Outsourcing in Supply Chain Management

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Outsourcing is one of the major challenges for production firms in the current supply chain management (SCM) due to limited skilled workers and technology resources. There are too many parameters involved in the strategic decisions of the outsourcing level, quantity, quality, and cost.

Keywords: process outsourcing ; inventory management

1. Introduction

Outsourcing has become the prime attention of organizations due to several advantages, e.g., low initial investment, reduction of cost, and enhanced customer services [1]. In the basic production order quantity model, it is assumed that a complete lot of products that are produced are non-defective; however, in real-life productions, there are some defective items. These defective products are discarded, while others are reprocessed to ensure good-quality products. An example of outsourcing is an anime figure designing company in Japan that outsources its production activities to its CM. They outsource the coloring process, which is a difficult task and usually takes more time to complete the duplicated figure. The CM to which this company outsources its activities reduces the estimated amount by about 25%.

Outsourcing in a supply chain (SC) is an epithet of economic globalization, which, on the other hand, decentralizes the SC and encounters the OPM with uncertainty. A few years back, a survey conducted by Deloitte depicted that almost 71% of a pool of 600 executives from worldwide companies observe SC risk as a significant factor affecting the company's strategic decisions [2]. Particularly, the original product manufacturer (OPM) designs a new product due to technological advantage in developed countries. Later on, it outsources its manufacturing to a contract manufacturer from a developing country. The advantages are obvious, such as freeing up the capital, labor cost reduction, and worker productivity [3].

Several researchers have attempted to deal with yield uncertainty in which they have typically used multiplicative fashion to model it. However, these researchers have assumed a case in which the items produced are exactly equal to the ordered quantity, which is physically not always possible. A production environment that follows make-to-order scenario may face a lack of the Requisite products. Still, there is certain research work in which the researchers have picked production and order quantity of their own choice [4][5]. In these cases, the optimization of both the production as well as of order quantity is equally important. Several researchers have done work on product outsourcing, but very little work is available on process outsourcing and its mathematical model's development. The purpose of this project takes into consideration the process of outsourcing in an imperfect environment for optimization to minimize the cost. Organizations with restricted resources require outsourcing to satisfy customer demands. Additionally, in the proposed research, the mathematical models for the supply chain are developed and tested using the data, which provides a platform to the decision makers to minimize total cost by optimizing the lot size and outsourcing quantity.

2. Role of Outsourcing

Outsourcing is considered as a prime factor to gain the best possible performance by an organization [6]. For flexible, low-cost production in a supply chain, outsourcing from suppliers is critical. In this regard, better supplier selection as an outsourcer is important. Kumar et al. developed a logical method in which, for multi-objective modeling, they used three different types of fuzzy logic and some hard constraints. In addition to this, they also opted for goal programming for the problem solution [7]. To simultaneously find the order quantity and formulation impression, more sophisticated fuzzy multi-objective methods have been considered by [8]. In another study, [9] developed a model in which the consumer needs to determine the goods that need to be ordered, the amounts, the suppliers, and the times. To find the best suppliers and how to assign orders among them, Karpak et al. [10] used goal programming, evaluating trade-offs between multiple objectives, such as cost, quality, and delivery, simultaneously.

Next, outsourcing strategies are also one of the important aspects of production business schemes of specific operations. While outsourcing some of their operations, the organizations can have a special focus on their core operations. In conventional outsourcing, only the non-specialized activities are outsourced except the activities that may have a competitive advantage [11][12][13]. In a production environment, different researchers have modeled several optimal batch problems considering different production conditions to minimize the total system cost. For instance, E.W. Taft [14] is among the pioneers who developed Economic Production quantity (EPQ) inventory model. Subsequently, this basic model was modified and expanded by other researchers. Previous research studies have shown that small perturbations in parameters of EOQ and EPQ models do not impose any significant impact on the solution of a problem. Owing to this, the Economic Production quantity (EPQ) model emerged as an optimal substitute, which shows promising results for a production environment when applied with some assumptions.

In an actual production environment, the system runs with some imperfections. The imperfections in a production system produce low-quality items for several reasons, namely defects in raw materials, changes in machine capabilities, backorders, rework, and differences in the experience of the operators. Some research studies are available and proposed models considered these imperfections. For example, Jamal et al. [15] studied the EPQ model to obtain the optimum Batch size. The proposed model is considered a re-work process after several production cycles. Expanding the contributions of Jamal et al. [15], Sarkar et al. [16] formulated the same problem with additional terms of backorders. The model proposed by Cardenas-Barron [17] encompasses numerous parameters. The model undertakes the reworked production quantities and other production system defects. Wee et al. [18] adopted the same methodology and developed a model that considered the development of refurnished products with non-conformities. It was concluded that in repeated manufacturing cycles, there is an effective way to reprocess faulty products. The data obtained confirmed the critical aspects could be more related to the manufacturing cost and the service expenditures of the process. An identical model was presented by [19], which focused on the inflation effect. It was shown that the prolonged use of the manufacturing units could potentially damage the smooth operating of the system, i.e., could produce defects in the system. The focus of the research was on how to overcome the defects produced during the smooth operation and to reprocess the defective products. The overtime of the workers could be the potential reason for the introduction of defects into the system, or it could be due to unrealized reasons. Lastly, the study of Talizadeh et al. [20] is emphatic towards dealing with imperfection in an outsourcing supply chain environment.

