

Supplier selection in the textile industry implementing the analytical hierarchy process

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Abstract:

Focusing on the vendor selection issue and how it relates to the supply chain planning and objectives is the main purpose of this research. To begin, we take a look at the state of the textile and clothing business right now and examine the globalisation of the sector to determine what is most important for an effective supply chain. We provide an analytical hierarchy process (AHP) model that a clothing business can use to choose their suppliers, and then we utilise that model to build a supplier relationship management (SRM) strategy. To help choose the best supplier to support the business goal, we also establish strategic goals for choosing a supplier issue and assign weights to each. We conclude by talking about the results and what the model's implementation implications are.

Keywords: Vendor Selection, Supply chain, Analytical hierarchy process (AHP), Supplier Relationship management (SRM), Supplier issue.

1. Introduction

In today's interconnected world, numerous clothing stores are establishing reliable supply chains to outdo their rivals and provide unbeatable value to their consumers. In order to deal with the complexity, volatility, and risk associated with global sourcing, supply-chain management (SCM) has grown in importance. If the business wants to reap the full advantages, it needs an integrated supply chain.

For the supply chain to be built to perfection, one must be familiar with both the goals of the entire system and the performance metrics. Supply management solutions may be evaluated for their potential and effectiveness using performance measures.

Choosing reputable vendors in a competitive global market is an important part of supply chain management (SCM). Successful supply chain management in the current competitive environment calls for fewer partners working towards close, long-term partnerships rather than the traditional opposing connections.

The importance of maintaining long-term relationships with suppliers in the garment business has grown in recent years due to the competitive nature of the sector and the need for customers to always seek the greatest value. Consequently, clothing stores are on the lookout for suppliers that can provide the quickest and most cost-effective solutions. Activities like exchanging knowledge, working together to create products, or even just using each other's storage areas qualify this kind of interaction as a partnership.

Highlighting the significance of the vendor-selection challenge and its connection to the supply-chain strategy is the aim of this study. A model for supplier relationship management (SRM) and supplier selection that is based on the method of analytical hierarchy (AHP) is provided for use by an apparel manufacturer. Quantitative and qualitative metrics form the basis of the performance assessment system. (1)

2. The Supply Chain Management (SCM)

One definition of a supply chain is the series of interconnected entities that facilitate the flow of goods, services, money, and information from producers to consumers. Included in this area as well are activities such as transport, storage, data processing, and materials handling. Many entities carry out the many steps of the supply chain, beginning with sourcing and procurement and ending with customer service. These steps include scheduling production and manufacturing, order processing, stock management, storage, and customer care. Supply chain management (SCM) seeks to more effectively meet customer demand by assuring the right product is transported to the right location at the correct moment and in the proper condition.

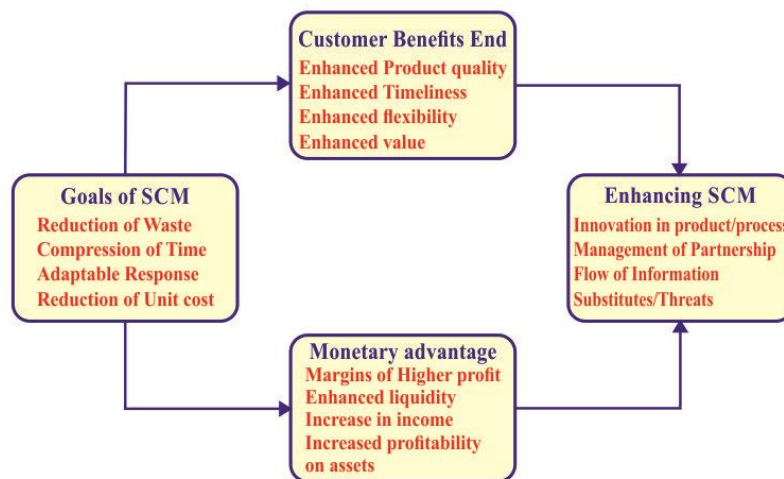


Figure 1. Framework of Supply chain management

Supply chain management (SCM) is an approach to business that aims to boost quality, streamline processes, and cut down on waste at every stage of the supply chain. Time savings in manufacturing and logistics allow all links in the chain of supply to work more effectively, which in turn leads to lower inventory levels overall. A cost-effective solution to each customer's specific needs may be achieved via adaptable order processing in terms of goods diversity, purchase arrangement, order size, and other parameters. All things considered; these objectives contribute to minimising expenses while maintaining a certain level of consumer value. (2)

