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A Review on Optimizing Profit with the Linear Programming Model in a Manufacturing

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***Abstract-* Manufacturing companies often face some difficulty to measure the actual production efficiency and productivity and this is due to many circumstances like resource availability and the uncertainties may happen during the production process. To improve the production and supply chain's performance under demand uncertainty (which happens by chance) in the Bansal Pipe Industries, Indore a review of mathematical programming models for supply chain production and transport planning is inevitable. The purpose of this study is to identify current and future researches in this field and to propose a taxonomy framework based on the following elements: supply chain structure, decision level, modeling approach, purpose, shared information, limitations, novelty and application.**

***Keywords-* Linear Programming, production, inventory, Linear Programming Solver**

I. INTRODUCTION

Manufacturing companies often face some difficulty to measure the actual production efficiency and productivity and this is due to many circumstances like resource availability and the uncertainties may happen during the production process. Industries all over the world are continuously faced with shortages of production inputs which result in low capacity utilization and consequently low outputs. But an economy can only grow if management decisions at the firm level result in boosted output through either cost minimization or output maximization culminating in increased production in the real sector.

Thus firm managers are always seeking for the right decisions so as to meet their objectives which mainly revolve on how best to increase profit. The growth in industries puts pressure on management in finding the optimal planning, organizing, leading and controlling levels of production in the various productive industries of the economy. As a result of this pressure, managerial theories of the firm are introduced to analyze business environments and to solve practical business problems such as operational problems emanating from within the industry, and environmental problems in which the industry operates. Both theoretical and quantitative techniques1 are developed to model and analyze these decision problems. Among these quantitative techniques is the linear programming model, which uses mathematical method in seeking the optimum course of action in any decision situation under the restriction of limited resources and uncertainties. Other mathematical approaches include; least squares model, time series, network system, inventory control, markov analysis and a host of others.

Linear Programming is a subset of Mathematical Programming that is concerned with efficient allocation of limited resources to known activities with the objective of meeting a desired goal of maximization of profit or minimization of cost. In Statistics and Mathematics, Linear Programming (LP) is a technique for optimization of linear objective function, subject to linear equality and linear in equality constraint. Informally, linear programming determines the way to achieve the best outcome (such as maximum profit or lowest cost) in a given mathematical model and given some list of requirement as linear equation. Although there is a tendency to think that linear programming which is a subset of operations research has a recent development, but there is really nothing new about the idea of maximization of profit in any organization setting i.e. in a production company or manufacturing company.

For centuries, highly skilled artisans have striven to formulate models that can assist manufacturing and production companies in maximizing their profit, that is why linear programming among other models in operations research has determine the way to achieve the best. Linear programming can be applied to various fields of study. Most extensively, it is used in business and economic situation, but can also be utilized in some engineering problems. Some industries that use linear pro transportation, energy, tele communications and production or manufacturing companies.
brief in fourth section.

II. LITERATURE SURVEY

Babazadeh et al. (2018) presents a novel robust optimization model based on polyhedral uncertainty set for integrated production and distribution planning in multi-echelon, multi-products closed-loop supply chains over a mid-term multi-periods horizon. The proposed model is able to consider different transportation modes, direct or indirect shipments, and several customer zones for different products beside the traditional features considered for tackling such problems in the literature. Computational results were provided by using a numerical example and its related scenarios to discuss different features of the proposed robust optimization model to handle the uncertainty of parameters. According to the achieved results, using robust optimization method would assure the feasibility of the model under uncertainty. Also, the DM could select the best approach through the provided sensitivity analysis. In our view, the realistic approach (scenario 6) will provide suitable solutions with reasonable costs of handling uncertainty. It should be noted that when there is not reliable and historical data for making probability distribution of uncertain parameters, we cannot use stochastic programming methods. In this case, robust optimization method based on different uncertainty sets could be efficiently used. Since many real world problems usually have the limitation of data availability, the robust optimization method is a suitable tool to deal with the uncertainty of such problems.

Jabbarzadeh et al. (2018) In today's globalized and highly uncertain business environments, supply chains have become more vulnerable to disruptions. This paper presents a stochastic robust optimization model for the design of a closed-loop supply chain network that performs resiliently in the face of disruptions. The proposed model is capable of considering lateral transshipment as a reactive strategy to cope with operational and disruption risks. The objective is to determine facility location decisions and lateral transshipment quantities that minimize the total supply chain cost across different disruption scenarios. A Lagrangian relaxation algorithm is developed to solve the robust model efficiently. Important managerial insights are obtained from the model implementation in a case study of glass the industry.

Darvish et al. (2018) investigates a challenging and practical problem of integrated production, location, inventory, and distribution, in which multiple products are produced over a discrete time horizon, stored at the DCs before being shipped to final customers. The paper contributes to the integrated optimization literature as it combines distinct features of delivery time windows, distribution with direct shipment, and dynamic location decisions. A state of the art commercial solver is able to find optimum solutions for very small instances of our problem, however, it does not prove optimality in a reasonable time for larger instances. To achieve better solutions in an acceptable computation time, we have proposed a mathuerisric algorithm. Several instances are generated and the solutions are compared to the optimal ones (if any) obtained by the exact method. On average the solutions obtained with our algorithm improve the ones from of the exact method by up to 49.66%, generally in only a third of the running time.

