

Selection of Strategic Suppliers for Partnership: A Model with Two Stages Approach

Safak Isik, Ozalp Vayvay

Abstract—Strategic partnerships with suppliers play a vital role for the long-term value-based supply chain. This strategic collaboration keeps still being one of the top priority of many business organizations in order to create more additional value; benefiting mainly from supplier's specialization, capacity and innovative power, securing supply and better managing costs and quality. However, many organizations encounter difficulties in initiating, developing and managing those partnerships and many attempts result in failures. One of the reasons for such failure is the incompatibility of members of this partnership or in other words wrong supplier selection which emphasize the significance of the selection process since it is the beginning stage. An effective selection process of strategic suppliers is critical to the success of the partnership. Although there are several research studies to select the suppliers in literature, only a few of them is related to strategic supplier selection for long-term partnership. The purpose of this study is to propose a conceptual model for the selection of strategic partnership suppliers. A two-stage approach has been used in proposed model incorporating first segmentation and second selection. In the first stage; considering the fact that not all suppliers are strategically equal and instead of a long list of potential suppliers, Kraljic's purchasing portfolio matrix can be used for segmentation. This supplier segmentation is the process of categorizing suppliers based on a defined set of criteria in order to identify types of suppliers and determine potential suppliers for strategic partnership. In the second stage, from a pool of potential suppliers defined at first phase, a comprehensive evaluation and selection can be performed to finally define strategic suppliers considering various tangible and intangible criteria. Since a long-term relationship with strategic suppliers is anticipated, criteria should consider both current and future status of the supplier. Based on an extensive literature review; strategical, operational and organizational criteria have been determined and elaborated. The result of the selection can also be used to determine suppliers who are not ready for a partnership but to be developed for strategic partnership. Since the model is based on multiple criteria for both stages, it provides a framework for further utilization of Multi-Criteria Decision Making (MCDM) techniques. The model may also be applied to a wide range of industries and involve managerial features in business organizations.

Keywords—Kraljic's matrix, purchasing portfolio, strategic supplier selection, supplier collaboration, supplier partnership, supplier segmentation.

I. INTRODUCTION

COMPETITION, globalization, progressive technological innovations, and shortened product life cycles have

Safak Isik is with the Marmara University, Engineering Faculty, Industrial Engineering Department, Goztepe Kampus, Kadikoy, Istanbul 34722, Turkey (e-mail: safakisik@marun.edu.tr).

Ozalp Vayvay is with the Marmara University, Engineering Faculty, Industrial Engineering Department, Goztepe Kampus, Kadikoy, Istanbul 34722, Turkey (e-mail: ovayvay@marmara.edu.tr).

changed supplier relationships. Traditional relationships are no longer sufficient; closer, more collaborative, strategic approaches are needed for supplier relations management (SRM). These pressures drive organizations to actively invest in supply chain management (SCM), and to establish strategic alliances against their competitors. These organizations must find more efficient suppliers to increase supply chain competitiveness. Among various available suppliers, how to choose suitable suppliers who can develop long-term collaborative relationships is a critical issue in establishing a supply chain and increasing its value and efficiency [1].

The strategic selection of a supplier is a multi-dimensional decision that needs to consider the ability to create value between the buying organization and its supplier [2].

In contrast to conventional supplier selection, strategic supplier selection comprehensively considers various influencing factors, such as supplier quality, price and delivery as well as company strategies, cultures, technology, and human factors [3]. Therefore, selecting strategic partners requires the consideration of multiple, and often qualitative criteria [4]. However, strategic supplier selection topic has been not much analyzed compared to other supplier selection frameworks and criteria [5].

The conceptual frameworks directly targeting strategic supplier selection for partnership are missing in previous studies to our best knowledge, therefore this was main motivation factor of this study and it thus proposes a new model for direct selection of strategic supplier for partnership.

On the other hand, the model in this study uses a new approach of integrating the segmentation to the selection process considering that not all suppliers are strategically equal.

The paper is organized as follows: Section II gives literature reviews and explains theoretical basis of the study. The proposed model and the supporting concepts are presented in Section III. Section IV concludes the paper and suggests for future work.

