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Integration of Sustainability Aspects in The Supplier Selection Process: A Case Study from A German Electronics Firm

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ABSTRACT

The supplier selection process has become an important area of research and professional activity, and it is fundamental to understand the types and trends of research in this field. The appropriate supplier selection decision is a fundamental strategic process and plays an important role in supply chain management. In the last decade, academic research on sustainability has evolved rapidly in the supply chain literature. However, there has been scant opportunity for the research community to complete a global assessment of sustainable supplier selection activities to date. This paper seeks to address this need by exploring sustainability in supply chain management, developing a sustainable supplier selection framework with a tool for its operationalization to help managers evaluate supplier selection decisions. Our proposed model is based on the TOPSIS concept as a multiple criteria decision-making (MCDM) model and is validated through a case study. This research work follows the best-in-class approach to comply with all applicable environmental regulations and laws in the supplier selection process.

1. Introduction

Today European and U.S. manufacturers spend an important amount of their revenue to purchase goods and services. This leads to an increase of the relevance of outsourcing decisions and link their decision results to the firm performance. According to the data extracted in June 2017 from Eurostat, the EU's resource productivity has increased by 41% from 2000 to 2016. This could be the result of outsourcing material-intensive production to other parts of the world. A resource-efficient Europe is one of the flagship initiatives of the Europe 2020 strategy: it supports the shift towards a resource-efficient economy to achieve sustainable growth (Eurostat, 2017). In order to implement a sustainable supply chain strategy in firms, the role of procurement managers is key to introduce a sustainable policy in their firms' procurement process and develop a framework and process for its operationalization.

Many researchers studied the dilemma managers face during the supplier selection phase in the past. However, they failed to consider the social responsibility guidelines summarized at the ISO 26000 released in 2010. The international standard ISO 26000 provides guidance on understanding, implementing and continuously improving the social responsibility of organizations, which is understood as the impacts of firm's actions on society and the environment. The ISO 26000 standard is expected to set the norm for social responsibility in the future (ISO 26000, 2010).

Why is sustainable procurement worthwhile for firms? Sustainable procurement strengthens the firm's reputation, reduces costs and is rewarded by customers. In essence, firms want to (1) *manage risks* (brand protection, supply chain disruptions, fines and litigations), (2) *reduce costs*

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(improve total cost of ownership, reduce over specification, reduce consumption) and (3) *increase revenue* (product/service differentiation, access to new markets, income from recycling projects) (EcoVadis, 2018). While the traditional external provider selection focuses mainly on criteria such as price, quality, flexibility or delivery performance (Öztürk and Özçelik, 2014), the goal of corporate social responsibility (CSR) is to ensure a sustainable development of the supply chain by increased resource efficiency. In order to implement social responsibility requirements throughout the supply chain process, this paper introduces the CSR sustainable criteria for the evaluation of external providers. We develop a sustainable external provider selection framework extending the Triple-Bottom-Line[1] (TBL) concept (Elkington, 1994; Jackson et al., 2011) and presenting a multi criteria approach. The TBL model consists of social equity, economic, and environmental factors.

The paper is structured as follows: Firstly, the supplier selection framework with a clear focus on sustainability is developed based on a detailed literature review. In a next step, the case study of the German industrial firm is presented, and the application of the supplier selection framework as well as the supplier selection process is explained and specified. Finally, the consideration of the sustainability criteria in the selection of suppliers is presented based on a specially developed decision matrix.

2. Development of an external provider selection framework

Due to the increased relevance of sustainable procurement in the last decade, we have adapted and extended the categorization of five criteria for supplier selection identified by Chen et al. (2006) into six main clusters combined in the developed external provider selection framework. Chen et al. (2006) presented a fuzzy decision-making approach to deal with the supplier selection and evaluation problem based on the TOPSIS concept as a multiple criteria decision-making (MCDM) model. The six main clusters are (1) strategic value, (2) resource position, (3) performance, (4) potential for opportunism, (5) conformance quality and (6) corporate social responsibility (CSR). Every main cluster is subcategorized into TOP sub criteria for the corresponding evaluation. Figure 1 includes the definition of all main clusters of the framework. For instance, the main cluster CSR combines the following sustainability criteria: (TOP1) Code of conduct (CoC) for suppliers, (TOP2) ISO 14001 – Environmental management system, (TOP3) REACH / RoHS / Conflict minerals reports such as CMRT reports (conflict minerals reporting template), (TOP4) Occupational Health and Safety ISO 45001 and (TOP5) ISO 50001 – Energy Management. The five categories are described in detail in section 4.3.

Triggers and possible outcomes from the supplier selection process are also integrated in the supplier selection framework. Detailed analyses regarding these topics follow in the next sections.

