-administered and interviewer-administered. Since the self-administered questionnaires can be used to reach a larger number of respondents, it is the preferred version for this thesis.

Questionnaires can also contain open questions to which the respondents can answer freely and elaborate on their answers. In the case of this thesis, the respondents will be asked to state whether they think certain criteria are missing from the questionnaire and why they think these criteria are important enough to be added.

4.2. LinkedIn is used as the main distribution channel for the questionnaire

The first step to distributing the survey questionnaire is defining the ideal respondent profiles and the channels for distribution. This helps ensure that the results of the questionnaire are relevant to the purpose of this research.

For the ideal respondent profile, the following job roles were considered: Purchasing Manager, Purchasing Agent, Purchasing Administrative Assistant, and Purchasing Consultant. These roles were selected based on the description of job advertisements that were posted by organisations on different websites, such as LinkedIn, Indeed, Monsterboard, Glassdoor, etc. Additional roles that were considered are Supply Chain Manager and Operations Manager since they have common interests regarding the selection of suppliers.

Regarding the channels for distribution, several approaches were used:

- LinkedIn groups relevant to the research scope (focus on purchasing and sustainability);

- NEVI (the largest network of purchasers in the Netherlands) was asked to share the survey in their newsletter;
- The research group at the University of Twente with a focus on purchasing was also asked to share the survey within their network.

4.3. Multi-part survey questionnaire to determine the most relevant Triple Bottom Line criteria for each purchasing product group

As mentioned before, the main purpose of the survey questionnaire is to help refine the design of the framework based on the opinions of purchasing practitioners. Therefore, the questionnaire should be structured in several sections based on the different aspects that are asked of the respondents. Below is an explanation of the eight sections of the questionnaire, their purpose, a justification of why they were included and an explanation of how they were implemented in the questionnaire.

The first section of the questionnaire contains several paragraphs of text which explain to the potential respondents the research they will be participating in. Therefore, the purpose of the research is briefly explained together with a short overview of the topics covered.

In order to convince the potential respondents to participate in the study, several benefits are mentioned. First, a comprehensive list of Triple Bottom Line is included in the questionnaire, which could provide ideas for new criteria that they have not considered using before. Second, as is also mentioned in literature, while the Kraljic Portfolio Matrix is quite a popular tool for purchasing, it is not usually used in the context of sustainability. Therefore, the connection that is made in the questionnaire between the two aspects could help the respondents to see this relationship in a new light. Finally, the respondents are offered the possibility to submit their email addresses if they would like to receive the results of the research. Therefore, they would have access to the conclusions and recommendations that are made based on the opinions of all the respondents.

Besides the aspects regarding the content of the questionnaire and its potential benefits, the respondents are informed about their rights regarding processing and managing the data they provide, according to the General Data Protection Regulation that is active in the European Union. Additionally, the participants are informed about the estimated amount of time it would take to fill in the questionnaire, which is estimated to be 20 minutes.

The second section of the questionnaire focuses on gathering background information from the respondents. Several demographic questions are asked to help differentiate, if necessary, between organisations operating in different industries, organisations of different sizes, or job roles.

The third section of the questionnaire is focused on sustainability and the Triple Bottom Line. The purpose of this section is to understand how familiar the respondents are with these concepts and how often they use them. This would help with making a distinction, if necessary, between the respondents that have more or less experience with these topics. Additionally, to ensure that all respondents have the same level of understanding of the Triple Bottom Line, for respondents who mentioned that they were not familiar with the approach, a short description of the main concepts is provided.

The fourth section of the questionnaire focuses on the Kraljic Portfolio Matrix and is similar in purpose to the third section of the questionnaire. It starts with asking whether the respondents are familiar with the Kraljic Portfolio Matrix and similarly to the previous section, for respondents who responded that they are not familiar, a short explanation of the main concepts is presented. The section continues with several questions relating to how often the respondents use sustainability criteria for the purpose of purchasing items from each of the four product groups, namely Leverage, Strategic, Non-critical, and Bottleneck. This creates a basis for understanding the current situation of the respondents and can be used to compare with the findings from literature which state that Economic criteria are most used, followed by Environmental, and then Social criteria.

The fifth, sixth and seventh sections of the questionnaire are very similar to each other and represent the core of the research. Their main purpose is to ask respondents to choose for which of the four product groups, if any, the Triple Bottom Line criteria mentioned are most important. Based on the opinions of the respondents, recommendations for which specific Triple Bottom Line criteria should be used for each of the quadrants of the sustainability framework.

Each of the three sections also contains an open question that asks respondents whether there are any criteria that they currently use but are not mentioned in the list from question one. If this is the case, then the respondents have the opportunity to provide this information, which could help improve the final selection of criteria and recommendations.

The final section of the questionnaire, section eight, includes a thank you message to the respondents and offers them the possibility to provide their email addresses. As mentioned in the first section, if respondents choose to provide their email addresses, then the results of the research will be sent to them when the thesis is published.

Based on the design described above, the survey questionnaire is implemented in Google Forms[1]. The link to the questionnaire is distributed via LinkedIn in several groups focusing on sustainability and purchasing.

4.4. The results of the questionnaire are analysed in Excel using descriptive statistics

The survey questionnaire was created using the Qualtrics software with a license from the University of Twente. After six weeks, the survey questionnaire was closed and no further respondents could participate. The responses that were gathered were exported to Excel for data cleaning and statistical analysis.

4.4.1. 31,5% of the persons who started the survey questionnaire also completed it

The survey questionnaire was made available for respondents for six weeks. In this period, 73 respondents started the questionnaire, with 23 respondents completing it. Appendix 9 shows an overview of the number of respondents who started and finished each question included in the questionnaire. As can be seen, 13,7% of respondents dropped off before the start of the questionnaire, on the page with the consent form. Another 19,2% completed the consent form but stopped before answering the first question. The highest remaining percentage of respondents who did not finalise the questionnaire can be seen for question 16 (31% of the respondents who viewed this question), which asks about the relation between the Environmental criteria and the four product groups.

On the other hand, four out of the five background questions were answered by all the respondents who viewed these questions. A similar result can be seen for questions 11-13 which refer to how often the respondents use sustainability criteria for purchasing Strategic, Non-critical and Bottleneck items. However, the first question in this series, concerning Leverage items, sees a drop of 13% of the respondents who viewed it. The last category of questions that saw no respondent drop-off is represented by questions 15, 17 and

[1] https://forms.gle/mEAptjTUbb2ST2DAA

19. All of these questions ask respondents to mention whether there are any criteria that they use which are not mentioned in previous questions. Since these questions are not mandatory to answer, all respondents completed them.

The complete overview of the number of respondents per question can be seen in Appendix 9.

4.4.2. Most of the respondents work in large organisations in the manufacturing industry and do private procurement

To have a better understanding of the respondents who completed the questionnaire, the information that they filled in questions 1-5 can be analysed. The answers provided by the respondents can be seen in Table 5.

Table 5: Profile of the respondents who answered the survey questionnaire

Question	**Options**	**Answers**
Which industry does your organisation operate in?	Manufacturing	7
	Wholesale & Retail Trade	3
	Construction/Utilities/Contracting	2
	Education	2
	Motor Vehicle	2
	Administrative support	1
	Business & Information Technology	1
	Finance & Insurance	1
	Food & Hospitality	1
	Health Services	1
	Other:	(2)
	• Capital Equipment Rentals,	1
	• Oil and Gas Services.	1
How large is your organisation?	>1000 employees	14
	101-500 employees	6
	<100 employees	3
What is your role within the organisation?	Purchasing Manager	8
	Purchasing Agent	3
	Purchasing Administrative Assistant	2
	Supply Chain Manager	2
	Operations Manager	1
	Other:	(7)
	• Category Purchaser	1
	• Cooperative Purchasing	1
	• Product Manager	1
	• Senior Purchasing Officer	1
	• Senior Buyer	1
	• Supply Chain Officer	1
	• Vendor Manager	1
In your purchasing role, you do…	Private procurement	16
	Both public and private procurement	6
	Public procurement	1

From Table 5, it can be concluded that the majority of respondents (~60%) work in a large organisation with more than 1000 employees and are focusing on private Procurement (~70%). In terms of the industry that the respondent's organisation is operating in, Manufacturing is mentioned most often (~30%). The most commonly mentioned role is Purchasing Manager with several variations of the Purchasing Agent mentioned in the Other category.

4.4.3. Most respondents always use Economic criteria for supplier selection except for Non-critical items where the least number of respondents use any sustainability criteria

In question 6, the respondents were asked to rate how important their organisation considers sustainable purchasing. The majority responded that their organisation considers sustainable purchasing extremely important (10) or very important (7), with only 3 respondents stating that it is considered not important at all.

To get a better understanding of the prior knowledge the respondents have regarding the Triple Bottom Line, in question 7 they are asked to answer if they are familiar with it or not. Out of the 23 respondents, 12 answered that they were familiar with the Triple Bottom Line, while 11 said they were not. For those respondents who said they were not familiar, a short description of the Triple Bottom Line concepts is presented.

In a follow-up question (question 8), respondents were asked to rate how often they use each type of sustainability criteria. The answers, as can be seen in Table 6, show that most respondents (78%) use Economic criteria always (13) or often (5). The second most used criteria are Environmental (10), followed by the Social criteria which are always used only by 6 respondents. This is in line with the findings from the literature, which mention that historically, Economic criteria are the most used, with Environmental and Social criteria being emphasised in recent years.

Similar to question 7, in question 7, the respondents are asked whether or not they are familiar with the Kraljic Matrix. In this case, 17 out of 23 respondents said they are familiar with the Kraljic Matrix, while 6 said they were not and were presented with a short description of the core concepts.

Table 6: How often do respondents use Triple Bottom Line criteria for supplier selection

	Always	**Often**	**Sometimes**	**Rarely**	**Never**
Economic criteria	13	5	4	0	1
Environmental criteria	10	5	4	2	2
Social criteria	6	7	6	3	1

In questions 10-13, the respondents were asked to rate how often they use sustainability criteria for purchasing each type of item from the four product groups. Table 7 shows the results for these questions. Similarly to the results from question 8, the Economic criteria are the most used always, with the Environmental and Social coming in second and third. The last column shows the average results based on the Likert scale values (1-5).

