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Review on Supplier Selection for an Industry

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***Abstract* - Outsourcing has become widespread in contemporary industry. A significant aspect of outsourcing is the selection and evaluation of suppliers. However, most of the models documented in the supplier selection literature treat the supplier selection process as an isolated purchasing activity, rather than as an integrated component of the supply chain. The models discussed select suppliers based on various criteria established by an organization's purchasing department, including cost, quality, and delivery. In this paper, we provide a review of supplier selection methods found in the literature that facilitate the outsourcing process. The conclusions are organized in a matrix that elucidates the selection process phase within the outsourcing framework. This matrix references models that illustrate how suppliers influence the manufacturer's productivity, asset utilization, inventory management, setups, lead times, layout, quality, and schedule deviations.**

Keywords: Production outsourcing, Supplier selection, Supplier's influence.

1. INTRODUCTION

In the present age of globalization, organizations can no longer afford to remain hidden from their rivals. It is a matter of being either aligned with us or opposed to us. Numerous enterprises have come to understand the importance of reevaluating their business practices. Companies can no longer operate in isolation; they must now collaborate with other firms to enhance outcomes for all parties involved. Furthermore, businesses have acknowledged that in order to be sufficiently agile and adaptable to thrive amidst today's intense competition, they must engage in partnerships and collaborations with others to fortify their market position. A prevalent approach in contemporary business is to concentrate on core competencies, persist in executing what the business excels at, and subsequently outsource the areas where the business is least proficient or knowledgeable. Making such a strategic choice is quite challenging. Numerous factors, parameters, and considerations must be evaluated by a company to ascertain that outsourcing is indeed the appropriate decision. Outsourcing has been a practice for many years. Various business processes have been outsourced, including human resources, maintenance tasks, and, more recently, information technology. In recent years, a new trend in outsourcing has emerged: production outsourcing. This encompasses the outsourcing of components for a final product or even an entire production line. A significant challenge associated with production outsourcing is the selection of suppliers. Extensive research has been conducted, and numerous methods have been devised to address the issue of supplier selection; however, there is no definitive evidence indicating that the impact of suppliers on the production system has been adequately addressed. Specifically, factors such as productivity, asset utilization, inventory, setups, lead time, layout, quality, and schedule deviation have not been sufficiently considered. It is clear that much of the research in the field of supplier selection has overlooked the influence of suppliers. The aim of this paper is to provide a review of the models and methods for supplier selection found in the literature, viewed from a production standpoint.

2. SUPPLIER SELECTION OVERVIEW

This section outlines the findings of a comprehensive literature review concerning supplier selection models and methodologies. Articles were chosen from earlier literature reviews, including the work of Boer et al., who performed the latest review in 2001 [1]. Furthermore, contemporary articles were also examined. The supplier selection methods analyzed exhibit various patterns. These patterns can be classified into three primary categories: appraisal, mathematical, and hybrid. Articles are organized within each of the main categories according to their content. If an article describes a methodology for evaluating supplier performance, it is categorized under appraisal. A supplier performance evaluation methodology refers to a method or model that evaluates a supplier's essential performance criteria, including quality, delivery, performance history, and additional factors. Conversely, if an article lacks

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a supplier performance evaluation methodology, it is classified as a mathematical method. Furthermore, if an article combines a supplier performance evaluation methodology with a mathematical method, it is classified as a hybrid method. Subsequently, each primary category is further divided into subcategories to distinguish the content of each article within the respective main category. For example, the primary category of appraisal methods includes two subcategories: criteria rating and cost methods. The mathematical category consists of four subcategories—optimization, linear weighting, statistical, and neural network methods.

3. METHODS FOR SELECTING SUPPLIERS

This section outlines three primary categories and their respective subcategories for supplier selection as follows:

3.1 Evaluation Techniques

Appraisal methods utilize both subjective and objective methodologies for evaluating supplier performance, which includes assessing a supplier's quality and delivery performance. The outcomes of this methodology are compiled for each supplier, leading to a corresponding ranking for each one. Subsequently, a supplier is chosen based on its superior rank relative to other suppliers. The methods for selecting appraisal suppliers can be divided into two subcategories: criteria rating and cost methods. These criteria rating and cost methods fall under the appraisal category as they incorporate supplier performance evaluation methodologies, in contrast to mathematical methods.

Methods for rating criteria

Criteria rating methods provide a subjective evaluation and ranking of a supplier's performance criteria by utilizing rating schemes that focus on aspects such as quality and delivery. Evaluations are typically carried out through various mechanisms, including plant visits, interviews, reviews, and audits. An audit team from the company will conduct a "comprehensive examination" of the supplier's performance, which may involve either an existing or a new supplier. The audit team will scrutinize the supplier's operational performance, technical reports, documentation of issues, and more. Subsequently, the team members will subjectively rate the supplier's performance metrics. For example, a rating scale from 1 to 5 is employed, where 1 indicates poor performance and 5 signifies exceptional performance. Each area of the supplier's performance criteria will be assessed and rated subjectively by the team members. Following basic mathematical calculations, a numerical value is assigned to each supplier. Consequently, the desirability of a supplier for contracting purposes is ranked from high to low.