3. Stages of The External Provider Selection Process

Basically, the supplier selection process can be divided into four stages: (1) planning, (2) data collection and analysis, (3) performance evaluation and (4) improvement (see Figure 2). The project leader, assigned to the selection process, plans, coordinates and leads activities ensuring to ensure that tasks are accomplished according to the milestones plan to achieve the key milestone dates on time. The project should be documented in a project sheet containing the following points: (1) general information, (2) main objectives, (3) requirements criteria, (4) pairwise comparative evaluation and (5) decision matrix. Points four and five are described in detail in Section 4.3.

[1] The Triple-Bottom-Line approach is a method for measuring sustainable performance (Elkington 1994; Jackson et al. 2011).

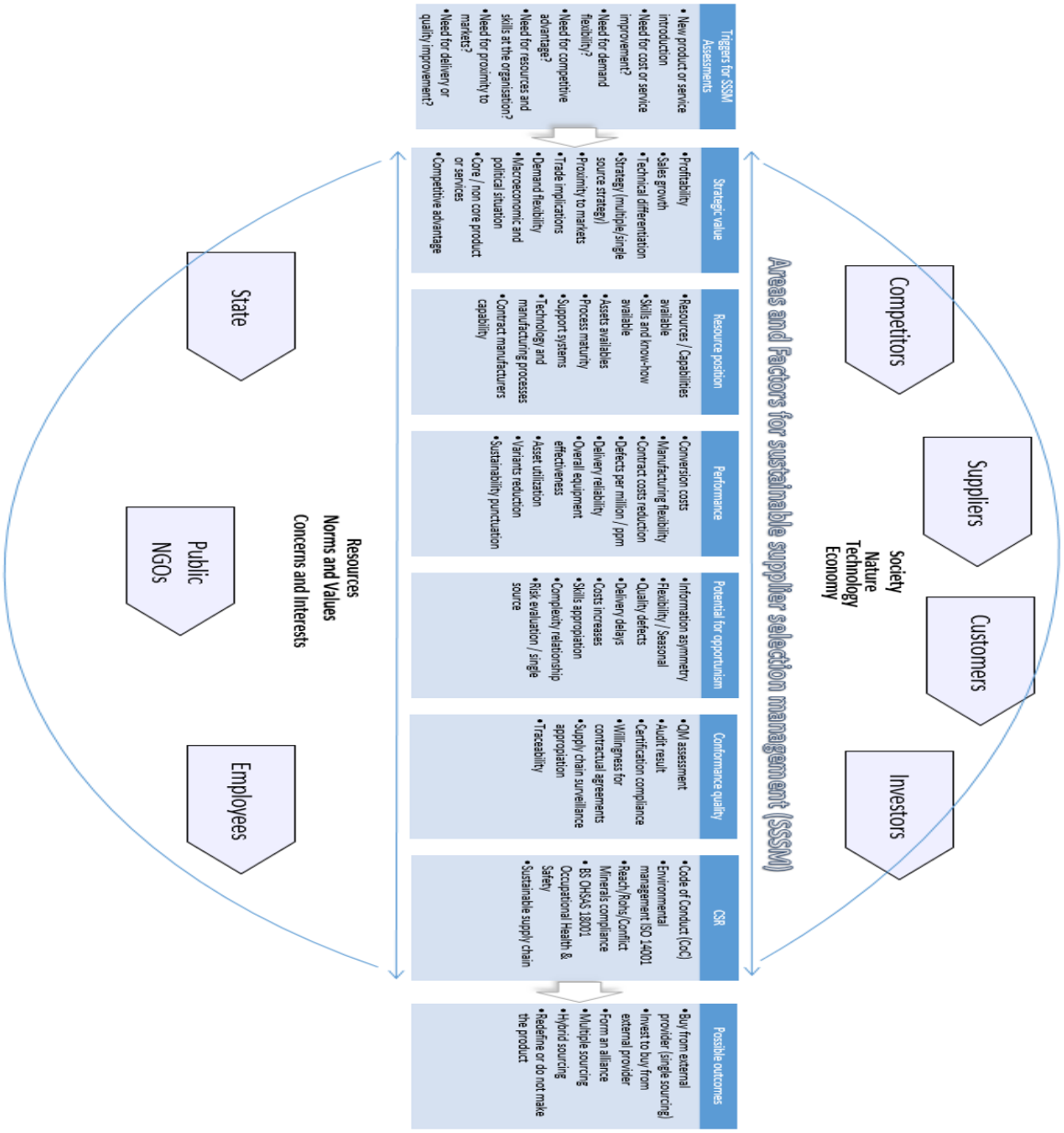

Figure 1. Sustainable supplier selection framework
Source: Own source

Phase one – the planning phase – identifies the products or assemblies for analysis, sets the objectives of the selection process as well as the required resources (including the selection of a multidisciplinary team) in accordance with the firm's strategy. In addition, risks and opportunities are analyzed, discussed and weighed each other. In phase two – data collection and analysis - the interdisciplinary team performs the data collection and analysis, gathering appropriate records and evidences. Workshops are carried out to determine the weighting, assessment and the supplier-related cost calculation. Whereas the weighting of main clusters is assessed through the pairwise tool in workshop 1, the evaluation of the preferred suppliers is performed with the matrix in workshop 2. Finally, suppliers' offers and qualification costs are evaluated in workshop 3. To ensure a holistic performance assessment in phase three – performance evaluation –, past supplier evaluations are integrated and a SWOT analysis of the

supplier is carried out on basis of the collected data. The result of phase four is the provision of the project and the preparation of an action plan, weighted according to the order of the potential effectiveness of the individual actions. Besides the derivation of improvement actions, the purpose of the selection process is also to set a clear timeframe and define clear responsibilities for the following implementation.