II. LITERATURE REVIEW AND THEORETICAL BACKGROUND

A. Strategic Supplier Partnership

The term *partnership* in supplier relationship is mostly used synonymously with *collaboration* and *alliance* and is described as a close relationship between a buying organization and a supplier to attain some considerable advantages mutually [6]. A partnership is similarly defined as an on-going collaborative relationship between two legally separate organizations, based upon a commitment to the equal

sharing of the costs, risks and rewards derived from trust and working together [7].

Strategic partnership is associated with the products and services that are of strategic importance to the success and growth of companies. This type of partnership is the most strategic and integral part of SRM approach and requires approaches based on long-term, mutually beneficial relationships between a buying organization and its suppliers.

The major enablers for the strategic partnership with suppliers are significant business growth, supply chain agility and value chain optimization. On-going, joint cross-organizational teams and top management support, contact and visibility are the backbone of strategic partnerships [6].

Numerous benefits can be derived from an effective managed strategic supplier partnership, such that:

1. Become 'customer of choice': preferential treatment regarding availability, costs, access to technology, innovation and risk reduction
2. Focus on value: increased market competitiveness through consideration of all relevant elements that add value to the supply chain
3. Leverage on supplier capabilities: advantageous position through early involvement in the innovation and product & process development processes
4. Share growth, profits, risks and investments: joint objectives, efforts and resource commitments resulting in a healthy culture for sustainable growth [8].

B. Supplier Segmentation

Firms frequently make purchases of various products and services of mostly large quantities to execute their operational mission and satisfy needs of the organization. While these procurement activities involve significant time and financial resources of the firm, they also carry a fair degree of risk for the firm. Therefore, the purchasing strategies have a large influence on the overall performance of the buying organization. [9].

Supplier segmentation can be defined as the initial and key process of classifying suppliers according to some defined criteria which will be basis of the relevant and effective strategy development towards suppliers. This segmentation process is essential since not all suppliers require the same strategical approach [10].

Supplier segmentation is especially critical issue for companies working with a large number of suppliers and results in manageable number of segments or categories, each of which requiring a specific and separate strategy [11].

The most established segmentation or portfolio model in literature and practice is known as the Kraljic Portfolio Matrix (KPM). The practicality and flexibility of the KPM framework has been a significant contributing factor to its popularity. Moreover, many empirical studies have validated the usefulness and efficacy of KPM and purchasing portfolio analysis in practice [12].

Kraljic's approach leverages a portfolio matrix that classifies purchased products and services on the basis of two dimensions: the external dimension (*Supply Risk/Complexity*)

concerns the factors regarding suppliers and supply market, while the internal dimension (*Profit Impact/Importance of Purchase*) relates to the importance and value impact of a given product or service purchased [13].

The result is a 2 x 2 matrix (from "low" to "high") and a segmentation or classification into four categories: bottleneck, noncritical, leverage and strategic items; see Fig. 1. Each of the four segments or categories requires a different approach and separate supplier strategies based upon the mapping position of a product in the KPM. For "leverage items", buying companies are admitted exploiting its purchasing power thoroughly using for instance tendering, target pricing and product substitution. Although "routine items" are of relatively low value, they are ordered frequently, and high transaction costs occur. Therefore, category management with e-procurement solutions is an effective strategy to reduce transaction costs. "Bottleneck items" cause significant problems and risks, therefore strategies for instance volume insurance, supplier control, safety stock and backup plans are used to handle with bottleneck problems and risks. In certain cases, a search for alternative suppliers or products are introduced. "Strategic items" requires much more attention due to high-high feature and the most appropriate strategy for this segment is collaboration or partnership between buyer and seller [14].



Fig. 1 Kraljic Portfolio Matrix [15]

In this study, we focus mostly on strategic quadrant in which the items falling require a long-term partnership development with the suppliers; in other words, strategic alliance should be developed with those suppliers where it is convenient.

C. Supplier Selection

Supplier selection (SS) topics earned much and continuous attention in published research mostly the last two decades and across many scientific journals [16].

Many previous studies on supplier selection and evaluation defined numerous evaluation criteria and selection frameworks for supplier selection [1]. Supplier evaluation and selection are complicated decisions by the fact that various qualitative and quantitative criteria must be considered in a decision-making process. Since the 1960s, many researchers have been focused on the determination and analysis of criteria for selecting and measuring supplier performance [17].