Another finding is that the Non-critical items have the lowest number of respondents always using sustainability criteria when selecting suppliers and the highest number of respondents who rarely or never use any Environmental and Social criteria.

Table 7: How often do respondents use sustainability criteria for purchasing items from the four product groups

	Always (5)	Often (4)	Sometimes (3)	Rarely (2)	Never (1)	Average
Leverage Items						
Economic criteria	15	4	2	1	1	4.35
Environmental criteria	9	3	8	1	2	3.70
Social criteria	6	5	5	5	2	3.35
Strategic Items						
Economic criteria	16	2	3	1	1	4.35
Environmental criteria	10	6	4	1	2	3.91
Social criteria	6	8	6	1	2	3.65
Non-critical Items						
Economic criteria	8	4	6	4	1	3.61
Environmental criteria	5	7	4	3	4	3.26
Social criteria	3	7	5	4	4	3.04
Bottleneck Items						
Economic criteria	15	3	3	1	1	4.30
Environmental criteria	12	1	6	2	2	3.83
Social criteria	9	2	8	2	1	3.57

4.4.4. Several sustainability criteria are mentioned for all four product groups

In questions 14, 16, and 18 respondents are asked to select which specific sustainability criteria from the Triple Bottom Line categories they use for each type of item from the four product groups. Table 8 shows an overview of the results for these questions by calculating the average number of respondents which indicated a criterion for each of the sustainability categories in relation to the four product groups. As can be seen, most respondents considered that Economic criteria are very relevant when purchasing strategic items, while for leverage items there seems to be a balance between all three categories. For the Non-critical items, the least percentage of respondents selected criteria from all of the three categories, which is in line with the results presented in Table 7.

In Appendices 5, 6, and 7 a complete overview of the results of which specific sustainability criteria are most mentioned by the respondents per product group can be seen. To provide an overview of the criteria with the top 5 scores for all of the sustainability criteria

per purchasing product group, the results of the questionnaire are consolidated in Appendix 10. Based on these results, several observations can be made.

Table 8: Statistics for each sustainability category related to the four product groups

Sustainability Category	Average Leverage Items	Average Strategic Items	Average Non-Critical Items	Average Bottleneck Items	Average	None
Economic	54.50%	76.50%	34.50%	50.70%	54.1%	3.3%
Environmental	54.10%	60.90%	31.30%	30.70%	44.3%	27.8%
Social	56.10%	60.40%	36.30%	38.00%	47.7%	27.8%
Average	54.9%	65.9%	34%	39.8%	48.7%	19.6%

For all three sustainability categories, the criteria for the Leverage and Strategic items were relatively close in the number of times it was selected by the respondents. For the Non-critical and Bottleneck items, it is easier to see which are the top chosen criteria due to a larger difference in how often it was selected.

Several criteria from all three sustainability categories were selected most often for multiple purchasing product groups. For example, Reputation, Pollution Control, and Social Responsibility can be seen as top selections in two or three categories, while other criteria, such as Green Packaging and Recycling Capability are top selections for all the product categories. In Appendix 10 all of the criteria that are marked in yellow are top selections in all four product categories.

As a result of the open questions, several respondents provided suggestions for which criteria could be added to the list. Several of the suggestions have a direct overlap with criteria that are already in the questionnaire, namely Service Capability (Economic), Green Transportation and Certificates (Environmental), and Welfare of employees (Social). Two of the suggested criteria have no overlap with the ones already included, namely Certifications and Well-defined roles and responsibilities (Social). However, since these responses are based on only 3 respondents, more research is needed to be able to draw conclusions regarding the suitability and usefulness of these criteria.

4.4.5. Differences and similarities between the importance of criteria mentioned in literature and the opinions of the respondents

In this section, an in-depth discussion of the results from the survey questionnaire is presented, as well as a comparison with the knowledge gathered from the literature review. In Table 9, the results of the comparison of the Economic criteria mentioned in literature versus the results from the survey questionnaire can be seen.

The column labelled Literature shows the percentage of the papers that mention a certain Economic criterion. For example, the Cost or Price of the Product criterion is mentioned in all 35 selected papers. The following four columns present the average of how many times a certain criterion is mentioned by the respondents. For example, the Cost or Price of the Product is mentioned by 16 of the 23 respondents as being relevant for Leverage items. The Average Product Groups column calculates the average times a criterion is mentioned by respondents across all of the product groups. Finally, the None column shows the percentage of respondents who mentioned that a certain criterion is not applicable to any of the product groups.

In Table 9, several results are highlighted that present a noteworthy difference between the literature and the results from the survey questionnaire. For Leverage items, the respondents of the survey questionnaire consider the Responsiveness and Ease of Communication, and Compliance to Policies and Guidelines to be significantly higher than what is suggested when looking at the literature. Furthermore, the same conclusion can be drawn for the first criterion in the case of Strategic items, as well as for the second criterion for all the product types, except Non-critical which has less of a difference.

In the case of Strategic items, most of the criteria are scoring much higher in the responses from the survey questionnaire than they are mentioned in the literature, except for the first three criteria related to Cost/Price, Quality and Delivery of the Product (which score very high in literature).

For the Non-critical items, the results from the survey questionnaire are in line with the expectations from the literature, with the exception of the first three criteria, which are significantly lower than expected.

Similarly, for the Bottleneck items, the results are within the expected ranges from literature, with the exception of the Cost/Price of the Product which is significantly lower, and the Compliance to Policies and Guidelines criterion which is significantly higher.

Thus, while the Leverage, Non-critical and Bottleneck items the results as similar to the expectations from literature, in the case of the Strategic items, the number of respondents who have selected the Economic criteria to be relevant to this product group is significantly higher than expected based on the literature review.

Table 9: Comparison between Economic criteria mentioned in literature versus the questionnaire results

No.	Economic Criteria	Literature	Leverage	Strategic	Non-Critical	Bottle-neck	Avg. Prod. Groups	None
1	Cost or Price of the Product	100.0%	69.6%	78.3%	39.1%	39.1%	56.5%	0.0%
2	Quality of the Product	85.7%	87.0%	87.0%	47.8%	60.9%	70.7%	0.0%
3	Delivery of the Product	77.1%	52.2%	69.6%	30.4%	73.9%	56.5%	0.0%
4	Technological Capability	51.4%	78.3%	82.6%	43.5%	47.8%	63.0%	0.0%
5	Service Capability	45.7%	65.2%	87.0%	43.5%	69.6%	66.3%	0.0%
6	Flexibility	42.9%	60.9%	56.5%	39.1%	52.2%	52.2%	0.0%
7	Financial Capability	40.0%	52.2%	82.6%	13.0%	34.8%	45.7%	0.0%
8	Responsiveness and Ease of Communication	31.4%	78.3%	82.6%	60.9%	60.9%	70.7%	4.3%
9	Production Facilities and Capacity	31.4%	65.2%	73.9%	17.4%	47.8%	51.1%	8.7%
10	Relationship with the Supplier	28.6%	60.9%	78.3%	26.1%	56.5%	55.4%	4.3%
11	Innovation Capability	25.7%	56.5%	82.6%	21.7%	26.1%	44.6%	0.0%
12	Mutual Trust	25.7%	60.9%	73.9%	39.1%	65.2%	59.8%	0.0%
13	Reputation	25.7%	73.9%	73.9%	43.5%	56.5%	62.0%	8.7%
14	Organisational Structure and Management Status	25.7%	52.2%	78.3%	21.7%	34.8%	46.7%	8.7%
15	Geographical Location	11.4%	47.8%	60.9%	21.7%	39.1%	42.4%	8.7%
16	Compliance to Policies and Guidelines	8.6%	69.6%	87.0%	39.1%	52.2%	62.0%	0.0%
17	Local Environment	8.6%	43.5%	65.2%	39.1%	43.5%	47.8%	13.0%
	Average per Product Group	39.2%	54.5%	76.5%	34.5%	50.7%	56.1%	3.3%

Table Legend

Literature	
0-8	0-25%
9-17	25-50%
18-26	50-75%
27-35	75-100%

Product groups	
0-5	0-25%
6-11	25-50%
12-17	50-75%
18-23	75-100%

Avg. Product Groups	
0-23	0-25%
24-46	25-50%
47-69	50-75%
70-92	75-100%

Blue highlight - values that are higher in the questionnaire results when compared to literature

Red highlight - values that are lower in the questionnaire results when compared to literature

When looking at the average results for all four categories, it can be seen that they are similar to the literature, and more specifically follow the same patterns as the Bottleneck items. One criterion is significantly lower (Cost/Price of the Product) than the expectation based on literature and one criterion (Compliance to Policies and Guidelines) is significantly higher than the percentage mentioned in literature.

Finally, there are some criteria for which some respondents have considered that they would not be applicable to any of the product groups. From these, the Local Environment is

selected most often as not applicable, followed by the Geographic Location, Reputation, Organisational Structure and Management Status, and Production Facilities and Capacity.

In Table 10, a similar analysis is performed for the Environmental criteria mentioned in literature and the responses gathered from the survey questionnaire. Similar to the Economic criteria, it can be seen that the Non-critical and Bottleneck items have less differences when compared to the results from literature. The Pollution Control and the Use of an Environmental Management System are the only two criteria with a significant difference.