2.1. Evaluation of Efficiency in the Clothing Sector (SCM)

When it comes to customer service and cost, the objective of supply chain management is to acquire a competitive edge over other businesses in the industry. The process of assessing the efficacy and efficiency of activity is the primary definition of performance measurement, according to conventional definitions. The monitoring of performance, the improvement in inspiration and communication, and the identification of issues are all significantly strengthened by its presence. In addition to this, performance assessment assists in determining the success or failure of management projects, as well as aiding the comprehension of the issue.

The practice of assessing the efficacy and efficiency of activity is historically considered to be the definition of performance measurement. The information that is required for executives and process managers to receive feedback is provided by performance, which is seen from the

perspective of management. The monitoring of performance, the acceleration of motivation, the facilitation of communication, and the identification of issues are all significantly aided by its presence.

There are two main types of performance metrics: qualitative and quantitative. Customer happiness and responsiveness, adaptability, supplier efficiency, and expenses are all part of these metrics. Resources, output, and adaptability are the three categories of metrics. There is a system in place for measuring supply chain effectiveness at the strategic, tactical, and operational levels; this system primarily addresses logistics, inventory, customer service, and delivery costs. (4)

Customer satisfaction is a measure of the expected quality of service provided by a certain organisation, and it is strongly linked to the overall success of its supply chain. Customers in various sectors prioritise different factors when evaluating products or services. For instance, in the delivery service industry, speed is undoubtedly the primary priority. On the other hand, in parts production, the correctness of specifications is often the most important aspect. Consequently, the allocation of importance to each performance metric may vary across various industries.

Centralised purchasing and extensive negotiation on pricing, quality, and delivery schedules are typical interactions between manufacturers and clothing shops. Nevertheless, the study's author believes that an intermediate, often an export or import agency, plays a vital role in many chains. As the sector becomes more globalised, the middleman becomes more important. Many corporations are already sourcing components from abroad or relocating production to countries with cheaper labour costs, which is strengthening internationalisation of the fabric and garment supply chain. Furthermore, there are a lot of characteristics that define the fashion sector, such as a short lifespan, a great deal of volatility, a lack of predictability, and a high level of impulsive buying. (5)

Within the textile sector, it is essential that sourcing strategies accurately represent the capabilities of the supplier base in terms of performance. In the majority of instances, there is a wide range of potential suppliers, each of which has a unique set of costs, lead times, and production flexibility. In general, vendors that provide the lowest prices often provide almost little room for flexibility when it comes to scheduling capacity and shipping dates that might take several weeks. Furthermore, they frequently demand that the entire output be distributed pretty equally throughout the year. There is a possibility that more responsive providers could have fewer delays and thus allow for more flexibility in relation to production arrangements. Furthermore, there is a possibility that other suppliers are prepared to receive payment in exchange for storing limited quantities of completed goods prior to delivery.

Retailers often utilise a combination of two types of suppliers: Type 1 vendors have longer lead times, lower unit costs, and less flexibility, while Type 2 vendors have shorter lead times, higher unit costs, and more flexibility. This allows retailers to take advantage of lower-cost production for the more established portion of request, while sourcing the more uncertain segment from the more flexible, but more expensive, vendors. Implementing this strategy in a setting with multiple products and vendors is challenging and made more complex by various production and logistical constraints.