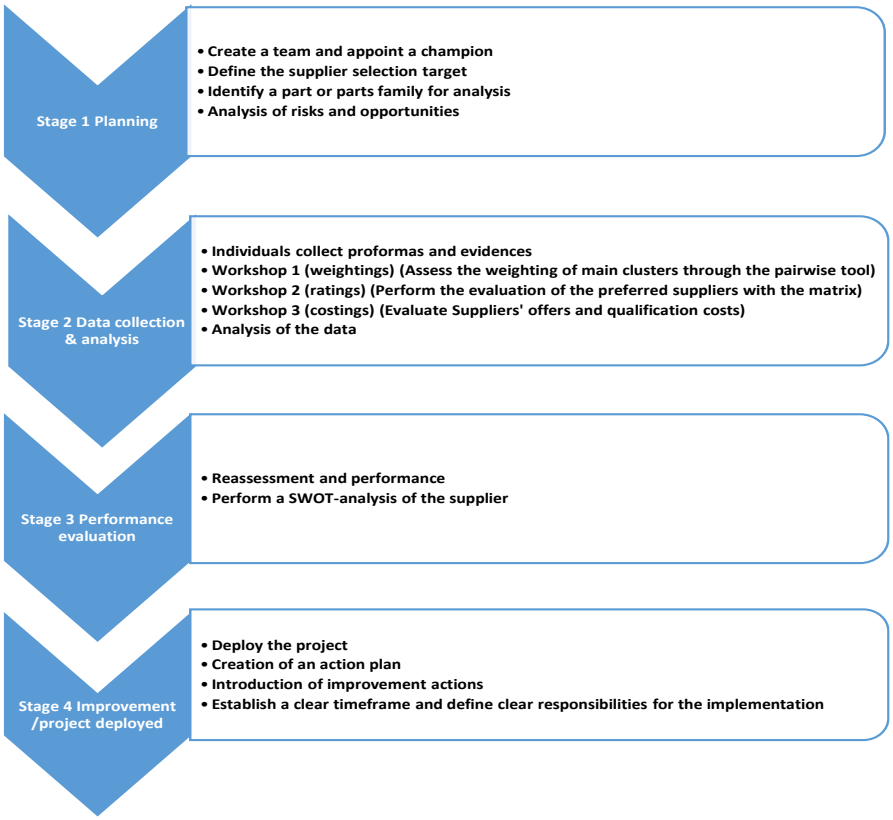

Figure 2. Stages of the external provider selection process
Source: Own source

4. Review of the theoretical models using the case study of a German industrial firm

Based on an in-firm case study, supplemented by further interviews with individual industry representatives, the practical application of the two previously presented models is analyzed. Whereas the social and environmental categories from the TBL model are adapted into the CSR main cluster, a decision matrix is built based on the TOPSIS model. The data was collected through a variety of surveys in the firm and its external supply chain partners as well as through the analysis of existing documents and a corresponding literature analysis.

4.1. Case Study

The case study is focused on a leading manufacturer of electronical products certified on NEC, CEC, ATEX, GOST, Inmetro and IECEx standards. The firm is a global player based in Germany with 1,788 employees and 286,6 m€ turnover (key figures from end 2016). The main criteria for the selection of the firm were that the firm had recently made different supplier selection decisions in a wide range of industries and sizes with different kinds of outcome, namely (1) buy products or services from an external provider, (2) invest to buy from external provider, (3) select a multiple sourcing in order to prevent single source risks, (4) forming a strategic alliance and (5) redesigning or discontinuing products. The case study was conducted to document the decision making process of the firm.

For analyzing the case study multiple sourcing of evidence were used, such as supplier non-disclosure agreements (NDA), confidential disclosure agreements (CDA), supplier self-disclosures, supplier selection assessments, quality assurance agrements (QAA), supplier audit reports, delivery contracts, final reports and project plans. This helped to provide validity and reliability to the case (Yin, 2018). In addition, the case study will be useful to refine the framework and to ilustrate how to use this framework in business practice.
The supplier selection process in the case study is limited to two suppliers for strategic reasons. The first supplier is a German global supplier from the EMS (electronic manufacturing services) market with core competencies in customized solutions for product lifecycle management of electronic applications. The supplier is part of a Dutch group which is listed in the Reed Electronics Research report as one of the leading EMS service providers in Europe in 2018 and generated Group-wide 439 m€ in 2017. The second supplier is from Slovakia and generated – in contrast to the Dutch group – only sales of around 11 m€ in 2017. The influence of the observed electronics firm on the Slovakian supplier is considerably higher than on the German supplier.