Table 10: Comparison between Environmental criteria mentioned in literature versus the questionnaire results

No.	Environmental Criteria	Literature	Leverage	Strategic	Non-Critical	Bottle-neck	Avg. Prod. Groups	None
1	Pollution Control	77.1%	65.2%	69.6%	39.1%	43.5%	54.3%	17.4%
2	Use of an Environmental Management System	68.6%	56.5%	65.2%	21.7%	26.1%	42.4%	26.1%
3	Reduction of Resource Consumption	60.0%	56.5%	56.5%	47.8%	34.8%	48.9%	30.4%
4	Environmental Competencies	42.9%	56.5%	69.6%	17.4%	34.8%	44.6%	26.1%
5	Eco-design	40.0%	47.8%	47.8%	13.0%	17.4%	31.5%	30.4%
6	Recycling Capability	37.1%	65.2%	65.2%	52.2%	39.1%	55.4%	21.7%
7	Green Packaging	37.1%	60.9%	65.2%	52.2%	39.1%	54.3%	21.7%
8	Green Research and Development	28.6%	39.1%	60.9%	13.0%	21.7%	33.7%	30.4%
9	Green Supply Chain Management	28.6%	47.8%	56.5%	26.1%	21.7%	38.0%	30.4%
10	Green Image	28.6%	47.8%	60.9%	26.1%	30.4%	41.3%	30.4%
11	Environmental-related Certificates	25.7%	69.6%	78.3%	26.1%	39.1%	53.3%	17.4%
12	Use of Hazardous Materials	25.7%	52.2%	52.2%	34.8%	34.8%	43.5%	34.8%
13	Re-use of Products and Materials	22.9%	52.2%	60.9%	39.1%	30.4%	45.7%	30.4%
14	Use of Environmentally Friendly Materials	22.9%	56.5%	56.5%	43.5%	30.4%	46.7%	30.4%
15	Environmental Commitment	20.0%	65.2%	60.9%	34.8%	34.8%	48.9%	26.1%
16	Use of Environmentally Friendly Technology	17.1%	52.2%	65.2%	26.1%	21.7%	41.3%	30.4%
17	Impact on Biodiversity	11.4%	43.5%	43.5%	26.1%	17.4%	32.6%	39.1%
18	Environmental Cost of Supplier's Activities	8.6%	47.8%	65.2%	26.1%	39.1%	44.6%	21.7%
19	Green Transportation	5.7%	47.8%	52.2%	30.4%	26.1%	39.1%	34.8%
20	Green Production	5.7%	52.2%	65.2%	30.4%	30.4%	44.6%	26.1%
	Average per Product Group	30.7%	54.1%	60.9%	31.3%	30.7%	44.2%	27.8%

Table Legend

Literature	
0-8	0-25%
9-17	25-50%
18-26	50-75%
27-35	75-100%

Product groups	
0-5	0-25%
6-11	25-50%
12-17	50-75%
18-23	75-100%

Total	
0-23	0-25%
24-46	25-50%
47-69	50-75%
70-92	75-100%

Blue highlight - values that are higher in the questionnaire results when compared to literature

Red highlight - values that are lower in the questionnaire results when compared to literature

In the case of Leverage and Strategic items, these two product categories also present similarities in their results. For both product groups, almost half of the criteria (8 out of 20) are considered significantly higher by the respondents than the expectations from the literature.

Unlike the results for the Economic category, for the Environmental criteria, there are many more respondents who considered that criteria are not relevant for any of the product groups. In fact, for all the criteria, there are at least four respondents who considered that they do not apply to any of the four product groups, with the highest number being Impact on Biodiversity (9 respondents), Use of Hazardous Materials (8 respondents) and Green Transportation (8 respondents).

Table 11 shows the results of the analysis comparing the literature to the results from the survey questionnaire for the Social criteria. For the Bottleneck and Non-critical items, the results from the questionnaire are similar to the expectations from literature, with two exceptions.

The Strategic items have most criteria (11 out of 20 criteria) which are significantly different from the expectations based on the literature, and in all cases, the values from the survey questionnaire are higher than the literature.

In the case of the Leverage items, six criteria are significantly different from the literature, all of them having higher values. One remarkable result is that there are two criteria (Health and Safety of the Employees, and Ethical Issues and Legal Compliance) for which the Leverage items are scoring higher than the Strategic items, which usually have the highest scores.

When looking at the average values, it can be seen that there are two criteria for which the average for all the product groups is significantly higher than the results based on

the literature. In both cases, these criteria are not often mentioned in literature but are selected by the respondents to be quite relevant for the Leverage and Strategic items.

Table 11: Comparison between Social criteria mentioned in literature versus the questionnaire results

No.	Top 10 Social Criteria	Literature	Leverage	Strategic	Non-Critical	Bottle-neck	Avg. Prod. Groups	None
1	Health and Safety of the Employees	82.9%	78.3%	73.9%	47.8%	52.2%	63.0%	13.0%
2	The Interest and Rights of the Employees	62.9%	56.5%	60.9%	52.2%	47.8%	54.3%	21.7%
3	Local Community Influence	34.3%	43.5%	47.8%	26.1%	26.1%	35.9%	39.1%
4	The Rights of the Stakeholders	31.4%	47.8%	56.5%	34.8%	39.1%	44.6%	30.4%
5	Information Disclosure Capability	31.4%	60.9%	73.9%	34.8%	43.5%	53.3%	13.0%
6	Social Responsibility	31.4%	69.6%	65.2%	52.2%	47.8%	58.7%	17.4%
7	Ethical Issues and Legal Compliance	28.6%	82.6%	69.6%	43.5%	47.8%	60.9%	13.0%
8	Labour Practices and Decent Work	25.7%	60.9%	65.2%	47.8%	47.8%	55.4%	21.7%
9	Staff and Employee Training Capability	25.7%	47.8%	56.5%	34.8%	39.1%	44.6%	26.1%
10	Career Opportunities for the Employees	22.9%	47.8%	47.8%	13.0%	17.4%	31.5%	30.4%
11	Welfare of the Employees	22.9%	56.5%	69.6%	39.1%	43.5%	52.2%	21.7%
12	Employment Compensation	20.0%	52.2%	56.5%	30.4%	30.4%	42.4%	30.4%
13	Job Stability for the Employees	20.0%	34.8%	52.2%	13.0%	26.1%	31.5%	34.8%
14	Social Reputation	20.0%	65.2%	60.9%	43.5%	39.1%	52.2%	26.1%
15	Social Sourcing Capability	14.3%	47.8%	52.2%	30.4%	26.1%	39.1%	30.4%
16	Diversity of Workforce	14.3%	47.8%	60.9%	21.7%	26.1%	39.1%	21.7%
17	Flexible Working Arrangements for the Employees	11.4%	39.1%	47.8%	21.7%	21.7%	32.6%	34.8%
18	Use of Child Labour	11.4%	65.2%	69.6%	52.2%	52.2%	59.8%	21.7%
19	Standard Working Hours for the Employees	11.4%	43.5%	47.8%	39.1%	30.4%	40.2%	34.8%
20	Product Responsibility	11.4%	73.9%	73.9%	47.8%	56.5%	63.0%	13.0%
	Average per Product Group	26.7%	56.1%	60.4%	36.3%	38%	47.7%	27.8%

Table Legend

Literature	
0-8	0-25%
9-17	25-50%
18-26	50-75%
27-35	75-100%

Product groups	
0-5	0-25%
6-11	25-50%
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18-23	75-100%

Total	
0-23	0-25%
24-46	25-50%
47-69	50-75%
70-92	75-100%

Blue highlight - values that are higher in the questionnaire results when compared to literature

Red highlight - values that are lower in the questionnaire results when compared to literature

For the criteria that are considered by respondents to not be relevant for any of the product groups, the results are similar to the Environmental criteria. At least three respondents consider that all of the criteria are not applicable to any of the product groups. The highest number of respondents who have selected None is for the Local Community Influence (9 respondents) and Job Stability for Employees (8 respondents).

4.4.6. Results of the survey questionnaire enhance the Sustainability framework

The Sustainability framework that is introduced in Figure 4 of Section 3.4 is a first attempt at defining the differences between the Triple Bottom Line criteria for the four purchasing product groups based on the knowledge gathered from literature. In this section, the Sustainability framework is revisited and the data from the survey questionnaire is used to provide another perspective.

Figure 5 presents the Sustainability framework according to the results from the survey questionnaire. For each of the Triple Bottom Line categories of criteria an aggregation of results is made to give a higher-level perspective of the opinions of the respondents. The colours that are used for each of the categories represent the average number of times (expressed in percentages) a specific criterion belonging to the specific category is mentioned by respondents as being used for the respective product category: Red (<25% respondents), Orange (26-50% respondents), Yellow (51-75% respondents), Green (>75% respondents).

In line with the expectations from literature, the Economic category of criteria is the most often mentioned by respondents for most of the product types, especially for the Strategic items (as expected). Similarly, for the Leverage and Non-critical items, the results from the survey questionnaire are in line with the expectation from theory, namely that they are less than for the Strategic items, and rather balanced across the categories of criteria.

The most surprising results come from the Bottleneck items, where the overall number of criteria selected by the respondents is similar to Non-critical items, and for the Economic criteria, the results are similar to the Leverage items. Similarly, the expectation for the Strategic items was that all three categories would have a similar number of criteria that are selected by respondents. However, only the Economic category is according to expectations, while the Environmental and Social categories are similar to the results for the Leverage items.