Suppliers are considerably important to a buying organization because of their role and strong influence in

overall supply chain starting from its earlier phases. Therefore, supplier selection is a crucial issue in both managerial and operational viewpoints because an effective decision considerably benefits a company while wrong decisions may induce damages. Conventionally, supplier quality, price and delivery issues dominate the evaluation criteria. However, other influencing factors, such as company strategies, human factors, operational techniques, relationship and other managerial and technological issues should also be taken into account based on the characteristics of different industries. Thus, scientific decision making with established systematic criteria is considerably critical for supplier selection. Therefore, supplier selection under the paradigm of multi-criteria decision making (MCDM) has been widely accepted by academic and industrial communities, which also enable its application to the strategic supplier selection [3].

Reference [16] performed a recent systematic and comprehensive literature review of 221 academic peer-reviewed journal papers and analyzed the development of SS issues between the years 1990-2015. The results show that the SS literature grew extensively in the last two decades. The analyzed papers address a large spectrum of issues and various methodologies. The findings of this study clearly indicate that authors have focused so far on SS approaches, selection criteria, green/sustainable, strategy oriented, R&D oriented, and operations-oriented themes within SS. The results shown that research on generic selection approaches, both Single-SS and Multiple-SS, clearly dominates the current body of SS, including a wide range of techniques, but is maturing and could develop towards a toolbox that will be useful for upcoming streams. On the other hand, green and sustainable as well as strategy-oriented SS are found to be at an early stage of their research cycle but could have a strong potential for further academic interest in the next years through empirical, mathematical and theoretical research. [16].

D. Strategic Supplier Selection

After a literature review with a time horizon of 2007-2017; 14 key papers which mainly focused on strategic supplier selection has been found. Brief descriptions are as follows:

Reference [18] describes a supplier evaluation and management methodology for strategic sourcing, in which suppliers are evaluated according to supplier's co-design capabilities and categorized based on overall performances, potential reasons for differences in performance of supplier groups are identified, and performances of the suppliers are improved through application of supplier development programs. A multicriteria sorting method based on the Promethee methodology is also introduced.

Reference [19] combines both quantitative and qualitative data for supplier selection and utilizes Fuzzy Theory and new emergent paradigms, to obtain an overall assessment of conformity of suppliers.

A dynamic decision making approach for strategic vendor selection based on the principles of hierarchical planning is proposed in [20] focusing on interdependencies in time arising from investment costs of selecting a new vendor and

costs of switching from an existing vendor to a new one.

Reference [21] presents an integrated methodology for assessment of the compatibility of potential members of a strategic partnership. The methodology is based on a model using Fuzzy Logic/Goal Programming which enables to analyze uncertain and generally subjective information which are available during the earlier stages of a strategic partnership.

Reference [22] presents a framework for defining the supplier selection criteria by investigating possible quantitative and qualitative criteria reported by earlier studies according to the levels of buyer–supplier relationship, the company's competitive situation and its corporate strategies, rather than investigating these criteria in respect of product category.

In reference [23], a model is introduced to handle with the information processing difficulties related to screening extensive number of potential suppliers at the beginning stages of the selection process. The model uses radial basis function artificial neural network (RBF-ANN) approach based on multiple criteria using both quantitative and qualitative attributes.

Reference [24] considers strategic and operational factors with the consideration of supplier integration spectrum to secure the efficacy of vendor selection on the initial product stage. This study adopts supplier's manufacturing process capability indices and process yields as operational (hygiene) factors to estimate their quality capabilities while the business process-oriented criteria related with the performance of business process improvement are suggested as the strategic criteria for a supplier assessment visit. A fuzzy approach then aggregates the total scores of individual suppliers considering of the strategic factors' extra effect on the operational metrics and the supplier integration levels objectively.

A research in [25] examines whether the strategic selection of suppliers based on supplier new product development capability, supplier quality capability and supplier cost capability directly and/or indirectly enhances the buyer's competitive performance capabilities in the matched domains of buyer product innovation, buyer quality and buyer competitive pricing, respectively.

In the study of [26], a fuzzy logic system was constructed to solve multi period dynamic decision making for selection of strategic suppliers with stochastic demand. The results of the proposed model demonstrated that dynamic strategic supplier selection system based on fuzzy logic can support the buying organizations to select strategic supplier properly and practically, since fuzzy logic-based systems are appropriate especially when working with uncertain parameters.