Another factor in outsourcing is optimally tweaking the resources. In this area, Alvarez and Stenbacka [21] and Benaroch et al. [22] researched flexible sourcing models for finding the optimal expected time to change resources. The outsourcing cost per transaction in their considered dynamic models is variable. Inderfurth and Kelle [23] and Spinler and Huchzermeier [24] took the outsourcing strategy when both cost and demand are not certain. Liu and Nagurney [25] put forward a model with a global outsourcing and quick-response mechanism. Vibrational inequality theory was used for investigation by considering uncertainty in cost and demand. Some cases were analyzed to take both demand and production costs into account. Nosoohi and Nookabadi [26] developed a model of outsourcing for the industrialist to study optimal ordering policy under the uncertainty of customer demand and final processing costs. They used different options contracts for neutralizing the effect of uncertainty in cost parameters. Chen et al. [27] studied the outsourcing and coordination mechanism for two Stackelberg game models by considering numerous uncertainty parameters, such as disruption risk, demand, and capacity. They concluded that the manufacturer will not be interested in outsourcing if the disruption-risk/production capacity is low/high. Zhao et al. [28] studied a situation where an industrialist outsources a portion of his production to a supplier. They considered the ordering behavior of companies that outsource their products over long distances. Min [29] considered the usual outsourcing techniques of logistics operations in factories of the United States and recognized the significant elements of outsourcing in logistics operations.

Research has also been carried out on outsourcing risk from various perspectives. Lacity et al. [30] stated that risk is the degree to which a transaction exposes a party to a chance of damage or loss. Qin et al. [31] studied the risks linked with ITO in Chinese institutions and concluded that mismatch in culture and goals, limited choice of vendors, and IT literacy are the significant risks. Oh et al. [32] utilized the stock market’s reaction to study the perceived transactional risks linked with ITO engagement. They determined the market’s reaction based on the cultural similarity with the vendor and the asset specification of the IT resources. Earl [33] pinpointed the role of inexperienced staff, lack of innovation, organizational learning, and hidden costs as risks in outsourcing. Gewald and Dibbern [34] determined the levels of perceived risk as well as benefits for finding the extent to which banks would select to outsource their processes.

Research on service outsourcing has been carried out widely by different researchers. Choi et al. [35] performed research and suggested service outsourcing as a critical topic in service supply chain management. Tsai et al. [36] examined the potential risks structural relationships that can lead to failure in an outsourcing relationship. Typically, business is linked with forward and reverse flows of products. Yet, customers are vastly involved in the service process. The valuation of the

service level is critical to the market demand [37]. Nowadays, outsourcing is a major development in the service industry for increasing the level of service. Chen et al. [38] considered an outsourced supply chain that consists of one original equipment manufacturer, one contract manufacturer, and a retailer. They studied the results of encroachment on the profit. Akan et al. [39] investigated two outsourcing settings, namely order fulfillment and call center, and examined how asymmetric demand information will affect the two parties. Xin et al. [40] compared the proactive inventory of relief items both in the presence and absence of outsourcing. They concluded that social efficiency improvement depends on the monitoring costs and the perishable rates under the outsourcing strategy. Wu et al. [41] investigated the incentives for information shared with two retailers in Cournot competition and with multiple suppliers in Bertrand competition. Li et al. [42] also studied the service channel choice. Huang et al. [43] investigated the quality risk from the viewpoint of a 4PL and considered asymmetric information in between 3PL and 4PL. Zhang et al. [44] discussed the retailer's information-sharing strategies when the service is delegated to the retailer or undertaken by the manufacturer. Yue and Ryan [45] carried out a comparison between single sourcing and multi-sourcing. They found that buyers always desire single sourcing to multi-sourcing. Ching et al. [46] used time-based competition for analyzing the model of outsourcing to multiple make-to-order suppliers. Ding et al. [47] used the customized integration service chain model for evaluating the business performance and found that it extends the service supply chain with multiple service providers in the oilfield service industry. Summing up the literature on outsourcing, an ample amount of work has been done by various researchers in service as well as manufacturing streams considering imperfection, outsourcing strategies, supplier selection, risk assessments of outsourcing products. However, mathematical modelling of outsourcing the processes with attributes of imperfection and recycling has not been pondered by any researcher, and this work provides insight into this gap.

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