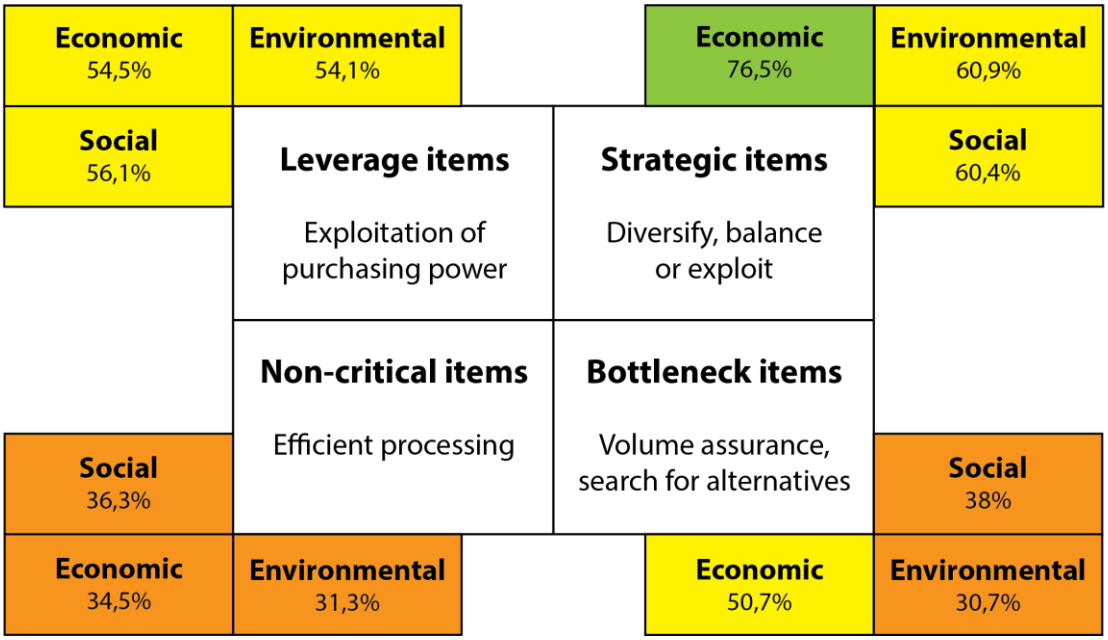

Figure 5: Sustainability framework with aggregated results of the questionnaire

Figure Legend

Colour	Explanation of frequency
Red	Rarely use Triple Bottom Line criteria for this product group
Orange	Sometimes use Triple Bottom Line criteria for this product group
Yellow	Frequently use Triple Bottom Line criteria for this product group
Green	Always use Triple Bottom Line criteria for this product group

Another interesting finding from Figure 5 is that for the Leverage and Non-critical items, the Social category of criteria has a slightly higher percentage of being selected by the respondents than the Economic and Environmental categories. While this difference is not significant, it still highlights an interesting perspective of Social criteria gaining importance in the supplier selection process.

5. Conclusion and Discussion

The main focus of this thesis was to propose a framework for including sustainability criteria in the process for supplier selection based on the four purchasing product groups. To do this, a Systematic Literature Review has been conducted, which resulted in the selection of 35 papers containing Triple Bottom Line criteria.

However, the results from literature did not indicate which of these criteria can be used for the four product groups from the Kraljic Matrix. To address this, a survey questionnaire was designed and distributed to respondents belonging to a representative sample of Purchasing related roles. By analysing the results of the survey questionnaire, several insights were gathered and presented in Section 4.4.

5.1. Discussion: interesting results gathered from the literature review and the survey questionnaire

One of the main findings of this research is that there is a significant difference between the Triple Bottom Line criteria that are relevant for each of the four purchasing product groups, according to the results from the survey questionnaire. On the one hand, this emphasises the value of the research that is conducted in this thesis, namely to define which Triple Bottom Line criteria are most suitable for each of the product groups. On the other hand, it provides insights into several outliers and patterns from both literature and the results of the survey questionnaire, which are described and interpreted in the following paragraphs.

To start, in Table 2, an overview of the number of criteria mentioned in the selected literature is presented. Here it can be seen that for all three categories, there are more than 200 criteria mentioned for sustainable supplier selection. While from an academic perspective having such a large number of criteria suggests a high coverage of what can be used in practice, it is unfeasible for purchasers to use these many criteria when selecting suppliers. Furthermore, in many cases, similar criteria are named by authors in different ways, as is the case with the Cost of the Product and Price of the Product. Thus, reducing the number of criteria by grouping ones that share similarities, as done in this thesis, is necessary to make them useful in practice.

When analysing the results for the grouped criteria, it can be seen that the Cost/Price of the Product is the only criterion that is mentioned by all the selected papers. This confirms the long history and emphasis on Economic criteria in literature (Azadnia et al., 2015; Song

et al., 2017). In contrast, the Cost/Price of the Product criterion is not considered to be very relevant for the Non-critical and Bottleneck items. One possible explanation for this, in the case of Non-critical items, is that organisations usually don't purchase a high quantity of these types of items and the suppliers are interchangeable, which implies there are low prices due to the high competition. In the case of Bottleneck items, the organisations usually only have a few suppliers for these items, which implies that they don't have much bargaining power to negotiate the Price/Cost of the Products they purchase.

One of the surprising results from literature is that the top Social criterion Health and Safety of Employees is mentioned in more papers that the top Environmental criterion. This is in line with the overall results from the survey questionnaire that put the average for the Social criteria in most cases as higher than the Environmental criteria. Additionally, this supports the argument by Petrudi et al. (2018) that Social criteria are gaining increased interest from both academia and practice due to increased pressure from government and stakeholders to include Social responsibility aspects in the supplier selection process.

For the results gathered from the survey questionnaire, the overview of how often respondents use sustainability criteria for the four product groups shown in Table 7 presents an interesting perspective when compared with the results for the specific criteria. While for three of the four product categories, the results are as expected, for the Bottleneck items a high percentage of respondents state that they always use all the three types of criteria. To put this into perspective, the results for the Bottleneck items are similar if not higher than for the Strategic items. On the other hand, when looking at the average percentage of participants selecting the Triple Bottom Line criteria as suitable for the Bottleneck items (Tables 9-11), this is significantly lower than for the Strategic items. Thus, it can be concluded that a smaller selection of the Triple Bottom Line criteria are used by respondents very often for selecting suppliers of Bottleneck items (e.g.: Delivery of the Product, Service Capability, Mutual Trust, Quality of the Product, Responsiveness and Ease of Use). However, according to Benchekroun et al. (2019) and Dabhilkar et al. (2016), for Bottleneck items, it could be very difficult if not impossible to influence the sustainability profile of suppliers for these types of items. When considering the Economic criteria that are mentioned by the respondents as relevant for Bottleneck items, this difference to the literature can be motivated by the nature of the relationship the organisations have with the suppliers of these types of products. Since the organisations are highly reliant on these unique products that cannot be easily obtained from other suppliers, a good line of

communication and mutual trust are necessary to ensure the on-time delivery of quality products and of a continuous service.

For the comparison between how often the Triple Bottom Line criteria are mentioned in literature and selected by the respondents as appropriate for the four purchasing product groups there are also several interesting insights. First, in literature, there are several criteria that are mentioned a lot, but afterwards there is a steep drop-off. On the contrary, when looking at the results from the survey questionnaire, these are more even throughout the list of criteria. This supports the argument by Luthra et al. (2017) and Zimmer et al. (2016) that there is a certain focus in literature on certain criteria, while for practitioners, when given the freedom to select from all of the criteria, this focus is not observed.

Second, the Strategic and the Leverage items have the highest percentage of respondents selecting criteria as suitable. While this is in line with the assumption based on the literature where several authors argue that organisations purchasing these types of items can stimulate and collaborate on implementing sustainability practices with suppliers (Krause et al., 2009). This could be explained by the fact that the purchasing organisation can have a high impact on the suppliers in both cases (Pagell et al., 2010). For the Strategic items this would come in the form of a strong close collaboration to reach sustainability goals (Dabhilkar et al., 2016), while for the Leverage items the purchasing organisation would impose certain sustainability requirements for their suppliers since they dominate in terms of relative power (Pagell et al., 2010).

Third, for the Bottleneck items, the results for all three categories of criteria are higher than expected from literature. Since organisations are highly dependent on suppliers of Bottleneck items, often only having one possible supplier, the expectation based on literature was that the purchasing organisation would not be able to impose sustainability requirements (Benchekroun et al., 2019; Dabhilkar et al., 2016). The most surprising result for the Bottleneck items is the suggested importance of the Economic criteria which are similar in score to the Leverage items. A possible explanation for this is that while there might be only a limited number of suppliers that an organisation can choose from, there are still some Economic requirements that suppliers need to comply to, especially when organisations sign long-term contracts for Bottleneck products to guarantee that the products are delivered. In addition, as argued by Krause et al. (2009), even though purchasing

organisations face certain limitations with these types of suppliers, they should still promote and devise industry-wide sustainability standards.

When looking at individual criteria, there are a few interesting results that stand out. In the case of the Economic category, the Geographical Location criterion is not mentioned very often in literature (11,4%) while the respondents of the survey questionnaire consider it relatively important for most product groups, except for Non-critical which has the lowest score (21,7%). One possible explanation for this could be related to the changes that have happened in the past few years, due to the global pandemic (end of 2019), which has had a negative impact on global supply chains. The literature review was conducted in 2019 and included papers published until the first half of 2019, while the survey was conducted in 2021. Thus, the importance of the Geographical Location could have increased due to these factors for all product categories, except Non-critical item for which organisations can easier find local suppliers.

Another interesting finding related to the Economic criteria can be seen in the case of Non-critical items. The four out of the five lowest scoring criteria (not considering the Geographical Location discussed earlier) are related to the business capabilities and infrastructure of the suppliers (e.g.: Financial Capability, Production Facilities and Capacity, Innovation Capability, and Organisational and Management Status). One possible explanation for these low scores could be that for Non-critical items, the purchasing organisations might not be interested in these criteria since they don't form long-term relationships with these organisations. On the other hand, for suppliers of Strategic items all of these criteria score very high as the purchasing organisations would have a high interest in forming long-term relationships with suppliers that have a solid financial position and organisational structure, and are highly invested into innovating.

In the case of Environmental criteria, the Leverage and Strategic items have very similar scores, and this pattern can also be observed for the Non-critical and Bottleneck items. An exception to this can be seen in the case of two criteria (Recycling Capability and Green Packaging) for which the Non-critical items score higher. One possible explanation for this could be that if the organisations purchases these items for end users (e.g.: own employees) and not for manufacturing or other intermediary process, it can be important for them to ensure that the products that are sourced are made out of recycled/recyclable materials and are packaged using sustainable materials.

For Social criteria, the scores are overall lower than for the Economic criteria, but comparable to the Environmental criteria. An interesting finding for this category can be seen for the criterion Use of Child Labour which is considered by all respondents almost equally important for all product groups (scores between 52,2% - 69,6%). When compared to how often this is mentioned in literature (11,4%), a clear difference can be observed. A possible explanation for this is that the Use of Child labour criterion might be considered by some authors as being part of other criteria, such as Labour Practices and Decent work or Ethical Issues and Legal Compliance, as suppliers scoring high on these criteria would probably not use child labour.