Apparel merchants provide a diverse range of products to their consumers, including both fashionable items and essential things. Goods may be categorised as either basic or fashion

depending on their manufacturing volume, level of style variance, and the rate of style changes. For instance, predicting the demand for fashion items is challenging due to their high fashion level, seasonality, and constantly changing styles. Essential commodities are generally simple to predict the demand for, have a low degree of trendiness, and minimal variation with seasons. They have a fundamental clothing design that stays consistent. Consequently, the store will allocate the stylish products to the Type 2 seller and the basic goods to the Type 1 supplier. (6)

The textile industry is characterised by the importance of quality as a major component in competitiveness. This rivalry extends beyond individual firms and encompasses the whole supply chain. Undoubtedly, the ultimate quality of the end product that is received by the consumer is unequivocally the outcome of a series of connected and consecutive stages: spinning, weaving, garment production, and distribution. In an increasingly competitive landscape, it is imperative that quality becomes an inherent characteristic across all market categories, including both basic and fashion, in order to cater to the distinct needs and preferences of diverse client demographics. In addition, quality cannot be limited just to the inherent quality of the items. It must also include other operational elements to an even greater extent.

The fashion sector has challenges of instability, which hinders the ability to forecast fashion trends and customer preferences. Although there have been some recent advancements, conventional forecasting methods are still unable to provide the level of precision necessary for successfully handling supplies in the fashion industry. Therefore, the reliance on projections might be reduced in order to mitigate the potential hazards associated with predicting. One way to do this is by reducing the amount of time it takes to complete a task, since this enables a more efficient and timely reaction to customer needs. The ability to quickly bring products to the public has become a crucial strategy for meeting the growing need for a wide range of fashion choices. (7)

2.2 In-Depth Model of Analytic Hierarchy Process for Choosing Suppliers

Supplier selection choices are made after creating a list of potential suppliers during the prequalification step of the supply chain architecture shown in Figure 2. These judgements are intricate since several factors must be taken into account throughout the procedure. It is important to analyse a substantial amount of supplier qualities, both quantitative and qualitative in nature. Evaluations should be conducted using both subjective as well as objective criteria, and compromises should be made. An intentional approach to buying may place more emphasis on the need of considering numerous factors.

Assessing suppliers is a complex decision-making process. The complexity arises from three main factors: firstly, the challenge of conceptualising and organising the different parts of the assessment problem into an organised analytical framework; secondly, the diverse nature of these components, with some being quantitative and others subjective; and thirdly, the proliferation of alternatives due to increased competition in the marketplace.

The Analytic Hierarchy Process (AHP) is a method used for decision making. It breaks down a complicated issue into a hierarchical structure consisting of several levels. These levels include goals, criteria, sub criteria, and alternatives. AHP has been used in several domains including mediation, choosing projects, allocation of funds, transportation, health care, and manufacturing. (8)

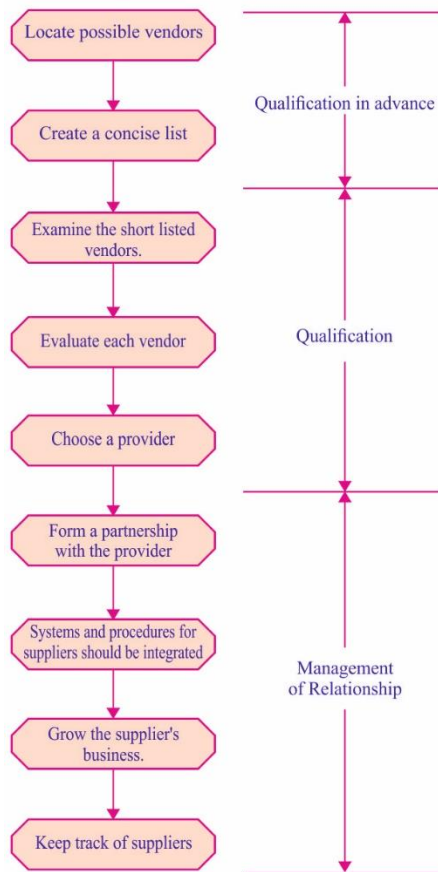


Figure 2. A Framework for Managing Relationships with Suppliers

The Analytic Hierarchy Process (AHP) offers a structured approach to handle problems that include several criteria, including both physical and intangible factors, as well as quantitative and qualitative features. The process comprises three sequential steps:

1. Breaking down intricate issues into a hierarchical structure comprising several levels of components.
2. Employing a measuring approach to determine the relative importance of the factors.
3. Integrating the importance of several factors to determine the ultimate conclusion.

