

Supplier Selection: Insight from Automotive Industry of Pakistan

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Abstract

Using fuzzy Analytical Hierarchy Process (AHP) model, this study exposed criteria and sub criteria which are commonly being practiced and declared significantly important in supplier selection process. Through structured questionnaire, data were collected from twenty seven Pakistani Automotive firms including both nationals and multinationals. Procurement and supply chain managers have participated in prioritization of ten major criteria and forty four sub-criteria as per their significance in supplier selection process. Based on variation in the priority weights (both local and global), this study has classified selection criteria into three group i.e. critical (most significant), supportive (moderately significant) and maintaining (least significant). Quality, cost, delivery of goods and communication were ranked as the most influential criteria and hence classified as critical. While, technology, integration, relationship, and services were being declared as supportive criteria. Finally, capability, flexibility and safety have been affirmed as maintaining criteria. The outcome of this study provides meaningful guidelines to business managers for the selection of their supply chain partners.

Keywords: Supplier Selection, Automotive Industry of Pakistan, Selection Criteria

I. Introduction

Rise in economic globalization, evolving consumer priorities, demand for highly customized products with shortened product life cycles and up gradation of network technologies have compelled industries to manage of their supply chains. In accordance, firms have established their core competencies, while preferring to outsource non-core activities to outside suppliers with professional expertise. The fundamental aim is to uplift competitive advantage and market position, by utilizing distinctive and useful

source of knowledge, capabilities and technologies of their supply chain partners. Hence, supplier selection process holds a special position in almost all organizations.

Numerous studies have focused on supplier selection and its significance to generate competitiveness. Different authors, for example, Verma & Pullman (1998), Ghodsypour & O'Brien (1998), Handfield et al (2002), and Bhutta & Huq (2002) have highlighted the significance of right suppliers and commented on supplier selection criteria and their impact on firm's overall performance. The outcome of these studies suggests the firms to rethink and redesign their suppliers' selection strategies. Moreover, it is suggested that in this highly competitive era, cost minimization, quick response, high customization and matchless customer services can only be possible through appropriate supply chain partner(s). Therefore, choosing the appropriate supplier(s) is considered the most crucial decision in the life of any organization.

Over the years, researchers have proposed many supplier selection criterions including both qualitative and quantitative, discussing the impact and significance of each criterion on supplier selection as well as on firm's overall performance. Nevertheless, these studies are mostly contextual and were conducted within specific socio-economic environment and hence the outcomes cannot be generalized. It is generally believed that each firm or industry observes different socio-economic environment and hence the significance of each criteria in terms of its weight and priority may vary from firm to firm and in each industry. The firms working in under developing countries like Pakistan encounter different socio-economic environment, wherein, competition and the rule of business is far different as compared to developed economies. For example, majority of the suppliers are SME's and they face financial and resources limitations. They either worked as subsidiaries of MNC's or their operations are restricted to assembling and marketing of the products only. It is therefore argued that significance and preference of supplier selection criteria's in tight economies with controlled competition may have different priorities as compared to the firms working in open markets.

Considering the above stated situation as research gap, a study aiming to identify criteria and sub-criteria, which are notably important for supplier selection in Pakistan can produce worth mentioning results both for academicians as well as practitioners. Accordingly, this study was initiated with two main objectives, first, to probe criteria and sub-criteria, which are substantial for supplier selection especially in Automotive Industry of Pakistan and secondly, using Analytical Process Model (AHP), prioritize each criteria and sub-criteria as per its significance in selection process.

II. Literature Review

Purchasing is no more a clever exercise rather it is considered as a strategic job due to supplier's major effect on the competitive positioning and success or failure of the company (Goffin et al., 1997; McIvor et al., 1997; Bhutta & Huq, 2002). Amazingly, raw material, parts, and services procure from supplier reflect approximately 50 to 70 percent cost of finished goods (Ghodsypour & O'Brien, 1998; Ballou, 1999). This has compelled procurement managers to consider wide range of available options before selecting and establishing long lasting relations with any supply chain partner. According to Handfield (1994), organization must ensure that the performance of their supplier in terms of capabilities and responsiveness and to whom they have selected as their partner, must be

equal to or surpass the suppliers of their competing organizations. Otherwise, they cannot secure a reasonably distinctive position in the market.

Over the years, a reasonable increase is witnessed in management of supply chains and supplier relationship management. Supplier relationship management (SRM) has evolved as vital aspect of supply chain management and it directly affects supply chain as well as organizational performance (see for example, Humphreys et al., 2004; Szejczewski et al., 2005; Terpend et al., 2008; So & Sun, 2010). Consequently, selection of the appropriate supplier has emerged as one of the most critical, multifaceted and multi-working activity and at present there is an emerging consensus that supplier-supplier and buyer-supplier relation can't really be ignored (Lazzarini et al., 2001; Wilhelm, 2011).