4.2. Sustainable supplier selection process at the electronics firm
Based on the general supplier selection phase model from Section 3, the process is now validated, standardized and further specified in the case study (see Figure 3).
Sustainable procurement begins with the search and selection of potential suppliers. Following the identification of potential suppliers, the firm requests a self-assessment from the suppliers. The following defined requirements for suppliers have been agreed internally and are requested and evaluated through the supplier self-assessment' questionnaire for each supplier:

1. Does the firm have a certified environmental / occupational health and safety / energy management system according to the standards in table 1?

Table 1.
Certification matrix

Norm	Yes	No	planned	Implemented, however, not certified
ISO 9001				
ISO 14001				
EMAS				
ISO 50001				
OHSAS 18001				
ISO 45001				

Source: Own source

2. Are the principles of the firm approved in accordance with the Supplier CoC?
☐Yes ☐No

3. Are the principles of the firm approved in accordance with the Quality Assurance Agreement (QAA) for suppliers?
☐Yes ☐No

4. Is the creditworthiness of the supplier confirmed?
☐Yes ☐No

As a result of the self-assessment, the suppliers are classified according to the following categories:

- **Fulfilled** (all questions answered with yes)
- **Partially fulfilled** (answering one question with no, creditworthiness, QAA and compliance with the CoC are mandatory)
- **Not fulfilled** (two or more questions answered with no)

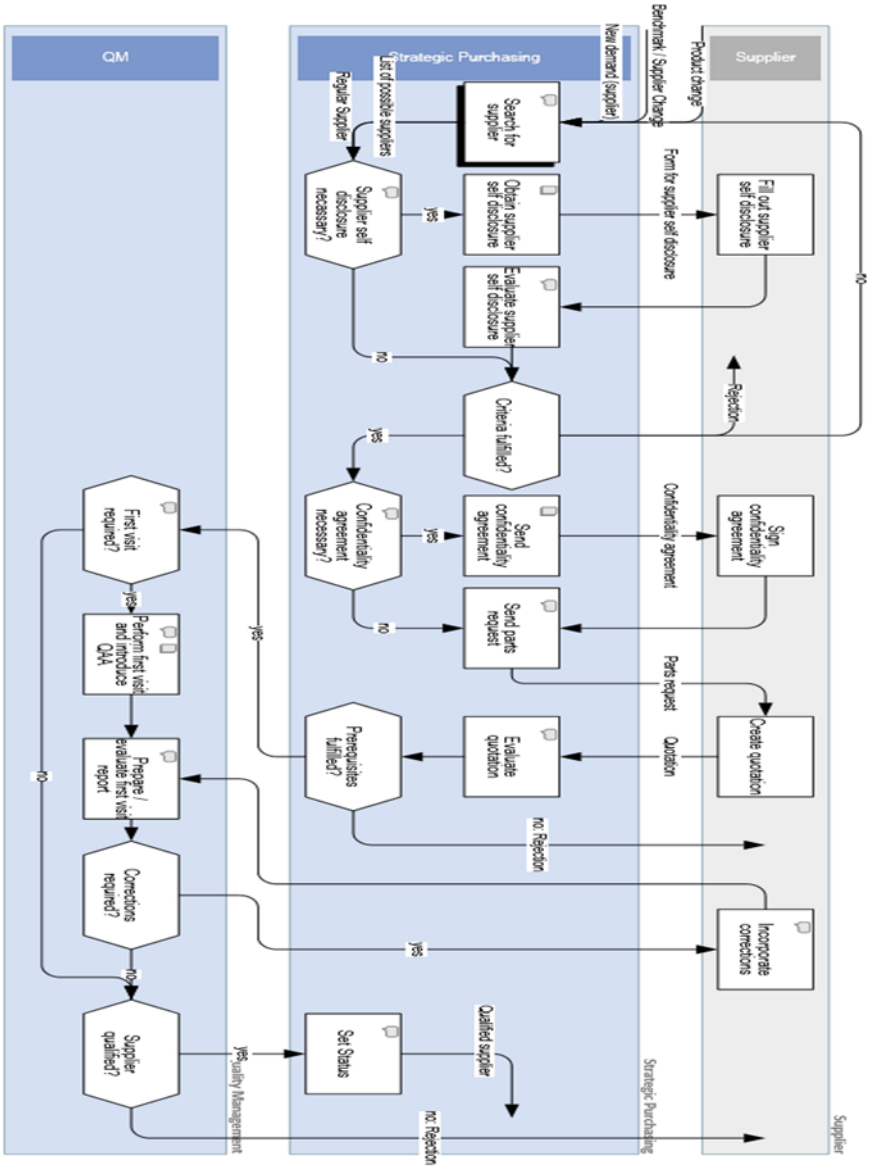

Figure 3. Sustainable supplier selection process at the electronics firm
Source: Own source