Initially, a complicated issue is divided into smaller sub-problems at different hierarchical levels. These sub-problems are defined by a collection of criteria or qualities that are specific to each sub-problem. The highest level is the ultimate aim, and comprises a single element, namely the comprehensive and overarching objective. Each subsequent level may have many items. The components have to be compared to each other based on a criterion at the upper level, but they must have the same magnitude.

In relation to this scenario, the primary objective is to choose the most optimal supply chain. The performance statistics that are applicable at the following levels are provided. These factors are essential for attaining the aim.

We first catalogue and quantify all of the options; then, we transform them into weights so that we may rank them in a portfolio. At each tier of a hierarchical structure, the weights of the elements are added together. (9)

Using pairwise comparison, you may identify the priority of each set of criteria and the strength of one element over another in relation to a advanced element. A nine-point scale scheme (refer to Table 1) clarifies the importance of each criterion. Quantifying intangible and non-economic elements in hierarchies enables rational trade-offs among many criteria for optimal goal selection.

The Analytic Hierarchy Process (AHP) offers a structured approach to handle many criteria that include both physical and intangible factors, as well as quantitative and qualitative features. The process comprises three sequential steps: The process involves breaking down intricate issues into a hierarchical structure of several levels of components, using a measuring approach to determine the importance of each component, then combining the priorities of the components to get a final choice. (10)

Hierarchical levels, which are a collection of criteria or qualities related to each sub-issue, are used to first break down a complicated problem into sub-problems. At its highest level, the aim, there is only one component: the overarching purpose. Several components may be present in subsequent levels as well. The components must be of equal magnitude and compared to one another using criteria from the next higher level.

In this scenario, the purpose is to pick the best supply chain. All performance metrics are specified at the following levels. From This you will find the conditions needed to attain the objective. After listing and quantifying all options, they are weighted to create a collection of ideas. Elemental weights have been gathered to the next hierarchical level.

Pairwise comparison may be used to assess the relative importance of distinct alternatives or traits. It helps identify the strength of one element's dominance over another in relation to a higher-level element. The nine-point scaling scheme (refer to Table 1) offers a more distinct ranking for each criterion. It aids in measuring intangible and non-economic aspects that are part of hierarchies, enabling a deliberate and well-informed decision-making process that involves weighing several traits or criteria to determine the optimal objective. (11)

Table 1. AHP Preferences: Pairwise Comparison Scale

Quantitative Evaluation	Evaluating Preferences Verbally
9	Preferred Extremely
8	Very strongly to extremely
7	Preferred very strongly
6	Strongly to very strongly
5	Preferred Strongly
4	Moderately to strongly
3	Preferred Moderately
2	Moderate Equally
1	Preferred Equally

To rate things and make decisions in a systematic and reasonable fashion, the AHP is useful. The decision-making process gains flexibility due to the fact that weighting may be adjusted to suit various organisations and sectors. The AHP stands out from other decision-making methods in three ways: first, it can deal with both concrete and abstract qualities; second, it can organise problems hierarchically to learn about decision-making; and third, it can track how consistently a decision-maker makes a judgement.

The five-step AHP strategy for supplier selection is:

1. Set criteria for assessing supplier offers.
2. Compare the relative relevance of criteria in accomplishing the objective and assign weights to them.
3. Measure how every supplier meets the requirements.
4. Calculate priorities by doing pairwise comparisons of supplier importance based on criteria from step 3.
5. Determine supplier priorities based on step 2 and 4 to achieve hierarchy goals.

A textile company's cost success elements may be summed up into three key sub criteria. First, there's the initial cost, which includes things like raw materials (clothing and trimmings), labour for cutting and sewing, packaging, and the vendor's profit. The landed cost's competitiveness is the second. Due to the inclusion of additional expenses, such as transportation and customs taxes, the landed cost differs from the initial cost.