Choosing the appropriate supplier(s) to minimize buying risk, increase overall performance, and making sound connections between buyers and suppliers, are the major objectives of the supplier selection process. The process can be easy and manageable, if the firm has to incorporate one criterion for a certain decision. However, in practical market, firms have to consider series of criteria to determine a supplier as their partner. It is obvious that multiple criteria help the decision-makers in analyzing a set of choices before they apt the final option. With an array of criteria applied, it becomes important to weigh separately the magnitude of each criterion in decision making process (Yahya & Kingsman, 1999).

The objective of supplier selection is to choose the most appropriate supplier, the one which is capable of giving the best all-around incentives of services and products to their buyers. Tahriri et al. (2008) stated that the purpose of supplier selection is to look for those suppliers who have greatest potential and capability of fulfilling, all the requirements of a firm regularly and at suitable cost. Over the years, companies have learned through experiences that supplier selection should not be restricted to selection of the supplier rather it should focus on locating the most suitable companion for long lasting and healthy connection. By making suppliers to upgrade their manufacturing abilities, the purchasing organization can increase its own efficiency by reducing waste reasonably (Pagell & Sheu, 2001; Gimenez et al., 2012).

Amazingly, over the years, price and per unit cost remained the only preferred criteria for the selection of 'most appropriate supplier'. This improvised supplier selection criteria help the firm to attain cost efficiency in the related activities (Ittner et al. 1999). Sometimes, the cheapest supplier is selected without assessing all the extra costs which company could bear at the end of the day. Unfortunately, while, concentrating on 'cost', companies ignore quality issues, cost of unreliable deliveries and loss due to delays and poor communication (Zeger & Roodhooft, 1999). Such practices are still common and there are 'number' of firms those prefer 'cost' or 'per unit cost' while selecting their supply chain partners.

With the passages of time, certain factors including rigorous competition, emerging pressures for sustainable products, open access to global markets, and demand for highly customized products have compelled organizations to consider multi-criteria to determine their supplier(s). According to the Weber et al. (2000), organizations must consider multi-criteria; cost, services, quality, delivery, and reliability, before settling

with a supply chain partner(s). Furthermore, it has been suggested that organizations must tradeoff between various possible options, as organizational requirements, demands, and market conditions. Similarly, it has also been observed that purchasing squads apply different criteria time to time, in their purchasing decisions (Goffin et al. 1997).

Research has suggested both tangible and intangible criteria, e.g. price, quality, cost, delivery performance, services, etc. (Ellram, 1990; Nydick & Hill, 1992; Pearson & Ellram, 1995; Ghodsypour & O'Brein, 1998) for supplier selection. In this regard, the most seminal work has been done by Dickson, 1966. His study was based on survey, where, 273 purchasing managers and different agents, from the list of National Association of Purchasing in US and Canada were asked to prioritize different supplier selection criteria's. Expectedly, quality was ranked as the most crucial criteria followed by delivery performance, previous history of supplier and supplier services including both warranties and claims. Major factors included in the study were, net price, quality, repair services, delivery schedules, geographical location, financial position, production & technical capacity, management competencies, quality control mechanism, position in the industry, suppliers overall attitude, willingness to do work, warranties offered, training, etc. He further pointed out that American and Canadian organizations also give due weight to factors like, reputation, communication system, management and organization and labor relations.

As compared to traditional criteria i.e. quality, price/cost, delivery time, number of other criteria have also been discussed. For example, Ellram (1990) studied, top management capability, strategic fit, operational compatibility, personal capability, management attitude/outlook for the future, trust, assessment of current manufacturing facilities/capabilities, supplier organizational structure & personnel, assessment of future manufacturing capabilities, supplier's customer base, design capabilities, speed in development, financial stability, supplier's safety record, economic performance/financial outlook, and business references. While, according to the Min (1994), the connection of a lot of closely interlinked decisions related to quality, distribution, procurement, negotiation, and cost shows the long-lasting and significant effect of supplier selection on sourcing. Additionally, some studies examine the role of gender, culture and area differences as other valuable aspects of supplier selection (Shahadat, 2003).

Kannan & Tan (2003) pointed out the significance of subjective criteria. In their study they explored that both the American and European managers conceive and regard more to the objective selection and assessment criteria as compared to subjective criteria. They further added that subjective criteria have great effect on the firm execution in other parts of the world. While, Petroni & Braglia (2000) commented that by considering the whole supplier capability, keeping in view their decision making capabilities, long-term and strategic way of thinking, and not just price is useful for supplier selection.

Verma and Pullman (1998) studied how different managers' tradeoff among different factors and selection tactics when evaluating and selecting a supplier(s). Interestingly, they observed quality as the most significant criteria, followed by cost and on time delivery. They concluded that managers mostly tradeoff quality on all other criteria's. George Spafford (2006) presented fourteen points guideline for the supplier selection which include formalize the process, identify the stakeholders, look for experience, beware of the low bid, think total costs, presale customer service, upgrades,

strategic vision, quality management, implementation, training, documentation, references, and risks. While, Pal & Kumar, (2010) presented trait based approach for supplier selection and evaluation.