Cost Methods

Cost methods allocate a monetary value to the performance criteria of suppliers, serving as a foundation for supplier selection. These methods enhance the criteria rating techniques, which also assign a monetary value to the criteria of chosen suppliers. Typically, cost methods presume that the cost information of a supplier is accessible.

Cost methods provide a high level of assurance in the decision-making process for supplier selection, as they rely on real dollar values. Consequently, the outcomes derived from cost methods are easily communicated to executive management, who will ultimately implement the decision.

3.2 Mathematical Techniques

Articles categorized under mathematical methods do not include methodologies for performance evaluation. Mathematical methods analyze the interactions and trade-offs of already assessed criteria to achieve an optimal solution through the application of scientific and mathematical techniques. The articles within the mathematical methods category can be divided into four subcategories based on their content, which are as follows: optimization, linear weighting, statistical, and neural network methods.

Articles within the subcategory of optimization methods employ the principles of operational research techniques. The criteria values that suppliers have already assessed, along with predetermined purchasing target values, are utilized in operational research methods to analyze the interactions and trade-offs among various criteria of interest. Ultimately, the organization aims to optimize these interactions and trade-offs to arrive at an optimal decision regarding supplier selection. A significant amount of research has been conducted in the domain of supplier selection through the use of optimization methods.

Linear Weighting Methods

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Linear weighting methods employ straightforward algorithms to subjectively rank a supplier's performance criteria, including quality and delivery. These methods are defined as mathematical, indicating that they lack performance evaluation methodologies, in contrast to appraisal criteria rating methods.

Statistical

Statistical methods found in the supplier selection literature leverage the discipline of statistics for supplier selection. Methods categorized as statistical are deemed mathematical and do not provide a supplier performance evaluation methodology. Several researchers have successfully applied statistical techniques to supplier selection.

Neural Network Models

Neural network (NN) models incorporate 'if' scenarios when addressing various variables. Only a limited number of researchers have utilized NN in the field of supplier selection.

3.3 Hybrid

Models and techniques classified as hybrid methods include both appraisal and mathematical approaches. The benefit of hybrid methods lies in their ability to merge the strengths of two distinct methodologies. Initially, the company needs to establish a supplier performance evaluation framework to assess the criteria of suppliers using appraisal methods. Subsequently, the company should apply the assessed criteria within mathematical methods to select suppliers in an optimal manner, utilizing mathematical techniques.

4. RESULTS

There have been several efforts to evaluate a supplier's influence on the production system. Regrettably, these efforts occur only after an organization has chosen a supplier, which serves as the foundation for minimizing the number of current suppliers. To progress towards becoming a world-class manufacturer, an organization should tackle the supplier's intensified impact on the production system prior to selecting a supplier. Furthermore, a world-class organization must not only respond but also anticipate a supplier's performance and influence. The predictive criteria measure column refers to models that forecast a supplier's performance metrics, such as predicting lead-time for suppliers. The reactive impact column includes models that assess a supplier's effect on the production system after the impact has occurred. Specifically, the reactive impact column evaluates the influence of a supplier on productivity, asset utilization, inventory, setups, lead-time, layout, quality, and schedule deviations. The predictive impact column consists of models that anticipate a supplier's effect on the production system prior to the occurrence of the impact. In particular, the predictive impact column forecasts a supplier's influence on productivity, asset utilization, inventory, setups, lead-time, layout, quality, and schedule deviations before they happen. The predictive criteria measure column indicates that there is no single model among the reviewed articles that predicts a supplier's criteria. Additionally, approximately 14% of the articles discuss reactive impact. For example, Monczka (1998) allocates costs per time lost or spent due to quality issues. Finnman et al. (2002) concentrate on uncertainties related to lead-time. Degraeve et al. (2000) links costs to quality and inventory holding expenses. Smytka et al. (1993) calculates average production-line downtime caused by defective shipments and extended lead-times. Chen et al. (2002) monitors the cost of quality across the entire organization, including purchasing, production, design engineering, production support, and sales. Barbarosoglu et al. (1997) evaluates production line rejections, costs, and delivery. Grando et al. (1996) addresses production delays resulting from long lead-times. Nevertheless, no model is cited under the predictive impact measurement column.

5. CONCLUSION

In general, most of the models discussed in the literature on supplier selection treat the supplier selection process as an independent purchasing activity rather than as an integrated component of the supply chain process. Suppliers are chosen based on various criteria established by the purchasing department, including cost, quality, and delivery, without adequately assessing or forecasting the influence of these criteria on the production system. Therefore, it is crucial to anticipate the performance criteria of new suppliers to evaluate their effects on the production system. By doing this, a purchasing organization can implement countermeasures against any negative impacts from suppliers, such as poor quality, to reduce inefficiencies within the supply chain.

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