The third factor to examine are the fixed costs, which are essentially the development expenses shared with the associated vendor. (12)

Proper sample quality from vendors determines quality. Vendors are asked for fit, promotional, shipping, and other samples throughout development and manufacturing. It's crucial for providers that sample quality meets buyer criteria. Shipment audit pass rates are the second sub criterion. Vendor returns are the third subfactor. Pre-shipment testing ensures that the clothes meet the firm's requirements, and product integrity (PI) screening is employed as a sub criterion to evaluate the vendor's manufacturing capabilities.

One of the methods of delivery success aspects that has to be examined when selecting a vendor is their ability and desire to give samples and pricing to the purchasing organisation. When assessing potential vendors, responsiveness is crucial due to the shrinking fashion industry cycle times. Time from cutting to shipping is a part of the manufacturing lead time, as is the time it takes to sample. Furthermore, the weekly reports make it easy to quantify the on-time shipping rate, which is a critical success component. The seller promises to supply a certain amount by a specified date for each purchase order. Shipments that are either late or provide less than what was expected may lead to financial loss and lost revenues. Both the precision and timeliness of the pricing are critical. (13)

A vendor's adaptability to fluctuating order quantities and product mix (style, colour, size, etc.) is crucial in the fashion sector. It is sometimes hard to apply the QR system in the tailoring category because to the materials' extensive lead periods, but the vendor's capacity to handle immediate reaction (QR) orders is still an essential factor. Another significant element to consider when expanding the vendor base is the vendor's readiness to travel to different nations to form strategic alliances or joint ventures in order to achieve trade and cost benefits.

Innovative aspects include the interior design team to provide purchasing firms with fresh ideas and features based on market trends. The seller must know the purchasing firm's designer's

aesthetics and apply them to the product. The vendor's sample room capacity, timeliness, and quality are crucial to vendor selection since development and prototyping start the final product. Buyers can choose the proper product if the vendor anticipates market trends. (14) To establish confidence with suppliers, customer service dimensions should include the vendor's capacity to handle complaints and follow up on orders. Vendors must demonstrate financial soundness to purchase raw materials, establish L/Cs, and more. Subcontractors increase production risk; thus, in-house production capability is usually favoured when assessing suppliers. In-house slicing, crafting, cleaning embroidery, printing, and packaging boost vendor dependability. Partner sharing of sensitive information raises confidentiality concerns. In the late 90s, compliance concerns became crucial as merchants sourced abroad. The public focused on sweatshops in underdeveloped nations, where labour is cheaper. Firms established auditing departments to verify suitable working conditions for suppliers, aligned with certifications, and enhance social responsibility.

You can see an example of a hierarchical tree with all the aforementioned criteria and sub criteria in Figure 3. The AHP technique involves comparing components at different levels based on criteria and sub criteria. This comparison is done by considering each parent element situated one level above. Subsequently, a number of universal priority weights may be established for each sub-criterion, taking into account the relative importance of all node parents above it. (15)