Time to time, quantitative and qualitative models were established aiming to categorize and classify different selection criteria. In this regard, Weber et al. (1991) have grouped quantitative supplier selection approaches into three major categories which are; linear weighting models, mathematical programming models, and statistical or probabilistic approaches. In linear weighting models, a weight (subjectively determined) is being allocated to each criterion. The aim is to find a total score for each supplier by summing up his performance for each criterion multiplied by allocated weights. While, mathematical programming models include linear programming, mixed integer programming and goal programming. Finally, statistical approaches include different methods such as cluster analysis and stochastic economic order quantity (EOQ) model. These models have been frequently used by number of authors to classify various supplier selection criteria's.

The above discussion on the existing supply chain literature provide in depth insight on suppliers selection criteria, their appropriateness, and their affect on organizational as well as supply chain performance. However, little work has been done regarding prioritization of selection criterion especially in context of Pakistan. Hence, this research is dedicated to explore criteria and sub-criteria which are notably important for supplier selection in Pakistan.

III. Methodology

Keeping in view the scarcity of research in Pakistan, this research was carried out in Automotive Industry of Pakistan with real aspiration of probing criteria and sub-criteria which practically gain due consideration by procurement manager(s) in the selection of their supply chain partners. Using fuzzy Analytical Hierarchy Process (AHP) model, efforts have been made to prioritize selection criteria and sub-criteria which are notably significant in gaining competitive advantages in market place. The outcomes of AHP model help us to prioritize selection criteria as per opinion of the practitioners. The results also explain systematic similarities and difference in supplier selection criteria's by comparing the outcome of this study with the outcomes of existing studies.

AHP is the most prominent, mathematical and psychological model, developed by Thomas L. Saaty in 1970s. This model has been extensively studied and refined since then. The AHP provides a comprehensive and rational framework for structuring a decision problem, representing and quantifying its elements, relating those elements to overall goals, and evaluating alternative solutions. The AHP is a modern multi-criteria decision making method that provides a framework to cope with multiple criteria (Satty, 2000). Initially, it structures the problem in the form of a hierarchy to capture the criteria, sub-criteria, and alternatives. All the criteria are compared fairly to determine their relative weights. Then, the alternatives are compared fairly with regard to each criterion. The final outcome of the procedure is a score for each alternative.

For data collection, the sampling frame of this research was obtained from two official representative bodies i.e. Pakistan Automotive Manufacturing Association (PAMA) and Association of Pakistan Motorcycle Assembler (APMA). Twenty seven

firms agreed to participate in this study. Accordingly, their procurement managers were requested to participate in data collection process. The same data collection procedure was observed as suggested by Saaty (2000). Table – 1 present snapshot of the firms participated in this study.

Table 1: Percentage Wise Data of Participated Firms

Sr. No.	Automakers	Type of Firms			Total
		National	Multinational	%	
1.	Auto Bikes	12	03	55.55	15
2.	Car	Nil	05	18.51	05
3.	Bus & Truck	Nil	02	7.40	02
4.	Tractors	Nil	02	7.40	02
5.	Auto Rickshaws	02	01	11.11	03
Total		14 (51.85%)	13 (48.14%)	100	27

Structured questionnaire is used for data collection as suggested by Saaty (2000). The content of the questionnaire is based on the criteria repeatedly cited as the most significant selection criteria in supply chain literature. Questionnaire contains 10 main selection criteria, i.e. quality, delivery time, cost, technology, communication, services, integration & relation, capability, flexibility and safety and 44 sub-criteria's. Figure – 1, present detailed snapshot of ten main criterions as well as forty four sub-criterions potentially used in supplier selection process. To increase the clarity, face validity, readability of the questionnaire and to ensure that respondents can make clear comparison between different criteria and sub-criteria, two supply chain professors with relevant expertise were requested to critically examine the questionnaire. Each criteria and sub-criteria was compared against other criterion on -9 to 9 point scale as suggested by Wind and Saaty (1980). Table – 2 demonstrate measuring mechanism used in this study.