In reference [3] strategic supplier selection issue is examined through uncertain decision environments. A soft decision model is proposed involving both multiple stakeholders and multiple perspectives. Based on interval and hesitant fuzzy methodology, the results of this model show significant capabilities in handling ambiguous judgments of stakeholders and conflicting opinions.

The research in [5] proposes different factors for instance

organizational practices, risk management, environmental and social practices factors for supplier evaluation and demonstrates a systematic method for identifying those factors with the involvement of relevant stakeholders and process mapping. A combined analytical model integrating quality function deployment and the analytic hierarchy process method is used for ranking of suppliers' performance.

Reference [27] describes the application of a decision-making approach for selecting a strategic partner. The approach starts with defining a set of criteria that corresponds the buying organization's needs. Subsequently, a model combining fuzzy-ANP and TOPSIS method is used to determine the weight for each criterion and rank all the alternatives.

Reference [28] identifies critical factors concerning key suppliers selection derived from resource-based view and constructs a hierarchical evaluation framework which has elements of implied change or transformation of the firm's resources for operation strategies when evaluating key suppliers relationships. Moreover, a Fuzzy Preference Relations (FPR) model is introduced, with a hierarchical evaluation framework, to address the imprecise and conflicting information used by managers to evaluate.

In [29], a hybrid model integrating Analytic Network Process (ANP) and Goal Programming (GP) is proposed to align strategic supplier portfolio selection with sustainability targets of buying organization.

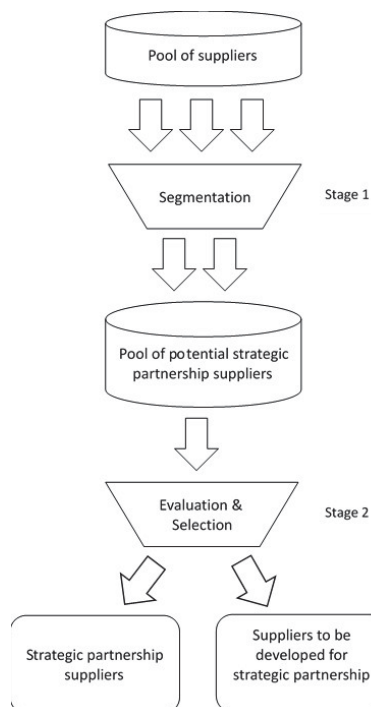


Fig. 2 The proposed model for selection of strategic partnership suppliers

III. CONCEPTUAL DEVELOPMENT AND PROPOSED MODEL

This study proposes a conceptual model for the selection of

strategic partnership suppliers with a two-stage approach incorporating first segmentation of suppliers and second selection of strategic suppliers as shown in Fig. 2.

Stage 1. Segmentation: This phase primarily searches for suitable potential suppliers for strategic partnership. Not all suppliers are at the same strategical level. Therefore, the proposed model uses the idea from KPM for segmentation to distinguish potential strategical suppliers.

First, the products and services (or their relevant categories to which they are linked) are positioned within the different quadrants of the matrix (Fig. 1) considering various quantitative and qualitative criteria of two dimensions of supply risk and profit impact (as shown in Table I).

Dimension	Criteria
Profit Impact (Importance of Purchase)	1. Volume/monetary value of purchases
	2. Percentage of total purchase cost
	3. Switching costs
	4. Impact on product quality
	5. Impact on business growth
	6. Impact on competitiveness
Supply Risk (Complexity of Supply Market)	1. Product/service availability/scarcity,
	2. Number of suppliers
	3. Entry barriers for new suppliers
	4. Competitive demand
	5. Make-or-buy opportunities
	6. Storage risks
	7. Substitution possibilities

*Adapted from [12], [15].

The KPM is essentially a multi-criteria decision model. Therefore, multi-criteria decision-making (MCDM) methods can be used for mapping items into KPM.

Consequently, the resulting matrix is formed by four quadrants (Fig. 1). Suppliers of "strategic" items should be defined as candidates for strategic partnership as shown in Fig. 3. Some suppliers of "leverage" and "bottleneck" items can also be taken into consideration based on organization's specific business needs and strategies.