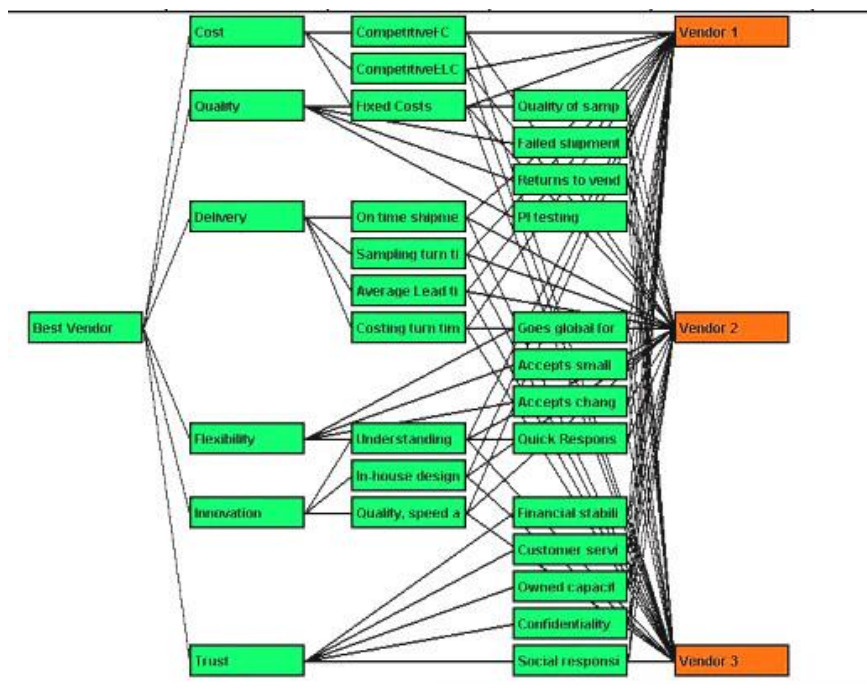


Figure 3. AHP-Based Vendor Evaluation Model

Each hierarchy level's items are compared pairwise using the nine-point scale. Instead of using arithmetic, the geometric mean technique is utilised to integrate the separate comparisons in pairs matrices to get the team agreement. This method was used to interrogate connected merchandising managers and merchandisers in the company's Mediterranean sourcing office.

The normalised weights were determined and calculated using Web-HIPRE, an AHP programme available at www.hipre.hut.fi, throughout the model construction process. The

purpose of this programme is to facilitate the building and use of decision-making models and problem-solving hierarchies. It was built on top of a programme named HIPRE +3. After taking into account the survey data, the programme adjusted the relative importance of each criterion (trust, cost, delivery, flexibility, and innovation), with quality coming out on top and innovation coming in last.

Next, produce the supplier selection solution after calculating normalized importance ratings for every pairwise comparison matrix. The worldwide composites focus values of all sub criteria in the final level of the AHP model are calculated by combining the normalised priority values of criteria and sub criteria from the third phase with regard to all subsequent hierarchical levels.

3. Results and Discussion

The relative weights of each specification of the second level have been calculated and are shown in Figure 4. The analysis indicates that the primary strategic considerations to be taken into account in the supplier selection conflict for the suiting category are quality, delivery, and trust. These factors have significant importance, constituting over 65 percent of the entire weight. Given that the suits category mostly consists of high-end items made from the more materials and designed for the best fit, the selection of suppliers heavily relies on the quality factor. The suppliers are required to possess state-of-the-art equipment and expertise in order to manufacture this premium product. The knowledge and skills necessary for both the development and manufacturing phases are crucial.

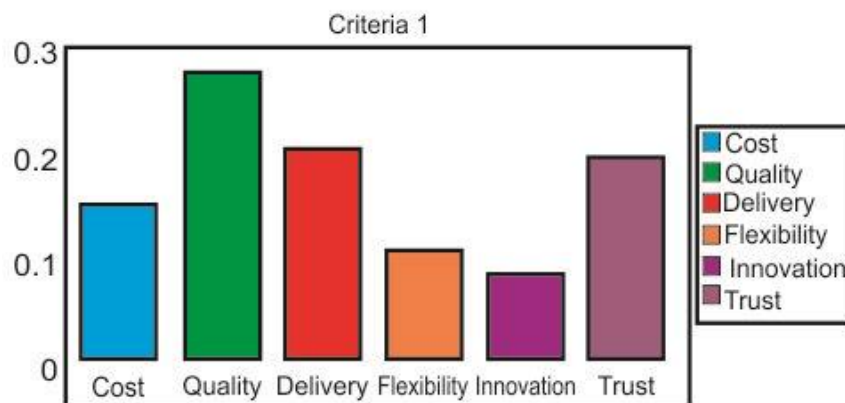


Figure 4. Priority of Factors Influencing the Ideal Vendor Selection

Delivering on time in the right amount is crucial to assessing a vendor's delivery performance, whereas satisfying customers is the most significant aspect in assessing trust. Interesting, money is less important than service and trust. Due to the strength of the suppliers in this area, cost is less important in supplier decisions compared to rivals. In garment sectors with several worldwide rivals, pricing will be a key factor.