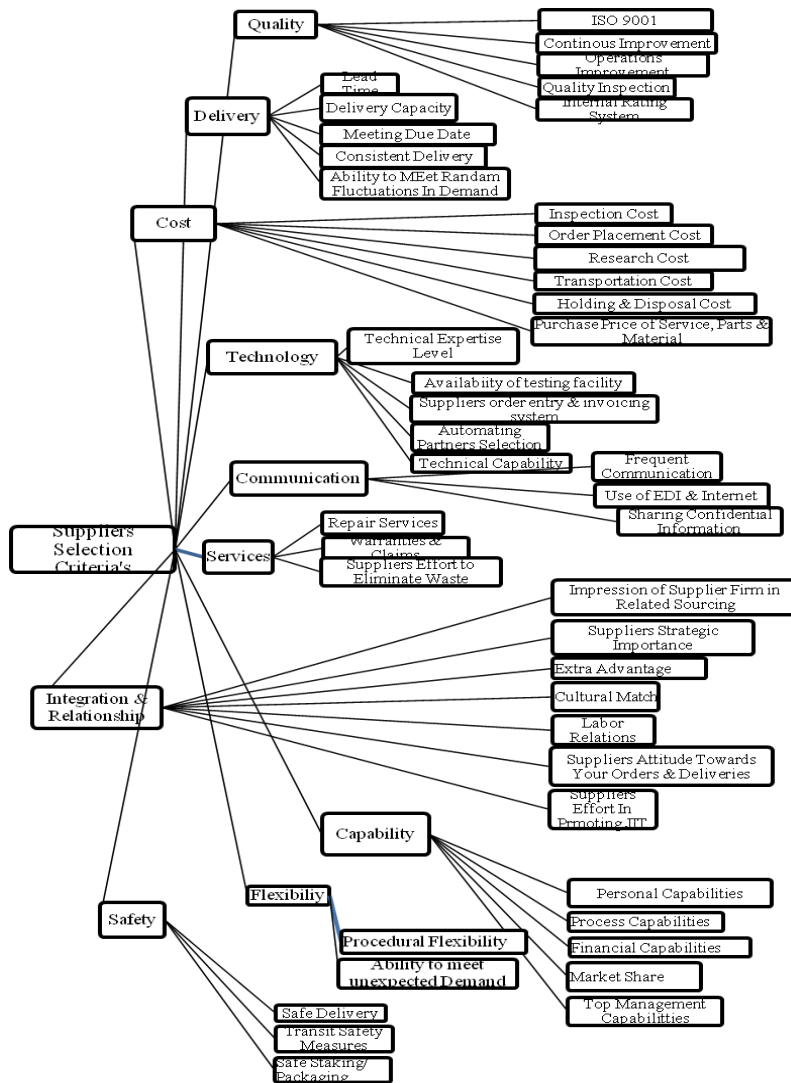
Table 2: Scale of Preference Between Two Elements

Preference weights / level of importance	Definition	Explanation
0	Equally preferred	Two activities contribute equally.
1	Preferred	Experience and judgment favors one a bit over another.
5	Strongly preferred	Experience and judgment strongly or essentially favor one activity over another.
9	Extremely preferred	The evidence favoring one activity over another is of the highest degree possible.
Reciprocals of above weights	Values in the right side of the scale / Opposite criteria's	Showing the importance of the right side activity over the left side activity.

Source: Wind and Saaty (1980). "Marketing application of analytical hierarchy process", Management Sciences, 26, pp.641-658.

The pair-wise comparison of the all main criteria and sub-criteria of supplier selection generate a matrix of relative rankings for each level of the hierarchy. The number of matrices depends on the number of elements at each level. The number of elements at each level decides the order of every matrix of the next higher level. After all matrices are developed, eigenvectors or the relative weights (the degree of relative importance amongst the elements) and the maximum Eigen value (λ max) for each matrix are calculated. The λ max value is an important validating parameter in AHP. It is used for calculating the consistency ratio CR of the estimated vector in order to validate whether the pair-wise comparison matrix provides a completely consistent evaluation (Saaty, 2000). It is generally recommended that CR value should less than 0.1.

Figure 1: Hierarchal Structure



IV. Findings & Discussion

Keeping in view the main objective of this study, Analytical Process Hierarchy (AHP) has been applied to prioritize selection criteria. Pair-wise comparison is made between main and sub-criteria, followed by computation of vector of priorities or weighting of elements in matrix. The results of principles vector reflect following approximate priority weights against mentioned criteria. These include quality (0.1975), cost (0.1498), delivery (0.1482), communication (0.1037), services (0.0999), technology (0.0744), integration & relationship (0.0712), capability (0.0599), flexibility (0.0508) and safety (0.0440). Table – 3 demonstrate pair wise comparison matrix of main supplier selection criteria.

Table 3: Pair-Wise Comparison Matrix of the Main Supplier Selection Criteria In Automotive Industry of Pakistan