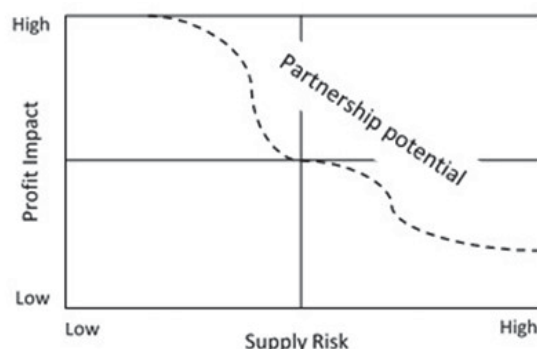


Fig. 3 Potential suppliers for strategic partnership after segmentation

Stage 2. Evaluation and Selection: From the pool of potential suppliers defined at first stage, a comprehensive evaluation and selection is performed to finally define strategic suppliers considering various strategical, operational

and organizational criteria as shown in Table II.

As in the first stage, MCDM techniques can also be used for evaluation since it involves a large number of attributes.

Establishment of criteria should consider both current and future status of the supplier since a long-term relationship is anticipated for strategic partnership. Therefore, for operational criteria such as cost, quality, delivery and service, improvement or development capability has been considered as attribute of those criteria.

With economic globalization, companies can choose suppliers from anywhere in the world, accordingly, international trade capability such as country risks, foreign exchange, tariff barriers etc. should be considered where applicable.

On the other hand, new environmental and sustainability challenges drive to include environmental and social criteria for partnership.

Suppliers who are not qualified for a partnership due to some inadequacies but to be developed for strategic partnership can also be determined with the same methodology considering criteria for which suppliers are insufficient.

For other non-selected suppliers, appropriate strategies other than strategic partnership should be considered to move them from “strategic” segment to “leverage” segment, thus minimizing supply risk.

IV. CONCLUSION AND FUTURE WORK

Within the current competitive business world, supplier partnership has ever been considered as an important objective for the organizations.

To achieve a competitive advantage and integration of suppliers to the value chain optimization, collaboration or partnership with the right suppliers is getting increasingly crucial. Therefore, powerful, effective and practical methodologies are required for companies to select right strategic suppliers for partnership.

This study presented a new conceptual model to select the strategic suppliers for partnership with the combination of two stages: segmentation and selection respectively.

Another benefit of the model is to identify the suppliers to be developed for partnership while specifying their missing capability during evaluation. The model may be applied to a wide range of industries and involve managerial features in business organizations to support their strategic decisions.

Since both stages involves several quantitative and qualitative criteria, various multi-criteria decision-making (MCDM) methods can be used in future works to develop the model. Multiple case studies could also be pursued in order to evaluate the acceptability and usability of the model by practitioners. Finally, for both evaluation stages, new criterion can be added to the criteria proposed while extraction of proposed ones is also possible according to the examined case.

TABLE II
SELECTION CRITERIA

Criteria	Sub-Criteria
1. Cost Improvement Capability	<ol style="list-style-type: none"> 1. Product price/cost 2. Logistics costs (Transportation, Inventory, Administration, Customs, Risk and damage, Handling and Packing) 3. Operating costs 4. Cost reduction capability/performance 5. After-sales service costs 6. Payment term
2. Quality Development Capability	<ol style="list-style-type: none"> 1. Product performance 2. Product durability 3. Process reliability 4. Continuous improvement
3. Delivery Improvement Capability	<ol style="list-style-type: none"> 1. Lead time 2. On-time delivery 3. Delivery frequency 4. Order fill rate 5. Packaging capability 6. Geographic location
4. Service Improvement Capability	<ol style="list-style-type: none"> 1. Reaction to demand 2. Technical support 3. After sales services 4. Warranties and claim policies
5. Strategic Alignment	<ol style="list-style-type: none"> 1. Strategic sourcing fit with mutual internal strategies 2. Strategic contribution 3. Expectation of continuity 4. Investment plans and future visions 5. Balance of power 6. Dependability level 7. Risk perception 8. Competitive advantage over competitors 9. Termination cost
6. Human Resources Capability	<ol style="list-style-type: none"> 1. Human resource quality 2. Organizational learning 3. Team structure 4. Compatibility across levels and functions of buyer and supplier firms

