

## Selecting the Best Yarn Supplier for a Bangladeshi Retail Apparel Industry Using Fuzzy Analytic Hierarchy Process: A Case Study

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**Introduction and Research Purpose:** Supplier selection is an important strategic decision for the retail apparel industry, as this significantly impacts production, and manufacturers invest 60% of total sales for procurement materials (Habib et al., 2018; Rahman et al., 2022; Su et al., 2022). Most apparel companies anticipate supplier selection solutions to improve their supply chain processes (Okur and Ercan, 2022). The fuzzy analytical hierarchy process (FAHP) helps decision-makers identify complex structures in decision-making problems (Ku et al. 2010). Selecting the best suppliers is critical to satisfying production needs, ensuring flawless production or services, reducing disruptions, and creating a surplus in the supply chain (Humphreys et al., 2003; Ku et al., 2010). Scholars recommend conducting in-depth research on apparel retail industries' supplier selection challenges in different contexts (Sarıçam and Yılmaz, 2021). Therefore, the study aims to select the best yarn supplier among four alternatives for a Bangladeshi (a developing country) local retail apparel industry using FAHP, exemplifying supply chain enhancement for other retailers.

**Literature Review:** Supplier selection is a vital decision for industries where products are manufactured. Selecting the most suitable supplier using qualitative and quantitative approaches is the most effective means of decision-making, according to Wu and Barnes (2011). The best supplier selection is commonly done by applying FAHP techniques (Wetzstein et al., 2016; Kubler et al., 2016). The critical operations for a manufacturing company are facility location, technology, and supplier selection. Applications for FAHP are seen in cases like supplier choices, the ERP field, machinery selections, location, and technology of projects (Cebeci, 2009; Liu et al., 2020), as well as in purchasing cars and measuring supply chain performance (Amid et al., 2011; Byun, 2001). The ranking of suppliers is crucial in the decision-making process of apparel manufacturers. In the past, research has centered on ranking suppliers within different contexts (Amid et al., 2011; Dweiri et al., 2016; Parthiban et al., 2012; Rahman et al., 2022), it has not addressed the unique challenges faced by local retail apparel industries in Bangladesh. As a result, this study is designed to choose the best yarn provider for Yellow, a Bangladeshi retail apparel manufacturer. This study strives to aid others in the apparel retail industry by adding to a body of existing knowledge.

**Methodology:** A qualitative and quantitative mixed method is used to conduct this research. In this study, the six-step FAHP multi-criteria decision-making (MCDM) analysis (Figure 1) was performed in line with the method guided by Liu et al. (2020) to identify the best yarn supplier for Yellow, Bangladesh. The steps involved in the analysis are as follows: (1) Construct the

problem: the objective of the research is to choose only one yarn manufacturer between four alternatives (A&E, Coats, KDS, and Amann) according to four criteria: quality, cost, delivery, and responsiveness. A hierarchical structure was developed to represent the goal, criteria, and alternatives, (2) Establish fuzzy pairwise comparison matrix: the comparison of the criteria and alternatives made four times by the general manager, head of operations, deputy general manager, and supply chain manager based on numerical data collected from expert opinion of qualitative inquiry where a nine-point numerical scale is used, (3) Synthesize the judgments of multiple decision-makers: the various pairwise comparison matrices were combined, (4) Calculate the fuzzy weights of the criteria: the local weights of the alternatives concerning each criterion were also determined, (5) Defuzzify the fuzzy weights, (6) Check the consistency: The consistency of the pairwise comparisons was evaluated using the consistency ratio (CR), where a CR value  $\leq 0.1$  was considered acceptable. The final weights of the alternatives were obtained by multiplying the local weights of the alternatives concerning each criterion by the corresponding criteria weights and summing up the results. The final weights indicate the alternatives' ratings for selecting the best yarn supplier using multi-criterion decision-making. Figure 2 shows one particular step of data analysis.

**Result and Discussion:** The six-step method for analyzing data is applied. Using the fuzzy AHP approach, the priority weights for the alternatives (Figure 3) were determined to be 0.452, 0.175, 0.311, and 0.063. Based on the final scores, supplier A&E emerges as the most preferred option due to its highest priority weight, while supplier KDS ranks as the second-best alternative supplier. Among these four suppliers, Coats is the third, and Amann is the fourth preference. There was a strong consensus amongst the respondents on the criteria weights. The rankings highlight A&E and KDS as the preferred suppliers for further supplier development and allocation of purchasing volume. This case study illustrates the effectiveness of fuzzy AHP in handling decision-maker subjectivity and uncertainties in supplier evaluation and selection, providing a robust ranking reflecting the team's priority. The results can guide purchasing strategy, reduce the time-consuming effort in supplier selection, and provide feedback to suppliers on where they need improvement.

