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A literature review on scheduling operation and inventory cost

Manish Kumar Singh, Suraj Kumar Rout, Purnesh Kumar Sahu
Chouksey Engineering College, Bilaspur

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ABSTRACT

REVIEW ARTICLE

Supply Chain Management is the management of a network of interconnected businesses involved in the ultimate provision of product and service packages required by end customers. The objective is to minimize the make span of batch-processing machines in a flow shop. The processing times and the sizes of the jobs are known and non-identical. The machines can process a batch as long as its capacity is not exceeded. This paper presents the scheduling and inventory management articles published in the major logistics journals, facilitates the awareness and appreciation of such work, and stands to guide future inventory management research by highlighting gaps and unknown topics in the present literature.

1. Introduction

Features of inventory management simulations are that the resulting optimal solutions can be implemented in a fast changing position where, for example, the conditions are changed daily. There is a need for new and effective methods for modeling systems related with inventory management, in the face of uncertainty. Uncertainty occurs regarding the control object, as the process of obtaining the necessary information about the object is not always possible. Management models differ in the nature of the available information on the belongings of the simulated system. When the value of the model parameters is well-defined, nature of the corresponding mathematical model is deterministic. If the parameters of the system are random values with a known probability, distribution models are stochastic (probabilistic). Materials management has been considered as a separate field of management discipline only in the recent past and is accorded the status of a separate functional area. On account of its latest origin, unfortunately research in the area of materials management both at the micro and macro levels was obviously absent. On the basis of the demand sources, demands are divided into independent and dependent. Independent demand is the demand that consists of the individual consumer's demands, each of them feeling the need independently of the other.

Sequencing is a technique to order the jobs in a particular sequence. There are different types of sequencing which are followed in industries such as first in first out basis, priority basis, job size basis and processing time basis etc. In processing time basis sequencing for different sequence, we will achieve different processing time. As a job is always characterized by its route,

processing requirement and priority, scheduling rates the works in order of its priority and then provides for its release to the plant at the proper time and in the correct sequence. Scheduling comes after Routing and the jobs may be scheduled based on various parameters such as lowest processing time, most work remaining etc. Scheduling is categorized into 3 categories. The sequence is adapted which gives minimum processing time. By Scheduling, we assign a particular time for completing a particular job.

2. Previous Literatures

Felix T.S. Chan et.al [1] developed optimization models for solving distributed FMS scheduling problems subject to maintenance: [Genetic algorithms approach]. The authors have made an attempt to optimize the following things during the cycle in the work: a) Allocation of jobs to suitable factories & b) Determination of the corresponding production scheduling in each factory. Their objective is to maximize the system efficiency by finding an optimal planning for a better collaboration among various processes. They proposed a genetic algorithm with dominant genes (GADG) approach to deal with distributed flexible manufacturing system (FMS) scheduling problems subject to machine maintenance constraint.

Kedad Sidhoum et.al [2] developed optimization models for lower bounds for the earliness–tardiness scheduling problem on parallel machines with distinct due dates considering the parallel machine scheduling problem in which the jobs have distinct due dates with earliness and tardiness. They considered the earliness tardiness problem in a parallel machine environment. Their objective is related with the parallel machine scheduling problem in which the jobs have distinct due dates with earliness and tardiness costs. The main objective of their model is to optimize tardiness.

Over the years several heuristic processes such as dispatching rules, locol search and a few metaheuristics for example tabu search, GA have been developed to FJSP. These can be classified into two broad categories: the hierarchical approach and integrated approach. The hierarchical approach reduces difficulty by solving the problem by decomposing into a sequence of sub-problems. Brandimarte [4] Paulli [5], rooms and Barnes [3] followed the same approach among others. They all used different dispatching rules to solve the assignment problem and also solved the resulting schedule using different heuristics.

Drstvensek et.al [6] developed a model of data flow in lower CIM levels considering ,models of production automation based on the idea of five levels CIM hierarchy where the technological database (TDB) represents a backbone of the system . Their main objective is to provide a common environment where the evaluation of a given general order and later composition of work orders, and designation of production resources could be done automatically under the operator's supervision.The authors have approximated these costs with the reason that with many products produced in each period, the percentage of unaccounted setups is usually small. Thus, in all three papers, the costs are underestimated and the capacity is not sufficient to allow for setups in some periods. This will sometimes result in infeasible schedules.

EzedeenKodeekha, (Department of Production, Informatics, Management and Control Faculty of Mechanical Engineering Budapest University of Technology and Economics) [7] developed "A new method of FMS scheduling using optimization and scheduling". Conventional methods of solving scheduling problems such as heuristic methods based on priority rules still result schedules, sometimes, with significant idle times. To optimize these, the author proposes a new high quality

scheduling method. He uses multi-objective optimization and simulation method. The method is called **"**Break and Build Method**"**, BBM.

Clarence H Martin [8] developed a hybrid genetic algorithm/mathematical programming approach to the multi-family flow shop scheduling problem with lot streaming. He developed a new aspect of the problem related with sub lots, the size of sub lots and the interleaving of sub lots from different jobs in the processing sequence. His approach allows for quicker movement of items through the manufacturing facility that is a key element of synchronous manufacturing. Of course, lot streaming raises new issues such as determining the number of sub lotsand their sizes.