Criteria	Sub-Criteria
	1. Production facilities and capacity
	2. Application of modern manufacturing techniques (lean, agile, JIT etc.)
7.Manufacturing Capability	3. Product line diversity and supply variety
	4. Value added productivity
	5. Inventory position
	6. Flexibility of operations
8.Technological Capability	1. R&D and Innovation capability
	2. Product and Process Improvement
	3. IT standards
	4. Information flow and e-commerce system (EDI etc.)
	1. Quality systems (certificates etc.)
	2. Information sharing level
	3. Industrial relations
9.Management Capability	4. Flexibility (payment, freight, price reduction)
	5. Availability and manageability of 2nd tier suppliers
	1. Communication openness/barriers
	2. Supplier's reputation/image
	3. Mutual Trust
10. Cultural Capability	4. Intellectual property rights
	5. Cultural fitment
	6. History of past business
11.Financial Capability	1. Financial condition and stability
	2. Asset management
12.Environmental Management Capability	1. Environmental policies and compliance to environmental regulations
	2. Waste and pollution prevention
	3. Energy usage parameters
	4. Green operations
	5. Green packing (recycling, reuse etc.)
	1. Occupational health & safety systems
13.Social Responsibility	2. Labor relations and employees' related factors
	3. Contribution to society
	1. Country risks
	2. Geographical distance
	3. Foreign exchange rates
	4. Trade restrictions
	5. Trade tariffs
14.Global Trade Capability (for global suppliers)	6. Exporting performance

*Adapted from [1], [22],[30]-[33]

REFERENCES

- [1] Y. J. Chen, "Structured methodology for supplier selection and evaluation in a supply chain," *Inf. Sci. (Ny)*, vol. 181, no. 9, pp. 1651–1670, 2011.
- [2] A. Trautrim, B. L. MacCarthy, and C. Okade, "Building an innovation-based supplier portfolio: The use of patent analysis in strategic supplier selection in the automotive sector," *Int. J. Prod. Econ.*, no. March, pp. 1–9, 2017.
- [3] J. Chai and E. W. T. Ngai, "Multi-perspective strategic supplier selection in uncertain environments," *Int. J. Prod. Econ.*, vol. 166, pp. 215–225, 2015.
- [4] J. S. Randhawa and I. S. Ahuja, "Examining the role of 5S practices as a facilitator of business excellence in manufacturing organizations," *Meas. Bus. Excell.*, vol. 21, no. 2, pp. 191–206, 2017.
- [5] P. K. Dey, A. Bhattacharya, and W. Ho, "Strategic supplier performance evaluation: A case-based action research of a UK manufacturing organisation," *Int. J. Prod. Econ.*, vol. 166, 2015.
- [6] J. R. Carter and T. Y. Choi, *Foundation of Supply Management*. Institute for Supply Management Professional Series, 2008.
- [7] D. Chicksand, "Industrial Marketing Management Partnerships: The role that power plays in shaping collaborative buyer – supplier exchanges," *Ind. Mark. Manag.*, vol. 48, pp. 121–139, 2015.
- [8] "Supplier Relationship Management - How key suppliers drive your company's competitive advantage," PwC, 2013. [Online]. Available: <https://www.pwc.nl/assets/documents/pwc-supplier-relationship-management.pdf>.
- [9] S. S. Padhi, S. M. Wagner, and V. Aggarwal, "Positioning of commodities using the Kraljic Portfolio Matrix," *J. Purch. Supply Manag.*, vol. 18, no. 1, pp. 1–8, 2012.
- [10] "Supplier Relationship Management (SRM) - Identifying and maximising the value of strategic supplier partnering," *Deloitte AG*, 2015.
- [11] J. Rezaei and R. Ortt, "Supplier segmentation using fuzzy logic," *Ind. Mark. Manag.*, vol. 42, no. 4, pp. 507–517, 2013.
- [12] R. T. Montgomery, J. A. Ogden, and B. C. Boehmke, "A quantified Kraljic Portfolio Matrix: Using decision analysis for strategic purchasing," *J. Purch. Supply Manag.*, 2017.
- [13] A. Dubois and A. C. Pedersen, "Why relationships do not fit into purchasing portfolio models: a comparison between the portfolio and industrial network approaches," *Eur. J. Purch. Supply Manag.*, vol. 8, no. 1, pp. 35–42, 2002.
- [14] C. J. Gelderman, "Purchasing Portfolio Models: A Critique and Update," *J. Supply Chain Manag.*, no. August, pp. 19–28, 2005.
- [15] P. Kraljic, "Purchasing must become supply management," *Harv. Bus. Rev.*, vol. Sept-Oct, pp. 109–117, 1988.
- [16] A. Wetzstein, E. Hartmann, W. C. Benton, and N. Hohenstein, "A systematic assessment of supplier selection literature – State-of-the-art and future scope," *Intern. J. Prod. Econ.*, vol. 182, pp. 304–323, 2016.
- [17] D. Simić, I. Kovačević, V. Svirčević, and S. Simić, "50 years of fuzzy set theory and models for supplier assessment and selection: A literature review," *J. Appl. Log.*, vol. 24, pp. 85–96, 2016.
- [18] C. Araz and I. Ozkarahan, "Supplier evaluation and management system for strategic sourcing based on a new multicriteria sorting procedure," *Int. J. Prod. Econ.*, vol. 106, no. 2, pp. 585–606, 2007.
- [19] R. Florez-Lopez, "Strategic supplier selection in the added-value perspective: A CI approach," *Inf. Sci. (Ny)*, vol. 177, no. 5, pp. 1169–1179, 2007.
- [20] E. Sucky, "A model for dynamic strategic vendor selection," *Comput. Oper. Res.*, vol. 34, no. 12, 2007.
- [21] O. Famuyiwa, L. Monplaisir, and B. Nepal, "An integrated fuzzy-goal-programming-based framework for selecting suppliers in strategic