At this point, the Supplier CoC of the electronics firm will be discussed in detail in order to emphasize the importance of sustainable aspects. The observed firm has established strict ethical principles for itself, which guide it in its business. In return, suppliers are expected to work according to the same ethical principles

Therefore, the firm has developed a CoC that defines the minimum requirements for a possible business relationship and, as previously discussed, is part of the supplier self-assessment. By signing the CoC, the supplier agrees with the following points:

Human rights and social standards

- to comply with the laws of the applicable legal order(s) with respect to human rights and social standards
- to do not disclaim any discrimination, sexual or other personal harassment or a guidance to such a behavior
- to respect the personal dignity, privacy and personality rights of each individual
- to promote diversity in its firm
- the employees are free to unite
- to show no tolerance against child labor and forced labor
- to ensure adequate remuneration and to ensure the statutory national minimum wage
- to respect the maximum working time stipulated by law in the respective state

Safety, health & environmental protection

- to comply with the laws of the applicable legal order(s) with respect to safety, health & environmental protection
- to protect the environment and conserve its resources
- to pay attention to the safety of its employees and always try to improve it through e.g. trainings

Corruption and bribery

- to comply with the laws of the applicable legal order(s) with respect to corruption and bribery
- to pay attention to the competition and antitrust law
- to ensure fair competition and a fair contract design with its business partners
- to do not tolerate any kind of corruption or bribery, which includes any illegal payment offers or other donations to influence a decision

Supply chain

- to use reasonable efforts to promote among its supplier's compliance with this CoC

Conflict minerals

- to take reasonable efforts to avoid the use of raw materials which directly or indirectly finance armed groups who violate human rights

Specific quality marks and resp. or certificates can provide the proof of evidence that the supplier complies with the required social and environmental standards.

Once the information received meets or partially meets the minimum requirements for selecting a supplier, a supplier non-disclosure agreement will be requested. Upon receipt of the document, the electronics firm will request a quotation for the parts from the suppliers. In a next step, the firm will respond with an offer, which contains contract terms such as price conditions, lead times and quality requirements. After sending the offers and subsequently agreeing on the terms of the contract with the selected suppliers, the firm conducts a first supplier audit. Here, the minimum requirements of the Supplier CoC and the procurement documents are checked on site.

During the first visit, a quality assurance agreement is presented and discussed with the supplier. After the audit evaluation, an audit report is prepared and corrective actions are addressed. Finally, the results are evaluated using the developed decision matrix and the supplier status is established. The supplier should be added to the internal database as soon as the supplier selection process is released and the supplier qualified. A review report will be

created and the supplier will be notified. The firm determines which supplier or suppliers receive a contract and assesses the supplier during the entire contract period to support future supplier selection iterations. The developed decision matrix is described in detail in the next section.

4.3 Application of the sustainable supplier selection framework at the electronics firm

The question of this section is how to implement the sustainable supplier selection framework is in the firms' daily business. The framework model is oriented on the analytic network process (ANP) methodology, a special technique for solving multi-criteria decision problems by allowing the creation of decision networks, developed by Saaty (1996) and improved by Gencer and Gürpinar (2007). The application of the sustainable supplier selection framework is divided into eight steps: (1) analysis of the external provider problem (trigger), (2) determining the weights of decision makers, (3) determining the goals and criteria and sub criteria from the framework, (4) determining possible external providers, (5) building the external provider selection model, (6) making the paired comparisons matrices (PCM), (7) building the super matrix with TOPSIS (technique for order preference by similarity to ideal solution) and (8) decision based on the evaluation of the preferred external providers.

Step 1 – Determine the triggers for the analysis of external provider problems based on the developed framework. Following options are mentioned in the framework: (1) new product or service introduction, (2) need for cost or service improvement, (3) need for demand flexibility, (4) need for competitive advantage, (5) need for resources or skills at the organization, (6) need for proximity to markets, (7) need for delivery or quality improvement.

Step 2 – Determine the importance weights of the corresponding decision makers (DM). In contrast to the proposed four decision makers defined by Chaharsooghi and Ashrafi, (2014) "(An operations manager (DM1), a financial manager (DM2), a purchasing manager (DM3), and an environmental manager (DM4))", we defined three decision makers setting their importance weights based on the research of Boran et al. (2009). Whereas DM1 are represented by managers and strategic purchasers (40.6%), DM2 are Research & Development responsibles, industrial engineers and specialists (23.8%). Finally, DM3 are quality assurance and quality representatives (35.6%). The sum of the weights must be 100%. Our novelty is the introduction of fix decision makers' weights for all supplier selection decisions.
At least three decision makers should be integrated into the decision-making process at each level. Supplier selection decisions are thus not made exclusively by purchasing or a specialist department, but by firm-wide cross-functional teams.