The adaptability element is ranked fifth, followed by innovation in last place. The weighting of this factor is rather insignificant, which may be attributed to the fact that the fitting category is highly dependent on the lead times of the fabric. This category mostly uses luxurious Italian fabric, which limits the possibility of making numerous modifications during the season. If a fabric has been reserved for a certain style, it is not possible to reduce the amount unless you are able to take on the responsibility. The material mills are unwilling to make these modifications, or it may not be practical to alter the colour or quality. Regarding our specific circumstance, that dealing with the category of men's suits. However, it is important to note that the number of available designs is somewhat restricted, and any potential innovation

mostly relies on advancements in fabric development. Consequently, the clothing provider is not expected to meet numerous demands. The collection advance duration and the standard of the samples are the most crucial factors, accounting for 68% of the overall importance.

In the end, Supplier 1 emerges as the most formidable vendor, with Supplier 2 with Supplier 3 following closely after. Figure 5 provides a visual representation of the vendor's strengths and shortcomings in relation to the criteria. Consequently, Supplier 1 is deemed the top vendor despite ranking third in terms of cost. This is due to the fact that this provider has very high weights for quality, delivery, and trust. Cost, quality, delivery, and trust are all clearly weighed against one another.

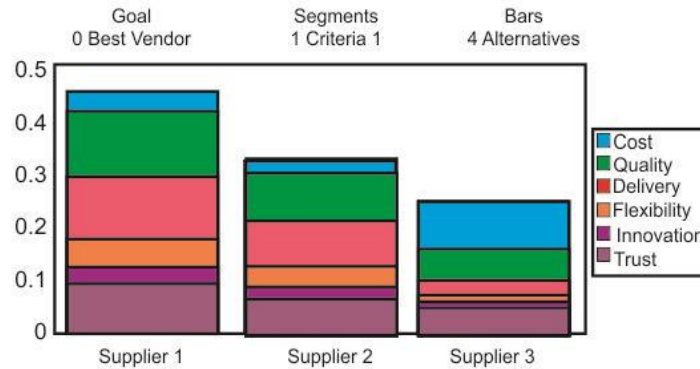


Figure 5. Conclusions for Assessing Vendors 1, 2, and 3

4. Conclusion

Suppliers are considered essential assets for textile/apparel merchants. In order to fully use the potential of the supply chain, it is necessary to effectively manage its many components. Among these components, choosing of a supplier is the highest priority and requires careful consideration. This research defined six strategic goals as the main criteria, with priority measures serving as the sub-criteria. Subsequently, a model based on the Analytic Hierarchy Process (AHP) was developed to determine the optimal supplier. Once the worldwide priority weights have been identified, they may be used to calculate the ultimate composite priority weights of the provider at the lowest level of the hierarchy.

The AHP model is used to define the requirements for vendor selection and methodically organise the issue. This allows decision makers to assess the supplier's strengths and shortcomings by comparing products based on relevant criteria and sub-criteria. Furthermore, the use of the suggested Analytic Hierarchy Process (AHP) model may greatly diminish the duration and exertion required for decision making. Nevertheless, experts have seen how the weights will need adjustment for wardrobe categories other than suits, since the priority will undoubtedly shift. Potential future research may be undertaken for more categories. The Analytic Hierarchy Process (AHP) is applicable in a broad range of situations where judgements need to be made based on qualitative factors.

Nevertheless, Web-HIPRE allows for the integration of actual information into the model. Actually, decision makers may also utilise this functionality to track how well the current supplier portfolio is doing. Using this information and the suppliers' present capabilities, more contracts in various segments may be negotiated.

This analysis concludes that AHP is a useful tool for stakeholders to obtain insight into which vendors are most suited to meet their needs by taking into account in all aspects of a company's

operations that must be in sync with its overall objectives and strategy. Consistent use of this instrument will also aid in reviewing plans and preventing objectives from deviating from the established ones.

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