- alliance formation," *Int. J. Prod. Econ.*, vol. 113, no. 2, 2008.
- [22] S. Sen, H. Basligil, C. G. Sen, and H. Barali, "A framework for defining both qualitative and quantitative supplier selection criteria considering the buyer-supplier integration strategies," *Int. J. Prod. Res.*, vol. 46, no. 7, pp. 1825–1845, 2008.
- [23] X. Luo, C. Wu, D. Rosenberg, and D. Barnes, "Supplier selection in agile supply chains: An information-processing model and an illustration," *J. Purch. Supply Manag.*, vol. 15, no. 4, pp. 249–262, 2009.
- [24] C.-Y. Shen and K.-T. Yu, "An integrated fuzzy strategic supplier selection approach for considering the supplier integration spectrum," *Int. J. Prod. Res.*, vol. 50, no. 3, 2012.
- [25] X. Koufteros, S. K. Vickery, and C. Dröge, "The Effects of Strategic Supplier Selection on Buyer Competitive Performance in Matched Domains: Does Supplier Integration Mediate the Relationships?," *J. Supply Chain Manag.*, vol. 48, no. 2, 2012.
- [26] A. Aksoy, E. Sucky, and N. Öztürk, "Dynamic Strategic Supplier Selection System With Fuzzy Logic," *Procedia - Soc. Behav. Sci.*, vol. 109, pp. 1059–1063, 2014.
- [27] R. Govindaraju, M. I. Akbar, and L. Gondodiwiryo, "The Application of a Decision-making Approach based on Fuzzy ANP and TOPSIS for Selecting a Strategic Supplier," *J. Eng. Technol. Sci.*, vol. 47, no. 4, pp. 406–425, 2015.
- [28] J.-W. Tang and T.-H. Hsu, "A fuzzy preference relations model for evaluating key supplier relationships in TFT-LCD TV panel manufacturing industry," *Manag. Decis.*, vol. 53, no. 8, pp. 1858–1882, 2015.
- [29] C. Neumüller, R. Lasch, and F. Kellner, "Integrating sustainability into strategic supplier portfolio selection," *Manag. Decis.*, vol. 54, no. 1, 2016.
- [30] M. Punniyamoorthy, P. Mathiyalagan, and P. Parthiban, "A strategic model using structural equation modeling and fuzzy logic in supplier selection," *Expert Syst. Appl.*, vol. 38, no. 1, 2011.
- [31] S. H. Huang and H. Keskar, "Comprehensive and configurable metrics for supplier selection," *Int. J. Prod. Econ.*, vol. 105, no. 2, 2007.
- [32] L. Osiro, F. R. Lima-Junior, and L. C. R. Carpinetti, "A fuzzy logic approach to supplier evaluation for development," *Int. J. Prod. Econ.*, vol. 153, pp. 95–112, 2014.
- [33] F. R. Lima-Junior and L. C. R. Carpinetti, "Combining SCOR® model and fuzzy TOPSIS for supplier evaluation and management," *Int. J. Prod. Econ.*, vol. 174, pp. 128–141, 2016.