Step 3 – Determine the goals for the supplier selection assessment and determine and customize the criteria and sub criteria to be weighted at the pairwise comparison matrix. The procedure's overview is drawn in Figure 4. The criteria and sub criteria are defined in the proposed framework and consider the sustainability criteria from the ISO 26000. Therefore, we have built up the CSR main cluster where we grouped environmental attributes like REACH / RoHS / CMRT Reports, ISO 14001 Certificate effective environmental management system, social attributes like OHSAS 18001/ISO 45001 Occupational Health and Safety Assessment, social audit report, Health & Safety plan and Accident Incident Rate Scorecard and organizational and cultural attributes like ethical internal CoC and CoC for suppliers. The goal of an energy management system according to ISO 50001 is the continuous improvement of a firm's energy-related performance.

Step 4 – Determine possible external providers for a specific subcontracting assessment. Possible external providers can either be new or existing suppliers. In order to obtain the necessary evidence for the subsequent supplier evaluation, supplier self-assessments, supplier surveys and creditworthiness information are obtained and supplier audits are carried out.

Step 5 – The sustainable supplier selection procedure was developed together with the decision makers and released internally at the electronics firm, based on the case study.

Step 6 – Every cluster sub criteria is pairwise compared concerning their importance towards the before determined main goals following the Thurstone's Law of comparative Judgment (Li et al, 2001). Decision makers are asked to respond to a series of pairwise comparisons where two criteria elements at a time will be compared in terms of how they contribute to their particular upper-level criterion. Also, in this step, the consistency of each comparison is checked. The relative importance values are determined with a scale of 0 to 2, where a score of 0 represents less importance than the other criteria, a score of 1 indicates equal importance between the two elements and a score of 2 indicates the extreme importance of one element (row component in the matrix) compared to the other one (column component in the matrix). The weights of every criterion are determined afterwards and will be adapted into the pair wise supplier comparison in the next step.

Pairwise comparison — Determine the weights of criteria

more important than

		Strategic value / Business Strategy	Performance	Product supply chain risks / Potential for opportunism	Resource position	Conformance quality	CSR (Sustainable procurement) ISO 26000	Total	Weight (%)-Factor
1	Strategic value / Business Strategy		1,2	1,6	1,6	0,6	1,4	6,4	8,0
2	Performance	1,4		1,8	1,6	1,6	1,6	8,0	10,0
3	Product supply chain risks / Potential for opportunism	1	2		1,6	1	1,6	7,2	9,0
4	Resource position	1,6	0,8	1,2		1,2	1,4	6,2	7,0
5	Conformance quality	1,6	1	1,4	1,4		1,6	7,0	8,0
6	CSR (Sustainable procurement) ISO 26000	1	0,4	2	0,4	1		4,8	6,0
TOP1	CoC (Code of Conduct)	1	1	2	1	1			
TOP2	Environmental management ISO 14001	1	0	2	0	1			
TOP3	Reach/Rohs/Conflict Minerals	1	1	2	1	1			
TOP4	BS OHSAS 18001 - Occupational Health & Safety	1	0	2	0	1			
TOP5	Sustainable supply chain	1	0	2	0	1			
								8,0	

Figure 4. Pairwise comparison
Source: Own source

The paired comparisons method for scaling is implemented to obtain an ordering of the preference of the main clusters based on the comparative judgments of the group of criteria. For instance, the weighting factor of the criterion CSR is calculated as follows: CSR weighting

factor = integer ((sum of the mean values of the series of criterion CSR (1; 0.4; 2; 0.4; 1) / maximum value of the column "total") * 10); gives 6 = ((4,8 / 8) * 10) (see Figure 4). Subjective estimations and judgements can forward to incongruences as seen by the rating of criteria in the study. However, this method is well-established for researchers and practitioners.

Step 7 – Building the super matrix according to the TOPSIS[2] method. In the super matrix, the supplier rating is determined by the decision makers on a scale from one to five. A rating of one means that the condition does not meet the requirements, a rating of two means that the requirements are only partially met, a score of three indicates that the requirements are almost completely met, a value of four means that the requirements are fully met, and a value of five indicates that the condition is exemplary (see Figure 5). For instance, for the criterion "strategic value", suppliers A and B are rated with four and five points, respectively. The weights of each criterion are taken from the pairwise comparison matrix and inserted into the super matrix. For the criterion "strategic value", the weighting factor is eight. The results of the calculation are rounded off, thus Supplier A receives a score of 4.1 in the category "Strategic Value", which using the weighting factor gives a weighted value of 33 points and finally leads to a total degree of fulfillment of supplier A of 65%.