Frazzon et al. (2018) The rise of new information and communication technologies leads to enhanced information transparency in supply chains. In order to utilise the resulting potentials, novel scheduling approaches that are capable of processing large amounts of data and coping with dynamic disturbances of manufacturing and transport stages have to be developed. For this purpose, the paper at hand proposes a hybrid approach for the integrated scheduling of production and transport processes along supply chains. The procedure combines mixed integer linear programming, discrete event simulation and a genetic algorithm. Obtained results show a significant reduction in the number of late orders, substantiating that proper scheduling approaches combined with information visibility allow for operational improvements in manufacturing supply chains.

Shou-feng et al. (2019) In contrast to traditional supply chain networks, Physical Internet (PI) is an interconnected open global logistics network based on open PI hubs and standard PI-containers that has the potential to achieve ground-breaking improvements in integrated production-inventory-distribution management. In this paper, to quantify the advantages of PI from a cost performance perspective, we propose a mixed-integer linear programming (MILP) formulation for addressing the problem that combines an integrated production-inventory-distribution decision with PI, which has been addressed separately in the existing literature. The results of computational experiments show that while achieving a comparable or better service level, PI can achieve significant cost savings compared to a traditional supply chain network with a dynamic configuration and a hybrid configuration. Moreover, we investigate the impact of several problem parameter changes on the total costs under each network setting, and managerial insights are derived.

Bagchi et al. (2018) Designing an aggregate plan is essential for firms to improve the efficiency of their inventory management as well as maintaining supplier relationships over a long run. Aggregate plan is primarily a function of demand uncertainty and the inventory policy in place. Firms tend to follow either a periodic review model (system) or a perpetual model (system) for managing inventory time to time; the former being more prevalent due to lower inventory monitoring costs associated. The article proposes a mathematical model that incorporates the principles of inventory model in deciding on the key components of an aggregate plan for each period in a multi-period stochastic demand environment for both stationary and non-stationary demand scenarios. The article also provides numerical illustrations to demonstrate the application of the model.

Farhad Habibi et al. (2018) presents a Location-Inventory-Routing Problem (LIRP) optimization model for designing an algae fuel production and distribution network consisting of biomass production facility, distribution facilities, and extraction sites. The proposed model minimizes the total cost of the network including the cost of locating the distribution facilities and transportation and the expected inventory costs including holding, shortage, ordering and purchase. The proposed model helps decision-maker determine the optimal location and order policy of algae fuel distribution facilities, allocation of extraction sites to these facilities, and the routing decisions. The proposed model falls within the category of NP-hard problems and is solved with the modified versions of three algorithms; namely Simulated Annealing (SA), Genetic Algorithm (GA) and Firefly Algorithm (FA), and the performance of these methods are measured by test problems in different sizes. The results show that SA outperforms both GA and FA, and GA outperforms FA in terms of the quality of the solutions. Finally, the proposed model is validated and evaluated by a case study of algae fuel distribution network in Iran and the results are discussed.

Mohammadi et al. (2019) Recently, many modern industries have adopted joint scheduling of production and distribution decisions. Such coordination is necessary in make-to-order (MTO) businesses, where it is challenging to achieve timely delivery at minimum total cost and meet the requirements for high customization. To deal with these challenges, a practical production configuration and delivery method is required, in addition to a closer link between production and distribution schedules. Hence, in this study, we address an integrated production scheduling-vehicle routing problem with a time window, where it is assumed that production is performed in a flexible job-shop system. Our framework is modeled as a novel bi-objective mixed integer problem, in which the first objective function aims to minimize a sum of the production and distribution scheduling costs, and the second objective function tries to minimize a weighted sum of delivery earliness and tardiness. To practically validate the application of our framework, a case study from a furniture manufacturing company producing customized goods is considered, and experimental data are derived. Based on the real data, the model is first optimally solved by an constraint method, and then a Hybrid Particle Swarm Optimization (HPSO) algorithm is developed to solve the model for medium- and large-sized problems in a reasonable time. We discuss the benefits of integration by comparing the results of the proposed model with that of the separate approach. The results show that the company can establish a proper rational balance between cost and customer concerns, and they can use the integration policy as a lever to improve customer satisfaction without the system experiencing a significant increase in total operational cost.

III. LINEAR PROGRAMMING

Linear programming is used as a mathematical method for determining and planning for the best outcomes and was developed during World War II by Leonid Kantorovich in 1937. It was a method used to plan expenditures and returns in a way that reduced costs for the military and possibly caused the opposite for the enemy. Linear programming is part of an important area of mathematics called "optimization techniques" as it is literally used to find the most optimized solution to a given problem.

A very basic example of linear optimization usage is in logistics or the "method of moving things around efficiently." For example, suppose there are 1000 boxes of the same size of 1 cubic meter each; 3 trucks that are able to carry 100 boxes, 70 boxes and 40 boxes respectively; several possible routes; and 48 hours to deliver all the boxes. Linear programming provides the mathematical equations to determine the optimal truck loading and route to be taken in order to meet the requirement of getting all boxes from point A to B with the least amount of going back and forth and, of course, the lowest cost at the fastest time possible.

The basic components of linear programming are as follows:

- Decision variables - These are the quantities to be determined.
- Objective function - This represents how each decision variable would affect the cost, or, simply, the value that needs to be optimized.
- Constraints - These represent how each decision variable would use limited amounts of resources.
- Data - These quantify the relationships between the objective function and the constraints.

IV. CONCLUSION

The study has successfully determined the product mix of Bansal Pipe Industry, Indore. In the process, the optimal quantities of the various PVC pipes to be produced within the study period in order to maximize profit were established. Also the status of the resources and the unit worth of each resource to the objective function were known with respect to varying budget resources and labour time. This is the advantage of going beyond mere knowledge of existing decision making tools to actual practical proof of its workability.

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