**Conclusion and Implication:** Fuzzy AHP methodology helps deal with subjectivity and uncertainties during supplier assessment and selection for the Bangladeshi local retail apparel industry. The results provide a robust supplier classification. The most preferred suppliers seem to be A&E and KDS. The outcome can lead to the purchase strategy refinement and giving feedback to the vendors for possible improvement. The study shows fuzzy AHP's simple applicability in understanding the issues in the local apparel industry from developing countries such as Bangladesh.

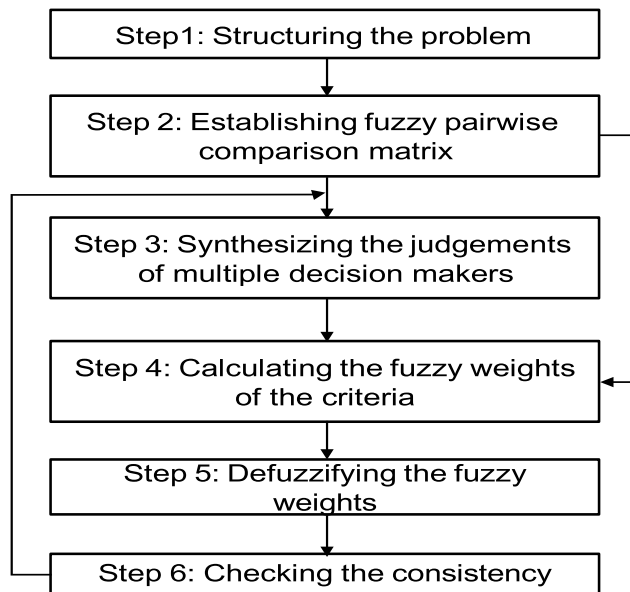


Figure 1: Six-steps FAHP MCDM Approach

General Manager: Evaluations with respect to Quality:

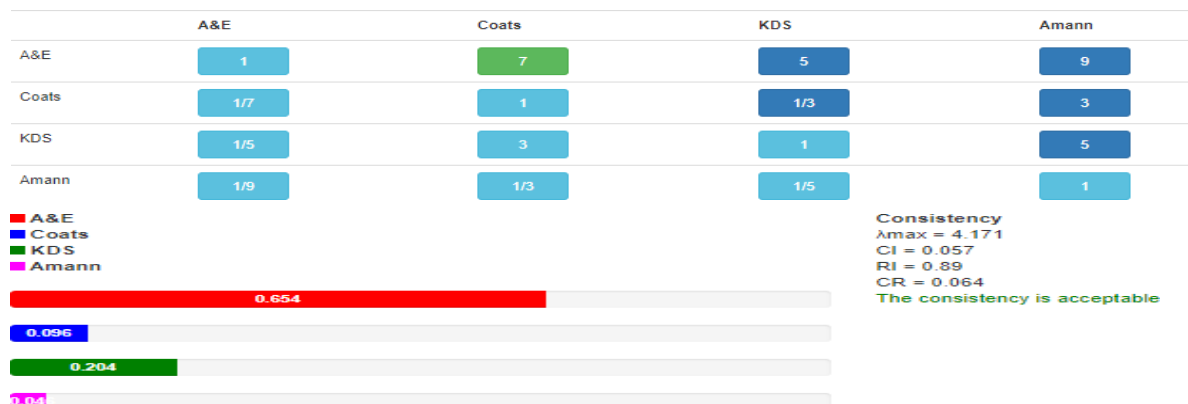


Figure 2: One Particular Step of Data Analysis with Consistency Values

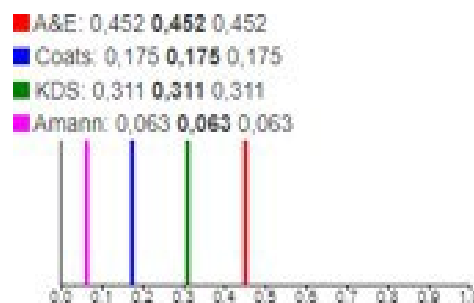


Figure 3: Priority Weights of the Alternatives

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