5.2. Limitations and future work: The sustainability framework should be applied to case study organisations to further validate it

The research presented in this thesis has several limitations and possibilities for future work. First, for the Systematic Literature Review, several inclusion and exclusion criteria were used to limit the potential candidate papers to consider for this research. By using these criteria, several relevant papers might have been missed. Thus, as suggested future work, snowballing techniques can also be used next to the Systematic Literature Review to ensure that relevant papers are considered, even though they don't fall within the criteria used for inclusion and exclusion.

Second, the design of the survey questionnaire received feedback from only two experts working at the University of Twente, who focused on assessing the face validity (if the measures seem appropriate for what needs to be measured) and partially on construct validity (if measures accurately assess what needs to be assessed). Thus, for future research, a pilot study should be performed to ensure a higher construct validity.

Third, the number of full responses received for the survey questionnaire is too small to be generalised to the whole population of purchasing-related roles. Thus, in order to enhance the generalisability of these results and to have a more robust framework that is applicable to different contexts, future work should focus on gathering more responses and conducting more advanced statistical analyses.

Finally, during this research, the results of the survey questionnaire are analysed and several conclusions are drawn. To get more in-depth insights into the applicability of this framework, future research should validate it by testing it with the help of several case studies. This would also help address some of the limitations of using only a quantitative

research method, namely that the context of the respondents can't be easily captured and used to explain their answers.

5.3. Recommendation: Only the most relevant Triple Bottom Line criteria to a certain organisational context should be used

Organisations that are looking to start incorporating Triple Bottom Line criteria into their supplier selection process can use the results of this thesis as a starting point. One recommendation for these organisations would be to first focus on one of the four product groups instead of trying to apply the Triple Bottom Line criteria to all four groups at once. The main reason for this is that depending on which suppliers the organisation currently has and what type of criteria they currently use, certain product groups might be easier to start with than others. For example, if an organisation has several suppliers of Strategic items that they have a close collaboration with already, it might be easier to introduce the idea of sustainability goals rather than to suppliers of Non-critical and Bottleneck items. The experience from this first group of products would be highly beneficial when starting with the other product groups and can have a higher chance of success.

Another recommendation is for organisations to consider their current organisational context before selecting criteria to use in the selection of suppliers. It might be that for some industries and countries easier to focus on certain criteria rather than others. For example, certain Environmental criteria might be easier to focus on in industries, like alternative energy, that already are conscious of the Environmental impact they might have. Additionally, it might not be feasible for purchasing organisations to focus on all criteria immediately as this would require a significant investment from both their side and the side of their suppliers. Thus, the recommendation is to start implementing the criteria that have the easiest gain and then make plans to work together with suppliers to implement the rest.

Finally, for organisations that are more advanced in their process of sustainable supplier selection, not all of the criteria mentioned in the sustainability framework need to be used, but rather there should be a balance between having criteria from all the three Triple Bottom Line categories. As a recommendation for what to focus on, there are several criteria that are very relevant for all the four product groups (mentioned in the top 5 scoring criteria): Quality of the Product, Responsiveness and Ease of Communication (Economic); Green Packaging, Recycling Capability (Environmental); Product Responsibility, Health and Safety of Employees, Use of Child Labour (Social).

Appendices

Appendix 1 – List of selected papers

Table 12: List of selected papers with IDs

ID	Author	Year	Title	Publication
P1	Azadnia et al.	2015	Sustainable supplier selection and order lot-sizing - an integrated multi-objective decision-making process	Journal
P2	Gold & Awasthi	2015	Sustainable global supplier selection extended towards sustainability risks from -1+n-th tier suppliers using fuzzy AHP-based approach	Journal
P3	Kafa et al.	2015	An integrated sustainable partner selection approach with closed-loop supply chain network configuration	Journal
P4	Ahmadi et al.	2017	Integrating sustainability into supplier selection with analytical hierarchy process and improves grey relational analysis - a case of the telecom industry	Journal
P5	Fallahpour et al.	2017	A decision support model for sustainable supplier selection in sustainable supply chain management	Journal
P6	Ghadimi et al.	2017	Making sustainable sourcing decisions -practical evidence from the automotive industry	Journal
P7	Luthra et al.	2017	An integrated framework for sustainable supplier selection and evaluation in supply chains	Journal
P8	Mohammed et al.	2017	Drafting a fuzzy TOPSIS multi-objective approach for a sustainable supplier selection	Conference
P9	Song et al.	2017	Developing sustainable supplier selection criteria for a solar air-conditioner manufacturer - an integrated approach	Journal
P10	Tavana et al.	2017	An application of an integrated ANP-QFD framework for sustainable supplier selection	Journal
P11	Abdel-Basset et al.	2018	A hybrid neutrosophic group ANP-TOPSIS framework for supplier selection problems	Journal
P12	Amindoust	2018	A resilient-sustainable based supplier selection model using a hybrid intelligent method	Journal
P13	Awasthi et al.	2018	Multi-tier sustainable global supplier selection using a fuzzy AHP-VIKORR-based approach	Journal
P14	Chen et al.	2018	Socially responsible supplier selection and sustainable supply chain development - a combined approach of total interpretive structural modelling and fuzzy analytic network process	Journal
P15	Cheraghalipour & Farsad	2018	A bi-objective sustainable supplier selection and order allocation considering quantity discounts under disruption risks - a case study in the plastic industry	Journal
P16	Ghadimi et al.	2018	A multi-agent system approach for sustainable supplier selection and order allocation in a partnership supply chain	Journal
P17	Goren	2018	A decision framework for sustainable supplier selection and order allocation with lost sales	Journal
P18	Hashemi Petrudi et al.	2018	An integrated approach to evaluate suppliers in a sustainable supply chain	Journal
P19	Jafarzadeh Ghoushchi et al.	2018	Evaluation and selection of sustainable suppliers in the supply chain using the new GP-DEA model with imprecise data	Journal
P20	Kannan	2018	Role of multiple stakeholders and the critical success factor theory for the sustainable supplier selection process	Journal
P21	Lu et al.	2018	A rough multi-criteria decision-making approach for sustainable supplier selection under a vague environment	Journal
P22	Sen et al.	2018	Sustainable supplier selection in an intuitionistic fuzzy environment - a decision-making perspective	Journal
P23	Vahidi et al.	2018	Sustainable supplier selection and order allocation under operational and disruption risks	Journal
P24	Zarbakhshnia et al.	2018	Sustainable supplier evaluation and selection with a novel two-stage DEA model in the presence of uncontrollable inputs and undesirable outputs - a plastic case study	Journal
P25	Zhou et al.	2018	Sustainable recycling partner selection using fuzzy DEMATEL-AEW-FVIKOR - a case study in small-and-medium	Journal
P26	Zhou & Xu	2018	An integrated sustainable supplier selection approach based on hybrid information aggregation	Journal

ID	Author	Year	Title	Publication
P27	Abdel-Baset et al.	2019	An integrated neutrosophic ANP and VIKOR method for achieving sustainable supplier selection - a case study in importing field	Journal
P28	Li et al.	2019	Sustainable supplier selection based on SSCM practices - a rough cloud TOPSIS approach	Journal
P29	Liu et al.	2019	A fuzzy decision tool to evaluate the sustainable performance of suppliers in an agri-food value chain	Journal
P30	Memari et al.	2019	Sustainable supplier selection - a multi-criteria intuitionistic fuzzy TOPSIS method	Journal
P31	Pishchulov et al.	2019	The voting analytic hierarchy process revisited - a revised method with application to sustainable supplier selection	Journal
P32	Rabbani et al.	2019	Sustainable supplier selection by a new decision model based on interval-valued fuzzy sets and possibilistic statistical reference point systems under uncertainty	Journal
P33	Rashidi & Cullinane	2019	A comparison of fuzzy DEA and fuzzy TOPSIS in sustainable supplier selection - implications for sourcing strategy	Journal
P34	Xu et al.	2019	Sustainable supplier selection based on AHPSORT II in interval type-2 fuzzy environment	Journal
P35	Yu et al.	2019	A group decision-making sustainable supplier selection approach using extended TOPSIS under an interval-valued Pythagorean fuzzy environment	Journal

Appendix 2 - Criteria which can be grouped into different Triple Bottom Line categories

Table 13: Criteria which can be grouped into different Triple Bottom Line categories

Criteria	Paper ID	Related criteria	New Category	New Criterion
Economic				
Human resource practices and labour relations	P20, P31	Labour relations, Labour, Local availability of skilled labour	Social	The interest and rights of employee(s)
Sub-tier supplier management	P31		Environmental	Green supply chain management
Environmental				
Responsiveness	P6, P30	Labour relations, Labour, Local availability of skilled labour	Economic	Responsiveness
Warehouse management	P5		Economic	Delivery
Social				
Energy and Resource Efficiency	P10, P11	Efficiency of resources, Energy management	Environmental	Resource consumption
Maintaining Long-term Relationships and Alliances	P20		Economic	Relationship with the Supplier