Criteria	QU U	DL	CT	TE	CO	SR	I & R	CP	FX	SF	Weights
QU	1.00	2.86	0.71	2.35	2.53	1.59	3.59	3.12	3.47	4.53	0.1975
DL	0.35	1.00	0.65	1.65	1.94	1.71	2.82	2.88	3.47	4.88	0.1482
CT	1.41	1.54	1.00	1.58	1.47	1.06	2.12	1.94	2.59	3.82	0.1498
TE	0.43	0.61	0.63	1.00	0.24	0.59	1.06	1.29	1.76	2.59	0.0744
CO	0.40	0.52	0.68	4.17	1.00	1.41	1.00	0.88	1.59	2.00	0.1037
SR	0.63	0.58	0.94	1.69	0.71	1.00	1.24	1.71	2.00	2.35	0.0999
I & R	0.28	0.35	0.47	0.94	1.00	0.81	1.00	2.44	0.76	1.41	0.0712
CP	0.32	0.35	0.52	0.78	1.14	0.58	0.41	1.00	1.18	1.35	0.0599
FX	0.29	0.29	0.39	0.57	0.63	0.50	1.32	0.85	1.00	0.59	0.0508
SF	0.22	0.20	0.26	0.39	0.50	0.43	0.71	0.74	1.69	1.00	0.0440
Eigen Vector(λ max) = 10.6			CI = 0.0709			RI = 1.4900			CR = 0.0476		

Above results reflect that quality, as expected, is among the most prioritized and leading criteria observed by auto makers in the selection of their suppliers. The outcome reveal that suppliers must concentrate on quality aspects, which include, ISO certifications (like, ISO-9000 series), continuous improvement, operations improvements, quality inspections, and internal rating & motioning systems. The vendors who are consistent on the above stated quality measures remained in the preferred list of Auto-makers in Pakistan. Interestingly, cost, delivery of goods and communication are the next major influential criteria which also gain due consideration by Pakistani auto-markers. The outcomes of this study is in line with many international studies (for example, Ellram, 1990; Nydick & Hill, 1992; Pearson & Ellram, 1995; Ghodsypour & O'Brein, 1998; Verma and Pullman, 1998), where in, it is suggested that quality, cost, and delivery are the most significant criteria for the selection of appropriate suppliers. Henceforth, (based on priority weights), quality, cost, delivery and communication can be recommended to policy makers for the supplier selection.

Amazingly, cost which should be at the top of list especially in tight economies like Pakistan has been prioritized as second preferable criteria followed by quality and its related concerns. The is because of the fact that majority of auto-makers in Pakistan are either the joint ventures of Japanese and Korean manufacturers or working as subsidiaries of big multinational giants. Unfortunately, while concentrating on quality, many

companies ignore cost issues, cost of unreliable deliveries and loss due to delays and poor communication. However, results of this study disclosed that Pakistani auto-manufacturers not only give importance to quality and its related issues, rather they give due consideration to cost, delivery of goods and communication in the selection of their supply chain partners.

Additionally, the study suggests certain supporting criteria, which include technology, integration & relationship and services. Supporting criteria are the criteria that play supportive role and persuade decision making process. The same has been suggested by Pal and Kumar, (2008), that managers normally rely on supportive criteria (trait based criteria) for the selection of most appropriate supply chain partner(s). In today's highly competitive environment, companies intend to select suppliers having state of the art technology which give them competitive advantage. Moreover, suppliers having capability to establish long lasting relations by integrating their strategic and operational activities, functions and processes are always at heart of their parent companies. While, a rise in products and related services being acquired from external suppliers has also increased the dependence of buying firms on the abilities and performance of their supplier base. Hence, technology, services, integration & relationship have been declared as the supportive criteria in suppliers' selection process.

Finally, criteria including capability, flexibility and safety have been ranked with minimum priorities weights and hence can be declared as least prioritized criteria. These criteria can be declared as maintaining criteria. Maintaining criteria may not be considered much valuable, yet companies comprehend them as supplementary offerings by their prospect suppliers. Capability, flexibility and safety are the criteria that enhance repute of the supplier.

Table 4: Local and Global Composite Priority Weights for Criteria and Sub-Criteria

Criteria	Local Weights	Sub-Criteria	Local Weights	Global Weights
Quality (QU)	0.19756	ISO – 9000	0.159	0.0134
		Continuous Improvement	0.150	0.0296
		Operation Improvement	0.284	0.0561
		Quality Inspection	0.198	0.0391
		Internal Rating System	0.209	0.0412
Delivery (DL)	0.1482	Lead Time	0.203	0.0300
		Delivery Capacity	0.202	0.0299
		Meeting Due Date	0.294	0.0435
		Consistent Delivery	0.137	0.0203
		Meet random Fluctuation in	0.164	0.0243
Cost (CT)	0.1498	Inspection Cost	0.090	0.0134
		Order Placement Cost	0.307	0.0459
		Research Cost	0.112	0.0167
		Transportation Cost	0.238	0.0356
		Holding & Disposal Cost	0.161	0.0241
Technology (TE)	0.0744	Purchase Price of Material &	0.092	0.0137
		Technical Expertise Level	0.079	0.0058
		Availability of Testing Facility	0.048	0.0035