Chia and Lee [9] developed the total completion time problem in a permutation flow shop with a learning effect. The concept of learning process plays a key role in production environments. Their objective is to minimize the sum of completion times or flow time .They used the dominance rule and several lower bounds to speed up the search for the optimal solution.Mathematical programming applications for production-planning decisions have been used in process industries like oil, steel, petroleum, food etc. Eilon (1969) proposed a mixed integer program (MIP) for production scheduling in multi-product, single stage environment with capacity constraints in a chemical industry. He developed heuristic algorithms based on batch scheduling approach to schedule 5 products, subject to normal demand distribution with known parameters. In a two-stage production environment, Prabhakar (1974) studied lot sizing and sequence dependent setup time sequencing in the chemical industry using an MIP to obtain production schedules only for a single planning period.

Koulamas and Kyparisis [10] developed single-machine scheduling with waiting-time-dependent due dates in which due dates are linear functions of the job waiting-times. They construct an optimal sequence and assign the optimal due dates analytically in a single-machine setting when due dates are linear functions of the job waiting-times and their objective is to minimize the maximum job lateness.They also compare their solution with the approach that considers lot sizing and sequencing as independent decisions. They argue that decomposing the problem into sub-problems can result in infeasible production schedules.

Das, et.al [11] developed, Optimization of operation and changeover time for production planning and scheduling in a flexible manufacturing system and deals with the production planning problem of a flexible manufacturing system. They specifically addresses issues of machine loading, tool allocation, and part type grouping with the objective of developing an operation sequencing technique capable of optimizing operation time, non-productive tool change times, and orientation change times when processing a group's design features.They present procedures to partition the overall production planning and scheduling problem into manageable and interlinked sub-problems. An important input in hierarchical modeling philosophy is the number of levels recognized in the product structure.

Chen and Lee [12] developed a model for Logistics scheduling with batching[LSB] and transportation. Their objective is to minimize the sum of weighted job delivery time and total transportation cost. Since their problem involves not only the traditional performance measurement, such as weighted completion time, but also transportation arrangement and cost, key factors in logistics management.At the third level, detailed schedules are prepared for each product family using standard inventory control methods, allocating the product type capacity among the product families and at the fourth level, individual run quantities are

calculated for each product in each family, again using standard inventory control methods.

Poulos and Zografos [13] developed a model for solving the multi-criteria time-dependent routing and scheduling problem in a multimodal fixed scheduled network. Their objective is to present the formulation and algorithmic solution for the multi-criteria itinerary planning problem that takes into account the aforementioned features. In addition, they proved that the Basic Unit of Concurrency (BUC) is a set of the executed control flows based on the behavioral properties of the net.

Hamaniaet.al, [14] developed a model for Reactive mode handling of flexible manufacturing systems. They deal with a new modeling approach for mode handling of flexible manufacturing systems (FMS). Based on a review of the modeling methods and the specification formalisms in the existing approaches, they show that the mutual benefit of functional modeling and synchronous languages is very convenient for mode handling problem.The three phase models developed by Bowers and Jarvis implements inventory planning, short-term production planning and daily sequencing tasks.

Hsu, et.al. [15] developed a model for cyclic scheduling for F.M.S. Modelling and evolutionary solving approach. They concern the domain of flexible manufacturing systems (FMS) and focuses on the scheduling problems encountered in these systems. They have chosen the cyclic behavior to study this problem with the objective to reduce its complexity. This cyclic scheduling problem, whose complexity is NP-hard in the general case, aims to minimize the work in process (WIP) to satisfy economic constraints. They study the problem of FMS control by a predictive approach to compute a cyclic and deterministic schedule.The two stages are the parts production and assembly operations and the third stage is the distribution system. This work lacks the consistency between aggregation and disaggregation procedures, i.e., the link between the production and a distribution module is relatively weak.

Sadykov [16] developed a branch-and-check algorithm for minimizing the weighted number of late jobs on a single machine with release dates. He consider the scheduling problem of minimizing the weighted number of late jobs on a single machine .He proposed a branch-and-check algorithm , where a relax edinteger programming formulation is solved by branch-and-bound and infeasible solutions are cut off using infeasibility cuts.

Wu and Zhou [17] developed a model for Stochastic scheduling to minimize expected maximum lateness. They concerned with the problems in scheduling a set of jobs associated with random due dates on a single machine so as to minimize the expected maximum lateness in stochastic environment. This is a difficult problem and few efforts have been reported on their solution.

Wang et.al [19**]** developed FBS-enhanced agent-based dynamic scheduling in FMS. The main objective is to show the feasibility of the approach and to evaluate the approach via computational experiments. They propose a multi agent approach integrated with a filtered-beam- search (FBS)-based heuristic algorithm to study the dynamic scheduling problem in a FMS shop floor consisting of multiple manufacturing cells.