Appendix 3 – Consolidated list of Economic criteria and papers that mention them

Table 14: List of Economic criteria

Grouped Economic Criteria	**Paper ID**	**Count**
Cost or Price of the Product	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20, P21, P22, P23, P24, P25, P26, P27, P28, P29, P30, P31, P32, P33, P34, P35	35
Quality of the Product	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20, P21, P22, P23, P24, P25, P26, P29, P31, P33, P35	30
Delivery of the Product	P1, P2, P3, P5, P7, P8, P9, P10, P12, P13, P14, P15, P16, P17, P18, P19, P20, P22, P23, P24, P26, P28, P29, P30, P31, P33, P35	27
Technological Capability	P6, P7, P8, P12, P14, P15, P16, P17, P18, P19, P20, P25, P26, P29, P30, P31, P33, P35	18
Service Capability	P3, P4, P5, P6, P7, P12, P15, P16, P18, P20, P22, P24, P26, P29, P31, P33	16
Flexibility	P2, P7, P12, P13, P14, P18, P19, P20, P29, P22, P26, P28, P31, P33, P35	15
Financial Capability	P3, P2, P10, P12, P13, P15, P18, P19, P20, P22, P26, P29, P31, P33	14
Responsiveness and Ease of Communication	P2, P6, P10, P11, P13, P17, P21, P27, P29, P30, P32	11
Production Facilities and Capacity	P1, P6, P7, P17, P18, P19, P20, P22, P26, P29, P31	11
Relationship with the Supplier	P1, P15, P17, P18, P20, P22, P26, P29, P31, P33	10
Innovation Capability	P2, P13, P14, P18, P19, P20, P29, P31, P33	9
Mutual Trust	P2, P6, P12, P13, P14, P20, P30, P29, P31	9
Reputation	P2, P6, P12, P13, P14, P20, P30, P29, P31	9
Organizational Structure and Management Status	P3, P16, P18, P19, P22, P26, P29, P31, P32	9
Geographical Location	P6, P20, P29, P30	4
Compliance to Policies and Guidelines	P29, P31, P32	3
Local Environment	P31	1

Appendix 4 – Consolidated list of Environmental criteria and papers that mention them

Table 15: List of Environmental criteria

Grouped Environmental Criteria	**Paper ID**	**Count**
Pollution Control	P1, P2, P3, P5, P6, P8, P10, P12, P13, P14, P15, P16, P18, P19, P20, P21, P22, P23, P25, P26, P29, P30, P31, P32, P33, P34	27
Use of an Environmental Management System	P1, P3, P4, P6, P7, P8, P9, P10, P12, P14, P15, P17, P18, P19, P21, P22, P25, P26, P29, P30, P31, P32, P33, P35	24
Reduction of Resource Consumption	P2, P3, P5, P9, P10, P11, P12, P13, P17, P18, P19, P21, P22, P23, P25, P26, P29, P31, P33, P34, P35	21
Eco-design	P9, P12, P15, P17, P18, P19, P20, P21, P22, P26, P28, P31, P32, P35,	14
Environmental Competencies	P5, P6, P7, P10, P11, P12, P14, P18, P19, P20, P22, P25, P26, P30, P31	15
Recycling Capability	P5, P6, P9, P10, P22, P24, P29, P30, P31, P32, P33, P35	13
Green Packaging	P5, P6, P7, P10, P11, P14, P16, P18, P24, P27, P29, P30, P31	13
Green Research and Development	P5, P7, P12, P18, P19, P22, P26, P29, P31, P32	10
Green Supply Chain Management	P2, P4, P13, P18, P20, P21, P26, P28, P29, P31	10
Green Image	P3, P4, P6, P16, P18, P20, P21, P26, P30, P33	10
Environmental-related Certificates	P5, P6, P19, P20, P23, P24, P29, P30, P31	9
Use of Hazardous Materials	P5, P10, P11, P16, P20, P23, P29, P30, P31	9
Re-use of Products and Materials	P5, P9, P10, P18, P29, P31, P33, P35	8
Use of Environmentally Friendly Materials	P2, P5, P6, P13, P18, P20, P30, P31	8
Environmental Commitment	P10, P11, P15, P18, P20, P28, P31,	7
Use of Environmentally Friendly Technology	P18, P20, P23, P24, P31, P32	6
Impact on Biodiversity	P2, P13, P29, P31	4
Environmental Cost of Supplier's Activities	P7, P18, P19	3
Green Transportation	P5, P28	2
Green Production	P24, P28	2

Appendix 5 – Consolidated list of Social criteria and papers that mention them

Table 16: List of Social criteria

Grouped Social Criteria	**Paper ID**	**Count**
Health and Safety of the Employees	P1, P3, P4, P5, P6, P7, P9, P10, P12, P14, P15, P16, P17, P18, P19, P20, P22, P23, P24, P26, P27, P28, P29, P30, P31, P32, P33, P34, P35,	29
The Interest and Rights of the Employees	P2, P3, P6, P7, P8, P9, P10, P12, P13, P14, P15, P19, P18, P20, P21, P26, P28, P29, P30, P31, P33, P35,	22
Local Community Influence	P3, P4, P7, P17, P18, P19, P20, P22, P26, P29, P32, P33	12
The Rights of the Stakeholders	P3, P4, P7, P18, P19, P20, P22, P26, P29, P31, P32, P33	11
Information Disclosure Capability	P7, P8, P18, P19, P22, P26, P27, P29, P32, P34, P35	11
Social Responsibility	P1, P10, P11, P12, P13, P15, P20, P21, P28, P31, P33	11
Ethical Issues and Legal Compliance	P10, P11, P18, P19, P20, P22, P26, P27, P31, P32	10
Labour Practices and Decent Work	P2, P3, P5, P10, P13, P16, P19, P20, P29	9
Staff and Employee Training Capability	P1, P4, P8, P9, P18, P19, P23, P26, P31	9
Career Opportunities for the Employees	P1, P5, P6, P23, P29, P30, P31, P33	8
Welfare of the Employee	P5, P6, P11, P14, P21, P23, P29, P30	8
Employment Compensation	P5, P15, P19, P20, P26, P29, P31	7
Job Stability for the Employees	P5, P6, P23, P25, P29, P30, P31	7
Social Reputation	P3, P14, P19, P23, P24, P25, P31	7
Social Sourcing Capability	P2, P13, P20, P29, P31	5
Diversity of Workforce (age, gender, origin, minorities, disabilities, religion)	P5, P19, P20, P29, P31	5
Flexible Working Arrangements for the Employees	P6, P20, P30, P31	4
Use of Child Labour	P6, P26, P30, P31	4
Standard Working Hours for the Employees	P5, P15, P29, P31	4
Product Responsibility	P2, P13, P20, P21	4

Appendix 6 – Overview of all Economic criteria selected by respondents for each of the four product groups

Table 17: Economic criteria selected by respondents for each product group

Criteria Number	Criteria Name	Leverage Count	Strategic Count	Non-Critical Count	Bottleneck Count	Total Count	None Count
1	Compliance to Policies and Guidelines	16	20	9	12	57	0
2	Cost or Price of the Product	16	18	9	9	52	0
3	Delivery of the Product	12	16	7	17	52	0
4	Financial Capability	12	19	3	8	42	0
5	Flexibility	14	13	9	12	48	0
6	Geographical Location	11	14	5	9	39	2
7	Innovation Capability	13	19	5	6	41	0
8	Local Environment	10	15	9	10	44	3
9	Mutual Trust	14	17	9	15	55	0
10	Organisational Structure and Management Status	12	18	5	8	43	2
11	Production Facilities and Capacity	15	17	4	11	47	2
12	Quality of the Product	20	20	11	14	65	0
13	Relationship with the Supplier	14	18	6	13	51	1
14	Reputation	17	17	10	13	57	2
15	Responsiveness and Ease of Communication	18	19	14	14	65	1
16	Service Capability	15	20	10	16	61	0
17	Technological Capability	18	19	10	11	58	0
Total		247	299	135	198		13
Average		12.53	17.59	7.94	11.65		0.76

Appendix 7 – Overview of all Environmental criteria selected by respondents for each of the four product groups

Table 18: Environmental criteria selected by respondents for each product group

Criteria Number	Criteria Name	Leverage Count	Strategic Count	Non-Critical Count	Bottleneck Count	Total Count	None Count
1	Eco-design	11	11	3	4	29	7
2	Environmental Commitment	15	14	8	8	45	6
3	Environmental Competencies	13	16	4	8	41	6
4	Environmental Cost of Supplier's Activities	11	15	6	9	41	5
5	Environmental-related Certificates	16	18	6	9	49	4
6	Green Image	11	14	6	7	38	7
7	Green Packaging	14	15	12	9	50	5
8	Green Production	12	15	7	7	41	6
9	Green Research and Development	9	14	3	5	31	7
10	Green Supply Chain Management	11	13	6	5	35	7
11	Green Transportation	11	12	7	6	36	8
12	Impact on Biodiversity	10	10	6	4	30	9
13	Pollution Control	15	16	9	10	50	4
14	Recycling Capability	15	15	12	9	51	5
15	Reduction of Resource Consumption	13	13	11	8	45	7
16	Re-use of Products and Materials	12	14	9	7	42	7
17	Use of an Environmental Management System	13	15	5	6	39	6
18	Use of Environmentally Friendly Materials	13	13	10	7	43	7
19	Use of Environmentally Friendly Technology	12	15	6	5	38	7
20	Use of Hazardous Materials	12	12	8	8	40	8
Total		249	280	144	141		128
Average		12.45	14	7.2	7.05		6.4

Appendix 8 – Overview of all Social criteria selected by respondents for each of the four product groups

Table 19: Social criteria selected by respondents for each product group

Criteria Number	Criteria Name	Leverage Count	Strategic Count	Non-Critical Count	Bottleneck Count	Total Count	None Count
1	Career Opportunities for the Employees	11	11	3	4	29	7
2	Diversity of Workforce	11	14	5	6	36	5
3	Employment Compensation	12	13	7	7	39	7
4	Ethical Issues and Legal Compliance	19	16	10	11	56	3
5	Flexible Working Arrangements for the Employees	9	11	5	5	30	8
6	Health and Safety of the Employees	18	17	11	12	58	3
7	Information Disclosure Capability	14	17	8	10	49	3
8	Job Stability for the Employees	8	12	3	6	29	8
9	Labour Practices and Decent Work	14	15	11	11	51	5
10	Local Community Influence	10	11	6	6	33	9
11	Product Responsibility	17	17	11	13	58	3
12	Social Reputation	15	14	10	9	48	6
13	Social Responsibility	16	15	12	11	54	4
14	Social Sourcing Capability	11	12	7	6	36	7
15	Staff and Employee Training Capability	11	13	8	9	41	6
16	Standard Working Hours for the Employees	10	11	9	7	37	8
17	The Interest and Rights of the Employees	13	14	12	11	50	5
18	The Rights of the Stakeholders	11	13	8	9	41	7
19	Use of Child Labour	15	16	12	12	55	5
20	Welfare of the Employees	13	16	9	10	48	5
Total		258	278	167	175		114
Average		12.9	13.9	8.35	8.75		5.7