		Automatic Partner Selection	0.351	0.0261
		Technical Compatibility	0.183	0.0136
		Order Entry & Invoicing System	0.337	0.0250
Communication (CO)	0.1037	Frequent Communication	0.350	0.0362
		Use of EDI, Internet etc	0.368	0.0381
		Sharing Confidential Information	0.280	0.0290
Services (SR)	0.0999	Repair Services	0.458	0.0457
		Warranties & Claims	0.282	0.0281
		Efforts in Eliminating Wastes	0.259	0.0258
Integration & relation (I&R)	0.0712	Impression of Supplier Firm	0.098	0.0069
		Supplier Strategic Importance	0.069	0.0049
		Extra Advantages	0.132	0.0093
		Cultural Match	0.192	0.0136
		Labor Relations	0.064	0.0045
		Attitude Towards Order &	0.199	0.1416
Capability (CP)	0.0599	Efforts in Promoting JIT	0.243	0.0173
		Personal Capability	0.130	0.0077
		Process Capability	0.246	0.0147
		Financial Capability	0.078	0.0046
		Market Share	0.399	0.0239
Flexibility (FX)	0.0508	Top Management Capability	0.144	0.0086
		Procedural Flexibility	0.531	0.0269
		Ability to Meet Unexpected	0.468	0.0237
Safety (SF)	0.0440	Safe Delivery	0.228	0.0100
		Transit Safety Measures	0.520	0.0228
		Safe Staking/Packaging	0.251	0.0110

Next, to determine the acceptance of the priority weights and to eliminate possible inconsistency revealed in weights, consistency ratios were calculated. It is generally believed that consistency test is one of the essential features of AHP that help researchers to eliminate inconsistency in priority weights. Saaty (1980) suggest that CR equal to 0.1 or less is acceptable. In this study, consistency ratio remained less than 0.1 that means the weight results are valid and consistent.

Later, the weights of the main criteria have been calculated and multiplied to obtain global weights. Table – 4, exhibits both composite priority weights (local as well as global) for major criteria and sub-criteria. Based on the global weighted results of each sub-criterion, the results indicate that attitude of the supplier(s) towards orders and deliveries as sub-criteria of supply chain integration & relationship has gain highest global weights (0.1416), followed by operations improvements (0.0561), order placement cost (0.0459) and repair service (0.0457). Additionally, sub-criterion like, meeting due dates, internal rating system, quality inspection, use of EDI, SAP or Internet, etc., frequent communication, transportation cost, and lead time have also been observed significant sub-criteria. These results reflect that not only main criteria rather sub-criteria are equally worthwhile for managers.

Table – 5 present snapshot of descending order of priority. Results signal that auto-manufacturers have great concerns about orders fulfillment & delivery capacity of the prospect suppliers. The outcome of this study recommends that suppliers should

establish fulfillment & delivery capacity to become permanent member of automotive supply chain. Timely order fulfillment & delivery capacity help focal companies to streamline and achieve their production plans, which in turn, help them to sustain their competitive advantage. Furthermore, it is also worth noting that suppliers order fulfillment & delivery capacity itself is subject to high levels of integration & strong relationship across supply chain. It also helps company to offer better customer services, while, keeping their cost at lowest possible level. Moreover, prioritizing consistent improvements in operations, order placement cost, after sales services, meeting due dates and internal rating system indicate four most critical supplier selection concerns that are, quality, cost, delivery and services.

Table 5: Ranking of Sub-Criteria's

Ranks (Tier)	Critical Success Factors Sub Criteria	Global Priority Weights	Ranks	Critical Success Factors Sub Criteria	Global Priority Weights
1	Attitude Towards Order & Deliveries	0.1416	23	Ability to Meet Unexpected Demand	0.0237
2	Operation Improvement	0.0561	24	Transit Safety Measures	0.0228
3	Order Placement Cost	0.0459	25	Consistent Delivery	0.0203
4	Repair Services	0.0457	26	Efforts in Promoting JIT	0.0173
5	Meeting Due Date	0.0435	27	Research Cost	0.0167
6	Internal Rating System	0.0412	28	Process Capability	0.0147
7	Quality Inspection	0.0391	29	Purchase Price of Material & Services	0.0137
8	Use of EDI, Internet etc	0.0381	30	Technical Compatibility	0.0136
9	Frequent Communication	0.0362	31	Cultural Match	0.0136
10	Transportation Cost	0.0356	32	ISO – 9000	0.0134
11	Lead Time	0.03	33	Inspection Cost	0.0134
12	Delivery Capacity	0.0299	34	Safe Staking/Packaging	0.011
13	Continuous Improvement	0.0296	35	Safe Delivery	0.01
14	Sharing Confidential Information	0.029	36	Extra Advantages	0.0093
15	Warranties & Claims	0.0281	37	Top Management Capability	0.0086
16	Procedural Flexibility	0.0269	38	Personal Capability	0.0077
17	Automatic Partner Selection	0.0261	39	Impression of Supplier Firm	0.0069
18	Efforts in Eliminating Wastes	0.0258	40	Technical Expertise Level	0.0058
19	Order Entry & Invoicing System	0.025	41	Supplier Strategic Importance	0.0049
20	Meet random Fluctuation in Demand	0.0243	42	Financial Capability	0.0046