Supplier comparison

External providers / Requirements	EVALUATION			RESULTS	
	Firm A	Firm B	Weight (%)-Factor	Firm A	Firm B
Strategic value / Business Strategy	4,1	4,8	8	33	38
DM1	4,0	5,0			
DM2	3,0	4,0			
DM3	5,0	5,0			
Performance	3,2	4,2	10	32	42
Product supply chain risks / Potential for opportunism	5,0	4,8	9	45	43
Resource position	1,2	4,2	7	9	30
Conformance quality	4,8	3,2	8	38	26
CSR (Sustainable procurement) ISO 26000	4,2	4,0	6	25	24
			Total	65%	79%

Figure 5. Decision matrix assessment
Source: Own source

Step 8 – Decision based on the preferred supplier rating. For the evaluation of the results, five categories are defined according to the degree of fulfillment:

(1) 100% to 80%: high potential (proven and preferred, continuing is recommended)
(2) 80% to 60%: intermediate potential (proven, continuing is recommended)
(3) 60% to 40%: low potential
(4) 40% to 20%: high risk (caution, looking for alternatives)
(5) 20% to 0%: does not progress (search for alternatives)

[2] The TOPSIS is a multi-criteria decision analysis method, which was originally developed by Hwang and Yoon (1981) with further developments by Yoon (1987), and Hwang et al. (1993).

In the following part of the paper, the main clusters of the sustainable supplier selection framework are discussed in detail using the case study. The case study focuses on the described high-tech manufacturing electronics firm, which is looking for a suitable supplier to buy key components for new products. The focus is on the manufacturing of innovative interface and system solutions, which include printed circuit board (PCB) assembly, painting and the execution of the respective functional and in-circuit tests. The research and development activities of the electronic devices are carried out internally. This product family represents a new product line within the business unit "automation" of the electronics firm.

Triggers

Based on the case study, the main trigger for the supplier selection was the new product introduction and the need to process the project in the required time. The current high demand of electronic manufacturing parts at the global market and the allocation of parts by suppliers makes it difficult to find EMS providers with available capabilities and enough expertise to accept this order. As a result of this, a multidisciplinary team was set up to carry out the supplier selection analysis.

Main clusters of sustainable supplier selection

The goal of the firm is to select a supplier with a high resource position, high profitability, high CSR reputation, low potential for opportunism, preferring the centralized arrangement of the completed processes/services and having qualitative proof for certification bodies.

Strategic value. The selected parts family provides a clear competitive advantage and has a relative high strategic value to the firm because of their technical differentiation against competitors.

Resource position. Whereas the lack of available contract manufacturers at the market with advanced technology and expertise on similar industry are currently an isssue, the firm identified a supplier located in Slovakia with available ressources to process and deliver the project within the expected time. Hence, this crucial criteria has the major importance for the supplier selection assessment. In contrast to the Slovakian supplier, the German supplier has lack of resources in its plant which impacts on long delivery times. The potential to deliver this new product to the firm's customers on time is a clear advantage for the firm against its competitors. Special test adapters and tooling would be required to perform the in-circuit and functional tests at the supplier site. In order to conduct a deep supplier evaluation, an on-site supplier audit was performed by both suppliers on 26/27 February and 13 March 2018 in Germany and Slovakia respectively. Due to special certifications and technical requirements of the parts, a support system and support team would be required.

Performance. The contract cost reduction criteria is relevant, but a high delivery performance was the fundamental criteria for the assessment in the case study. Whereas the evaluation of technology and manufacturing processes by the supplier located in Germany is higher, his current low resource position because of the high market demand makes it difficult to process the project within the firm's expected time. The sustainability level is higher at the German supplier compared to the Slovakian supplier, which is verified by certifications and the performed on-site audit. The definition of key performance indicators to monitor the process is essential to evaluate the outcome decision. Contract cost reduction indicators, delivery and quality performance figures and asset utilization were taken into account.

Potential for opportunism. While the level of quality by the German supplier is better evaluated, the delivery performance and the flexibility of the Slovakian supplier to deliver the project within the required time is exemplary. The information asymmetry plays an important role by the Slovakian supplier, but not by the German supplier who can communicate in the same language. The risk of an increase of quality defects, purchased costs, delivery delays and a complexity relationship with the external provider were also taken into account. Additionally, surveillance and auditing costs must be required to support the external provider until the process is matured and stable at its site.

Conformance quality. After the audit was performed at both suppliers, it was verified that both firms are ISO 9001:2008 and ISO/TS 16949:2009 certified. The German firm was additionally certified complying with the requirements for manufacturers of medical devices ISO 13485:2013. While the willingness for contractual agreements is higher with the Slovakian firm, a supply chain surveillance plan is more consistent and reliable by the German supplier. In contrast to the German supplier who performed six supplier audits in Asia in the last years, the Slovakian supplier prefers mainly supplier statistic evaluations.

CSR. As part of the sustainable supplier selection, both suppliers were evaluated with reference to environment, social, ethics and sustainable supply chain aspects. Both suppliers have defined an internal CoC. However, neither of them defined a specific supplier CoC. Both suppliers have a valid and certified environmental management system, which comply with the ISO 14001 requirements. Additionally, the Slovakian firm has granted a certification according to OHSAS 18001 – Occupational Health & Safety requirements. A CSR evaluation criteria is not performed by neither of both suppliers. However, the German supplier has a quality management system (QMS) which takes into account the Global Reporting Initiative (GRI) Standards which are the global standards for sustainability reporting (GRI Report, 2017). Additionally, the group of the German supplier has an internal sustainability policy valid for all firms and employees belonging to the group.