Appendix 9 – Overview of the number of respondents per question

Table 20: Number of respondents who started and finished the questionnaire, per question

Question Number	Question Formulation	# People Started	# People Dropped	# People Finished
Consent	By checking this box, I give my consent to participate in this research.	73	10	63
1	Which industry does your organisation operate in?	63	14	49
2	How large is your organisation?	49	0	49
3	What is your role within the organisation?	49	0	49
4	What are your main responsibilities in this role?	49	0	49
5	In your purchasing role, you do ...	49	0	49
6	How important does your organisation consider sustainable purchasing?	49	1	48
7	Are you familiar with the Triple Bottom Line sustainability concept?	48	0	48
8_	How often do you use sustainability criteria for supplier selection?	48	2	46
9	Are you familiar with the Kraljic Portfolio Matrix, as seen in the figure below?	46	1	45
10	How often do you use sustainability criteria for purchasing Leverage items?	45	6	39
11	How often do you use sustainability criteria for purchasing Strategic items?	39	0	39
12	How often do you use sustainability criteria for purchasing Non-critical items?	39	0	39
13	How often do you use sustainability criteria for purchasing Bottleneck items?	39	0	39
14	According to you, for which of the product groups are the following Economic criteria important?	39	4	35
15	Are there any Economic criteria that you currently use that are not mentioned in the list above? If so, please mention them below.	35	0	35
16	According to you, for which of the product groups are the following Environmental criteria important?	35	11	24
17	Are there any Environmental criteria that you currently use that are not mentioned in the list above? If so, please mention them below.	24	0	24
18	According to you, for which of the product groups are the following Social criteria important?	24	1	23
19	Are there any Social criteria that you currently use that are not mentioned in the list above? If so, please mention them below.	23	0	23
20	If you would like to receive the result of this research, please fill in your email address below. Your information will be processed according to the General Data Protection Regulation of the EU.	23	3	20

Appendix 10 – Top 5 scoring sustainability criteria for each product group

Table 21: The top five scoring sustainability criteria mentioned by most respondents for each of the four product groups

	Bottleneck	**Non-critical**	**Leverage**	**Strategic**
Economic	• Delivery of the Product • Service Capability • Mutual Trust • **Quality of the Product** • **Responsiveness and Ease of Communication**	• **Responsiveness and Ease of Communication** • **Quality of the Product** • Reputation • Service Capability • Technological Capability	• **Quality of the Product** • **Responsiveness and Ease of Communication** • Technological Capability • Reputation • Compliance with Policies and Guidelines • Cost or Price of the Product	• Compliance with Policies and Guidelines • **Quality of Product** • Service Capability • Financial Capability • **Responsiveness and Ease of Communication** • Technological Capability • Innovation Capability
Environmental	• Pollution Control • Environmental Cost of Supplier's Activities • Environmental-related Certificates • **Green Packaging** • **Recycling Capability**	• **Green Packaging** • **Recycling Capability** • Reduction of Resource Consumption • Use of Environmentally-friendly Materials • Reuse of Products and Materials	• Environmental-related Certificates • Environmental Commitment • Pollution Control • **Recycling Capability** • **Green Packaging**	• Environmental-related Certificates • Environmental Competencies • Pollution Control • Environmental Cost of Supplier's Activities • **Green Packaging** • Green Production • **Recycling Capability** • Use of an Environmental Management System • Use of Environmentally-friendly Technology
Social	• **Product Responsibility** • **Health and Safety of Employees** • **Use of Child Labour** • Ethical Issues and Legal Compliance • Labour Practices and Decent Work • Social Responsibility • Interests and Rights of the Employees	• Social Responsibility • Interests and Rights of the Employees • **Use of Child Labour** • **Health and Safety of the Employees** • Labour Practices and Decent Work • **Product Responsibility**	• Ethical Issues and Legal Compliance • **Health and Safety of the Employees** • **Product Responsibility** • Social Responsibility • Social Reputation • **Use of Child Labour**	• **Health and Safety of the Employees** • Information Disclosure Capability • **Product Responsibility** • Ethical Issues and Legal Compliance • **Use of Child Labour** • Welfare of the Employees

Appendix 11 – Overview of the questionnaire results for the Economic criteria

Table 22: Overview of the questionnaire results for the Economic criteria

No.	Criteria Name	Leverage Count	Strategic Count	Non-Critical Count	Bottle neck Count	Total Count	None Count
1	Compliance to Policies and Guidelines	16	20	9	12	57	0
2	Cost or Price of the Product	16	18	9	9	52	0
3	Delivery of the Product	12	16	7	17	52	0
4	Financial Capability	12	19	3	8	42	0
5	Flexibility	14	13	9	12	48	0
6	Geographical Location	11	14	5	9	39	2
7	Innovation Capability	13	19	5	6	41	0
8	Local Environment	10	15	9	10	44	3
9	Mutual Trust	14	17	9	15	55	0
10	Organisational Structure and Management Status	12	18	5	8	43	2
11	Production Facilities and Capacity	15	17	4	11	47	2
12	Quality of the Product	20	20	11	14	65	0
13	Relationship with the Supplier	14	18	6	13	51	1
14	Reputation	17	17	10	13	57	2
15	Responsiveness and Ease of Communication	18	19	14	14	65	1
16	Service Capability	15	20	10	16	61	0
17	Technological Capability	18	19	10	11	58	0
Total		247	299	135	198		13
Avg.		12.53	17.59	7.94	11.65		0.76

Appendix 12 – Overview of the questionnaire results for the Environmental criteria

Table 23: Overview of the questionnaire results for the Environmental criteria

No.	Criteria Name	Leverage Count	Strategic Count	Non-Critical Count	Bottle neck Count	Total Count	None Count
1	Eco-design	11	11	3	4	29	7
2	Environmental Commitment	15	14	8	8	45	6
3	Environmental Competencies	13	16	4	8	41	6
4	Environmental Cost of Supplier's Activities	11	15	6	9	41	5
5	Environmental-related Certificates	16	18	6	9	49	4
6	Green Image	11	14	6	7	38	7
7	Green Packaging	14	15	12	9	50	5
8	Green Production	12	15	7	7	41	6
9	Green Research and Development	9	14	3	5	31	7
10	Green Supply Chain Management	11	13	6	5	35	7
11	Green Transportation	11	12	7	6	36	8
12	Impact on Biodiversity	10	10	6	4	30	9
13	Pollution Control	15	16	9	10	50	4
14	Recycling Capability	15	15	12	9	51	5
15	Reduction of Resource Consumption	13	13	11	8	45	7
16	Re-use of Products and Materials	12	14	9	7	42	7
17	Use of an Environmental Management System	13	15	5	6	39	6
18	Use of Environmentally Friendly Materials	13	13	10	7	43	7
19	Use of Environmentally Friendly Technology	12	15	6	5	38	7
20	Use of Hazardous Materials	12	12	8	8	40	8
Total		249	280	144	141		128
Avg.		12.45	14	7.2	7.05		6.4

Appendix 13 - Overview of the questionnaire results for the Social criteria

Table 24: Overview of the questionnaire results for the Social criteria

No.	Criteria Name	Leverage Count	Strategic Count	Non-Critical Count	Bottle neck Count	Total Count	None Count
1	Career Opportunities for the Employees	11	11	3	4	29	7
2	Diversity of Workforce	11	14	5	6	36	5
3	Employment Compensation	12	13	7	7	39	7
4	Ethical Issues and Legal Compliance	19	16	10	11	56	3
5	Flexible Working Arrangements for the Employees	9	11	5	5	30	8
6	Health and Safety of the Employees	18	17	11	12	58	3
7	Information Disclosure Capability	14	17	8	10	49	3
8	Job Stability for the Employees	8	12	3	6	29	8
9	Labour Practices and Decent Work	14	15	11	11	51	5
10	Local Community Influence	10	11	6	6	33	9
11	Product Responsibility	17	17	11	13	58	3
12	Social Reputation	15	14	10	9	48	6
13	Social Responsibility	16	15	12	11	54	4
14	Social Sourcing Capability	11	12	7	6	36	7
15	Staff and Employee Training Capability	11	13	8	9	41	6
16	Standard Working Hours for the Employees	10	11	9	7	37	8
17	The Interest and Rights of the Employees	13	14	12	11	50	5
18	The Rights of the Stakeholders	11	13	8	9	41	7
19	Use of Child Labour	15	16	12	12	55	5
20	Welfare of the Employees	13	16	9	10	48	5
Total		258	278	167	175		114
Avg.		12.9	13.9	8.35	8.75		5.7

References

Abdel-Basset, M., Mohamed, M., & Smarandache, F. (2018). A hybrid neutrosophic group ANP-TOPSIS framework for supplier selection problems. *Symmetry, 10*(6), 226.

Ağan, Y., Kuzey, C., Acar, M. F., & Açıkgöz, A. (2016). The relationships between corporate social responsibility, environmental supplier development, and firm performance. *Journal of Cleaner Production, 112*, 1872-1881.

Amindoust, A. (2018). A resilient-sustainable based supplier selection model using a hybrid intelligent method. *Computers & Industrial Engineering, 126*, 122-135.

Awasthi, A., Govindan, K., & Gold, S. (2018). Multi-tier sustainable global supplier selection using a fuzzy AHP-VIKOR based approach. *International Journal of Production Economics, 195*, 106-117.

Azadnia, A. H., Saman, M. Z. M., & Wong, K. Y. (2015). Sustainable supplier selection and order lot-sizing: an integrated multi-objective decision-making process. *International journal of production research, 53*(2), 383-408.

Babbie, E. R. (2020). *The practice of social research*: Cengage learning.