21	Holding & Disposal Cost	0.0241	43	Labor Relations	0.0045
22	Market Share	0.0239	44	Availability of Testing Facility	0.0035

V. Conclusion

As per contingency theory, a firm's performance relies on the level of collaborative relationship between its environment (stakeholders-suppliers) and its processes, strategies and structures (Nielsen & Gudergan, 2012). Relaying on this theoretical proposition that a supplier can affect the performance of a buyer organization, this study has focused on analyzing the significance of various supplier selection criteria and their relationship with each other. Efforts have been made to empirically identify the significant criteria with reference to Automotive Industry of Pakistan. Supplier selection is the key concern of supplier's management and one of the multi-decisional complex problems. Prior research provides considerable evidence regarding the significance of different criteria. However, these studies are mostly contextual and were conducted within specific socio-economic environment and hence the outcomes of these studies cannot be generalized. Moreover, as to our knowledge little empirical evidences have been managed in term of significance of supplier selection criteria especially with reference to Pakistan.

In evaluating supplier source, organizations ideally consider a variety of criteria and keenly undergo complete supplier selection process, involving explicit or implicit aspects of these various criteria. The outcome of this research disclose quality, cost, delivery, integration & relationship and service as the most critical factors, while, technology, integration & relationship and service as being the supportive criteria. These results are in line with the outcomes of many international studies, for example, Nydick & Hill (1992) have suggested quality, delivery, cost, and services as the most significant supplier selection criteria. Similarly, Verma & Pullman (1998), observed quality as the most significant criteria, followed by cost and on time delivery. Yen et al. (2011) clarified that the perceived supplier's readiness to customize his services for a buyer has a positive effect on buyer's perceived trust towards a supplier. Liu & Hai (2005) have explained the significance of relationship, collaborative and cooperative behavior as the key criterion for the performance of both partners. However, supplier selection is highly firm and situation-specific and the organizations probably use a set of criteria, which they know and feel are relevant to the situation. In this study, greater discrepancies exist between prioritization of criteria and sub-criteria. Finally, this study has also explored capability, flexibility and safety, as maintaining criteria.

The major contribution of this study is the development of supplier evaluation and selection model using AHP method. Knowing the critical, supportive and maintaining supplier selection criteria can generate valuable managerial implications. It is believed that the model developed in this study can significantly assist policy makers to examine the strength and weakness of supplier selection by comparing them with appropriate criteria and sub-criteria. It is also worth mentioning that this model can confidently be applicable to any supplier selection problem in Automotive Industry of Pakistan. However, like many other studies, the criteria's for supplier selection, used in this study are less comprehensive than the full list, which could be generated from the literature. But it has been shown that all of them, taken together, have significant relationships with

the selection of vendor. The results of this study can be generalized by adding more industries and comprehensive criteria. Similarly, using AHP model software and other advance technologies like Robot technology can add worth to the model presented in this study.

References

- Ballou, R.H. (1999). *Business Logistics Management*, 4th Edition. Prentice Hall, Upper Saddle River.
- Bhutta, K.S. and Huq, F. (2002). Supplier selection problem: a comparison of the total cost of ownership and analytic hierarchy process approaches. *Supply Chain Management: An International Journal*, 7 (03), pp.126-135.
- Dickson, G. (1966). An analysis of vendor selection systems and decisions. *Journal of Purchase*, 2, pp.5-17.
- Ellram, L. (1990). The supplier selection decision in strategic partnerships, *Journal of Purchasing and Materials Management*, 26 (01), pp. 8-14.
- Ghodsypour, S.H. and O'Brien, C. (1998). A decision support system for supplier selection using an integrated analytic hierarchy process and linear programming. *International Journal of Production Economics*, 56/57, 199-212.
- Gimenez, C., Vaart, T.V.D. and Donk, D.P.V. (2012). Supply chain integration and performance: the moderating effect of supply complexity. *International Journal of Operations & Production Management*, 32 (05), pp.583–610.
- Goffin, K., Szwajczewski, M. and New, C. (1997). Managing suppliers: when fewer can mean more. *International Journal of Physical Distribution & Logistics Management*, 27 (07), pp.422-435.
- Handfield, R.B. (1994). US Global Sourcing: Patterns of Development. *International Journal of Operations & Production Management*, 14 (06), pp.40–51.
- Handfield, R.B., Walton, S.V., Sroufe, R., and Melynyk, S.A. (2002). Applying environmental criteria to supplier assessment: a study in the application of the analytical hierarchy process. *European Journal of Operational Research*, 141, pp.70-87.
- Humphreys, P.K., Li, W.L. and Chan, L.Y. (2004). The impact of supplier development on buyer–supplier performance. *Omega*, 32, pp.131–143.
- Ittner, C.D., Larcker, D.F., Nagar, V. and Rajan, M.V. (1999). Supplier selection, monitoring practices, and firm performance, *Journal of Accounting & Public Policy*, 18 (03), pp.253-281.
- Kannan, V.R. and Tan, K.C. (2003). Attitudes of U.S. and European managers to supplier selection and assessment and implications for business performance. *Benchmarking: An International Journal*, 10(5), pp.472-489.
- Lazzarini S.G., Chaddad F.R. and Cook M.L. (2001). Integrating supply chain and network analysis: the study of net chains. *Journal on Chain and Network Science*, 1 (01), pp.7-22.
- Liu, F. and Hai, H.L. (2005). The voting analytic hierarchy process method for selecting