Final Outcome

The final decision leads to the selection of the Slovakian provider. A risk assessment for the possible second source option has been evaluated. First, the weight of the specified criteria is calculated. The CSR variables were evaluated by three decision makers to determine the weighting of the criteria in this case study. The alternative with the highest weighted coefficient across all six rating categories is Supplier B with 79 percent of the maximum possible total compared to 65 percent for Supplier A. The calculation of the pairwise comparison matrix for the case study is described in detail in Section 4.3, "Step 6". Although both results are within 60 to 80 percent, the takeover for Supplier B was ultimately preferred. The assessment found that the sustainability criteria in practice are important for supplier selection, but it does not have the same relevance as often assigned by the research community (Winter and Lasch 2016). What is the most important information for firms that want to build and maintain a sustainable supplier selection process? In contrast to previous approaches, a multidisciplinary team has been formed and the assessment has not been solely based on the decision of executives focusing on cost savings, but also on areas of expertise that focus on a strategic perspective and delivery performance of the suppliers. Another key factor that needs to be taken into account is the mindset of continuously learning from earlier approaches to avoid previous mistakes in future supplier selection processes.

4.4 Operationalization of sustainable procurement

The success of sustainable procurement is reflected in the goals and success factors of the firm and is mainly fed by the following core tasks of the procurement team:

- Reduction of material costs and additional costs by sustainable global sourcing and negotiation of prices and terms as well as long-term payment terms.
- Avoidance of single sourcing and preference of multiple sourcing strategy.
- Proof of the creditworthiness and suitability of the suppliers.
- Avoiding complaints through setting clear instructions, expectations and reconciliation of quality assurance agreements with suppliers.
- Prevent late deliveries or failures in the contractual regulation of safety stock levels with suppliers on the basis of more accurate forecasts.
- Inventory reduction along the supply chain, reduction of store inventories, short replenishment times, minimization of warehousing and reduction of tied capital.
- Early involvement of suppliers in product development to integrate external expertise and realize the most cost-efficient development processes.
- Reduce product variations through standardization strategies to optimize throughput times, manufacturing costs and availability.
- Classification of suppliers in clearly defined product categories. Thus, similar suppliers can be compared with each other and necessary measures can be derived together.
- The tender documents must contain sustainability requirements to be monitored during the audit. Regular communication about corporate social responsibility activities and the corresponding achievement of goals takes place within the purchasing departments and between purchasing and corporate management.
- Establishment of a Supplier CoC, which fully incorporates the corporate social responsibility values.
- Training of employees in procurement. Corporate social responsibility aspects are reflected in regular mandatory trainings with buyers and suppliers. A dedicated corporate social responsibility module is part of the qualification process for new suppliers. The process of "sustainable procurement" has to be established.

5. Conclusions

The research presented in this paper has important implications for theory and practice in the supply chain in general and in procurement management in particular. Past literature reviews provide valuable results, but were based upon the assessment of supplier selection decisions failing to consider the TBL concept in combination with others based on strategic or resource-based viewpoints. This paper aims to contribute to the study of sustainable supplier selection in supply chain management through the graphical representation of why and how supplier selections are made. The sustainable supplier selection framework presented in this paper deals with the trends identified in the literature by capturing relevant approaches considered in supplier selection decisions. The aim is to provide a graphical representation of relevant dimensions, which need to be studied when examining external provider selection decisions. One of the main contributions made by the article consists in the integration of the framework into the proposed sustainable supplier selection model and the use of them in a case study, based on a German firm, to confirm the consistency of the methodology. In contrast to Song et al. (2018), a model was developed that integrates not only environmental aspects but also social aspects in order to fully consider sustainable supplier evaluation criteria.

The framework does not only capture relevant factors to be considered, but also provide a structure to investigate these factors and design a practical decision matrix with a pair wise comparison for the practical operationalization of the framework. In contrast to the Banaeian

et al. (2018), a basic model for the external provider selection process has been developed that uniquely integrates supplier classification classes according to the sustainability criteria in order to broaden the knowledge for practitioners and academics in this area (Banaeian et al 2018). This study provides a long-term framework for actions in many policy areas. It aims to increase certainty for investment and innovation and to ensure that all relevant policies take account of resource efficiency in a balanced manner.

The supplier selection framework can serve as a guideline to provide managers, practitioners, and academics with a practical solution to resolve external provider selection decisions more structured and consistent. As noted in the case study, a better understanding of the experiences and the potential for improvement should be considered for any future decision. As a result, practitioners can learn from past failures by adapting to future needs and keeping the framework and tool alive through ongoing updates.

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