Badri Ahmadi, H., Hashemi Petrudi, S. H., & Wang, X. (2017). Integrating sustainability into supplier selection with analytical hierarchy process and improved grey relational analysis: a case of telecom industry. *The International Journal of Advanced Manufacturing Technology, 90*(9), 2413-2427.

Bai, C., & Sarkis, J. (2010). Green supplier development: analytical evaluation using rough set theory. *Journal of Cleaner Production, 18*(12), 1200-1210.

Benchekroun, H. T., Benmamoun, Z., & Hachimi, H. (2019, 2019). *How to select suppliers when implementing a sustainable procurement strategy*.

Blumberg, B. C., Donald, R., & Schindler, P. S. (2008). Business Research Methods *McGrawHill Higher Education*.

Caniels, M. C. J., & Gelderman, C. J. (2005). Purchasing strategies in the Kraljic matrix—A power and dependence perspective. *Journal of purchasing and supply management, 11*(2-3), 141-155.

Chen, Y., Wang, S., Yao, J., Li, Y., & Yang, S. (2018). Socially responsible supplier selection and sustainable supply chain development: A combined approach of total interpretive structural modeling and fuzzy analytic network process. *Business strategy and the environment, 27*(8), 1708-1719.

Cheraghalipour, A., & Farsad, S. (2018). A bi-objective sustainable supplier selection and order allocation considering quantity discounts under disruption risks: A case study in plastic industry. *Computers & Industrial Engineering, 118*, 237-250.

Cousins, P., Lamming, R., & Squire, B. (2008). *Strategic supply management: principles, theories and practice*: Pearson Education.

Dabhilkar, M., Bengtsson, L., & Lakemond, N. (2016). Sustainable supply management as a purchasing capability: A power and dependence perspective. *International Journal of Operations & Production Management*.

Elkington, J., & Rowlands, I. H. (1999). Cannibals with forks: The triple bottom line of 21st century business. *Alternatives Journal, 25*(4), 42.

Fahimnia, B., Sarkis, J., & Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. *International Journal of Production Economics, 162*, 101-114.

Fallahpour, A., Olugu, E. U., Musa, S. N., Wong, K. Y., & Noori, S. (2017). A decision support model for sustainable supplier selection in sustainable supply chain management. *Computers & Industrial Engineering, 105*, 391-410.

Gelderman, C. J., & Van Weele, A. J. (2003). Handling measurement issues and strategic directions in Kraljic's purchasing portfolio model. *Journal of purchasing and supply management, 9*(5-6), 207-216.

Gelderman, C. J., & Van Weele, A. J. (2005). Purchasing portfolio models: a critique and update. *Journal of Supply Chain Management, 41*(3), 19-28.

Ghadimi, P., Dargi, A., & Heavey, C. (2017). Making sustainable sourcing decisions: practical evidence from the automotive industry. *International Journal of Logistics Research and Applications, 20*(4), 297-321.

Ghadimi, P., Toosi, F. G., & Heavey, C. (2018). A multi-agent systems approach for sustainable supplier selection and order allocation in a partnership supply chain. *European Journal of Operational Research, 269*(1), 286-301.

Ghoushchi, S. J., Milan, M. D., & Rezaee, M. J. (2018). Evaluation and selection of sustainable suppliers in supply chain using new GP-DEA model with imprecise data. *Journal of Industrial Engineering International, 14*(3), 613-625.

Gold, S., & Awasthi, A. (2015). Sustainable global supplier selection extended towards sustainability risks from (1+ n) th tier suppliers using fuzzy AHP based approach. *Ifac-Papersonline, 48*(3), 966-971.

Gören, H. G. (2018). A decision framework for sustainable supplier selection and order allocation with lost sales. *Journal of Cleaner Production, 183*, 1156-1169.

Jaenglom, K., & Tariq, Z. (2013, 2013). *The role of purchasing management towards sustainable supply chain: A lifecycle perspective*.

Joshi, Y., & Rahman, Z. (2015). Factors affecting green purchase behaviour and future research directions. *International Strategic management review, 3*(1-2), 128-143.

Kafa, N., Hani, Y., & El Mhamedi, A. (2015). An integrated sustainable partner selection approach with closed-loop supply chain network configuration. *Ifac-Papersonline, 48*(3), 1840-1845.

Kannan, D. (2018). Role of multiple stakeholders and the critical success factor theory for the sustainable supplier selection process. *International Journal of Production Economics, 195*, 391-418.

Kraljic, P. (1983). Purchasing must become supply management. *Harvard business review, 61*(5), 109-117.

Krause, D. R., Vachon, S., & Klassen, R. D. (2009). Special topic forum on sustainable supply chain management: introduction and reflections on the role of purchasing management. *Journal of Supply Chain Management, 45*(4), 18-25.

Li, J., Fang, H., & Song, W. (2019). Sustainable supplier selection based on SSCM practices: A rough cloud TOPSIS approach. *Journal of Cleaner Production, 222*, 606-621.

Liu, Y., Eckert, C., Yannou-Le Bris, G., & Petit, G. (2019). A fuzzy decision tool to evaluate the sustainable performance of suppliers in an agrifood value chain. *Computers & Industrial Engineering, 127*, 196-212.

Luthra, S., Govindan, K., Kannan, D., Mangla, S. K., & Garg, C. P. (2017). An integrated framework for sustainable supplier selection and evaluation in supply chains. *Journal of Cleaner Production, 140*, 1686-1698.

Memari, A., Dargi, A., Jokar, M. R. A., Ahmad, R., & Rahim, A. R. A. (2019). Sustainable supplier selection: A multi-criteria intuitionistic fuzzy TOPSIS method. *Journal of manufacturing systems, 50*, 9-24.

Mohammed, A., Filip, M., Setchi, R., & Li, X. (2017). *Drafting a fuzzy TOPSIS-multi-objective approach for a sustainable supplier selection*.

Pagell, M., Wu, Z., & Wasserman, M. E. (2010). Thinking differently about purchasing portfolios: an assessment of sustainable sourcing. *Journal of Supply Chain Management, 46*(1), 57-73.

Petrudi, S., Abdi, M., & Goh, M. (2018). An integrated approach to evaluate suppliers in a sustainable supply chain. *Uncertain Supply Chain Management, 6*(4), 423-444.

Pishchulov, G., Trautrims, A., Chesney, T., Gold, S., & Schwab, L. (2019). The Voting Analytic Hierarchy Process revisited: A revised method with application to sustainable supplier selection. *International Journal of Production Economics, 211*, 166-179.

Rabbani, M., Foroozesh, N., Mousavi, S. M., & Farrokhi-Asl, H. (2019). Sustainable supplier selection by a new decision model based on interval-valued fuzzy sets and possibilistic statistical reference point systems under uncertainty. *International Journal of Systems Science: Operations & Logistics, 6*(2), 162-178.

Rajeev, A., Pati, R. K., Padhi, S. S., & Govindan, K. (2017). Evolution of sustainability in supply chain management: A literature review. *Journal of Cleaner Production, 162*, 299-314.

Rashidi, K., & Cullinane, K. (2019). A comparison of fuzzy DEA and fuzzy TOPSIS in sustainable supplier selection: Implications for sourcing strategy. *Expert Systems with Applications, 121*, 266-281.

Rashidi, K., & Saen, R. F. (2018). Incorporating dynamic concept into gradual efficiency: Improving suppliers in sustainable supplier development. *Journal of Cleaner Production, 202*, 226-243.

Rouhani, B. D., Mahrin, M. N. r., Nikpay, F., Ahmad, R. B., & Nikfard, P. (2015). A systematic literature review on Enterprise Architecture Implementation Methodologies. *information and Software Technology, 62*, 1-20.

Sancha, C., Longoni, A., & Giménez, C. (2015). Sustainable supplier development practices: Drivers and enablers in a global context. *Journal of purchasing and supply management, 21*(2), 95-102.

Sen, D. K., Datta, S., & Mahapatra, S. S. (2018). Sustainable supplier selection in intuitionistic fuzzy environment: a decision-making perspective. *Benchmarking: An International Journal*.

Song, W., Xu, Z., & Liu, H.-C. (2017). Developing sustainable supplier selection criteria for solar air-conditioner manufacturer: An integrated approach. *Renewable and sustainable energy reviews, 79*, 1461-1471.

Tavana, M., Yazdani, M., & Di Caprio, D. (2017). An application of an integrated ANP–QFD framework for sustainable supplier selection. *International Journal of Logistics Research and Applications, 20*(3), 254-275.

Testa, F., Iraldo, F., Frey, M., & Daddi, T. (2012). What factors influence the uptake of GPP (green public procurement) practices? New evidence from an Italian survey. *Ecological Economics, 82*, 88-96.

Vahidi, F., Torabi, S. A., & Ramezankhani, M. J. (2018). Sustainable supplier selection and order allocation under operational and disruption risks. *Journal of Cleaner Production, 174*, 1351-1365.

WCED. (1987). World commission on environment and development. *Our common future, 17*(1), 1-91.

Yu, C., Shao, Y., Wang, K., & Zhang, L. (2019). A group decision making sustainable supplier selection approach using extended TOPSIS under interval-valued Pythagorean fuzzy environment. *Expert Systems with Applications, 121*, 1-17.

Zarbakhshnia, N., & Jaghdani, T. J. (2018). Sustainable supplier evaluation and selection with a novel two-stage DEA model in the presence of uncontrollable inputs and

undesirable outputs: a plastic case study. *The International Journal of Advanced Manufacturing Technology, 97*(5), 2933-2945.

Zhou, F., Wang, X., Lim, M. K., He, Y., & Li, L. (2018). Sustainable recycling partner selection using fuzzy DEMATEL-AEW-FVIKOR: A case study in small-and-medium enterprises (SMEs). *Journal of Cleaner Production, 196*, 489-504.

Zhou, X., & Xu, Z. (2018). An integrated sustainable supplier selection approach based on hybrid information aggregation. *Sustainability, 10*(7), 2543.

Zimmer, K., Fröhling, M., & Schultmann, F. (2016). Sustainable supplier management–a review of models supporting sustainable supplier selection, monitoring and development. *International journal of production research, 54*(5), 1412-1442.