- supplier. *International Journal of Production Economics* 97(3): 308- 317.
- McIvor, R., Humphreys, P. and McAleer, E. (1997). The evolution of the purchasing functions. *Journal of Strategic Change*, 6 (03), pp.165-179.
- Min, H. (1994). International supplier selection: A multi-attribute utility approach. *International Journal of Physical Distribution & Logistics Management*, 24 (05), pp.24-33.
- Nielsen, B.B. and Gudergan, S. (2012). Exploration and exploitation fit and performance in international strategic alliances. *International Business Review*, 21, pp.558-574.
- Nydick, R.L. and Hill, R.P. (1992). Using the analytic hierarchy process to structure the supplier selection procedure. *International Journal of Purchasing and Materials Management*, 28 (02), pp.31-36.
- Pagell, M. and Sheu, C. (2001). Buyer behaviors and the performance of the supply chain: An international exploration. *International Journal of Production Research*, 39 (13), pp.2783-2801.
- Pal, P. and Kumar, B. (2010). Toward a dynamic vendor evaluation model in integrated supply chain management processes. *Supply Chain Management: An International Journal*, 13 (06), pp.391-397.
- Pearson, J.N. and Ellram, L.M. (1995). Supplier selection and evaluation in small versus large electronics firms. *Journal of Small Business Management*, 33 (04), pp.53-65.
- Petroni, A. and Braglia, M. (2000). Vendor selection using principal component analysis. *Journal of Supply Chain Management*, 36, pp. 63-69.
- Saaty, T.L. (2000). *Fundamentals of The Analytic Hierarchy Process*. RWS Publications, Pittsburgh, PA.
- Saaty, T.L. (1980). *The Analytic Hierarchy Process*. McGraw-Hill Book Corporation, New York.
- Shahadat, K. (2003). Supplier choice criteria of executing agencies in developing countries. *International Journal of Operations & Production Management*, 16 (04), pp.261-285.
- So, S. and Sun, H. (2010). Supplier integration strategy for lean manufacturing adoption in electronic enabled supply chains. *Supply Chain Management: An International Journal*, 15 (06), pp.474-487.
- Spafford, G. (2006). Vendor selection: A fourteen point guide. available on www.datamation.com/netsys/article.php/3647621/Vendor-Selection-A-Fourteen-Point-Guide.htm, posted on 7th December, 2006.
- Szwejczewski, M., Lemke, F. and Goffin, K. (2005). Manufacturer-supplier relationships: an empirical study of German manufacturing companies. *International Journal of Operations & Production Management*, 25 (09), pp. 875-97.
- Tahriri, F., Osman, M.R., Ali, A., Yusuff, R.M. and Esfandiary, A., (2008). AHP

- approach for supplier evaluation and selection in a steel manufacturing company. *Journal of Industrial Engineering & Management*, 1 (02), pp.54-76.
- Terpend, R., Tyler, B.B., Krause, D.R. and Handfield, R.B. (2008). Buyer-supplier relationships: derived value over two decades. *The Journal of Supply Chain Management*, 44 (02), pp. 28-55.
- Verma, R. and Pullman, M.E. (1998). An analysis of the supplier selection process. *International Journal of Management Science*, 26 (06), pp.739-750.
- Weber, C.A., Current, J.R. and Benton, W.C. (1991). Vendor selection criteria and methods. *European Journal of Operational Research*, 50, pp. 2-18.
- Weber, C.A. and Current, J.R. (1993). A multi-objective approach to vendor selection. *European Journal of Operational Research*, 68, pp.173-184.
- Wind. Y. and Saaty, T.L. (1980). Marketing application of analytical hierarchy process. *Management Sciences*, 26, pp.641-658.
- Wilhelm M.M. (2011). Managing competition through horizontal supply chain relations: Linking dyadic and network levels of analysis. *Journal of Operations Management*, 29 (7/8), pp.663-676.
- Yahya, S. and Kingsman, B. (1999). Vendorrating for an entrepreneur development program: a case study using the analytic hierarchy process method. *Journal of Operations Research Society*, 50, pp.916-930.
- Zeger, D and Roodhooft, F. (1999). Improving the efficiency of the purchasing process using total cost of ownership information: the case of heating electrodes at Cockerill Sambre S.A. *European Journal of Operational Research*, 112 (01), pp.42-53.