Goncalves, et.al [20] developed a genetic algorithm for the resource constrained multi-project scheduling problem. They presents a genetic algorithm for the resource constrained multi-project scheduling problem. The chromosome representation of the problem is based on random keys. They constructed schedules using a heuristic that builds parameterized active schedules based on priorities, delay times, and release dates

defined by the genetic algorithm with the objective to optimize the resource constrained multi-project scheduling problem.

DA Koonce [20] used data mining to find the programming model for problems job shop scheduling. This work aimed at applying the method of data mining to explore the model. Genetic algorithm is used to generate a better solution and Data mining is used to find the relationship between the sequences of the operations and predict the next job in the sequence. The result of data mining can be used to summarize new rule that gives the result as a result of the genetic algorithm.They develop models for planning at product type level, product family level and planning at end product level. However, the disaggregation procedures suggested in this work do not guarantee feasibility. The study of earliness and tardiness penalties in scheduling models is a relatively recent area of research. Most of the existing literature on scheduling focuses on problems that have objective functions such as minimizing makespan (completion time of schedule) and tardiness.

Chandrasekharan [21] introduced three new dispatching rules for dynamic flow shop problem and the Job shop problem. He compared the performance of these rules, to 13 sequencing rules. The problem is modified by random route. Problems are changed Job shop flow programming problem scheduling problem. The study concluded that the performance of dispatching rules is influenced by the flow of work.

Cheng et.al [21] developed a model for Single-machine scheduling of multi operation jobs without missing operations to minimize the total completion time. They consider the problem of scheduling multi-operation jobs on a single machine to minimize the total completion time. Each job consists of several operations that belong to different families. In a schedule each family of job operations may be processed as batches with each batch incurring a set-up time. Their objective is to minimize the total completion time.

Teunter et.al [22] developed a model for Multi-product economic lot scheduling problem with separate production lines for manufacturing and remanufacturing. They study the economic lot scheduling problem with two production sources, manufacturing and remanufacturing, for which operations are performed on separate, dedicated lines. Their objective is to develop an exact algorithm for finding the optimal common-cycle-time policy. Their algorithm combines a search for the optimal cycle time with a mixed integer programming (MIP) formulation of the problem given a fixed cycle time.

Tang and Gong [23] developed a hybrid two-stage transportation and batch scheduling problem They study the coordinated scheduling problem of hybrid batch production on a single batching machine and two-stage transportation connecting the production, where there is a crane available in the first-stage transportation that transports jobs from the warehouse to the machine and there is a vehicle available in the second-stage transportation to deliver jobs from the machine to the customer. Their objective is to minimize the sum of the make span and the total setup cost.

Tseng and Liao [24] developed a discrete particle swarm optimization for lot streaming flow shop scheduling problem. They consider an n-job, m-machine lot streaming problem in a flow shop with equal-size sub lots where their objective is to minimize the total weighted earliness and tardiness.

Chang et.al [25] developed a hybrid genetic algorithm with dominance properties for single machine scheduling with dependent penalties. They developed a hybrid genetic algorithm to solve the single machine

scheduling problem with the objective to minimize the weighted sum of earliness and tardiness costs.

Cheng and Lin [26] developed Johnson's rule, composite jobs and there location problem. They consider two-machine flow shop scheduling with the objective to minimize make span. Johnson's rule for solving this problem has been widely cited in their work. They introduce the concept of composite job, which is an artificially constructed job with processing times such that it willincur the same amount of idle time on the second machine as that incurred by a chain of jobs in a given processing sequence.

Seong-Jong Joo et.al [27] developed a model for Scheduling preventive maintenance for modular designed components: A dynamic approach. Their objective is to develop a dynamic approach for scheduling preventive maintenance at a depot with the limited availability of drilled modules and other constraints. They proposed a backward allocation algorithm and applied it to scheduling the preventive maintenance of an engine module installed in T-59advanced jet trainers in the Republic of Korea Air Force.

He and Hui [28] developed a rule-based genetic algorithm for the scheduling of single-stage multi-product batch plants with parallel units. They present a genetic algorithm-based on heuristic rules for large-size SMSP. In their work, the size of the problems was enlarged, and the problems are first solved by MILP methods and then a random search (RS) based on heuristic rules has been proposed.

Chen and Askin [29] developed a model for Project selection, scheduling and resource allocation with time dependent returns. They formulate and analyze the joint problem of project selection and task scheduling. They study the situation where a manager has many alternative projects to pursue such as developing new product platforms or technologies, incremental product upgrades, or continuing education of human resources. Project return is assumed to be a known function of project completion time. Resources are limited and renewable. Their objective is to maximize present worth of profit.

Janiak et.al [30] developed a scheduling problem with job values given as a power function of their completion times. They deals with a problem of scheduling jobs on identical parallel machines, where job values are given as a power function of the job completion times. Minimization of the total loss of job values is the main objective of their work.

Grzegorz Waligo´ra [31] developed a model named Tabu search for discrete continuous scheduling problems with heuristic continuous resource allocation. His objective is to minimize the make span .He considered problems of scheduling non-preempt able, independent jobs on parallel identical machine sunder an additional continuous renewable resource.

Valls et.al [32] developed skilled workforce scheduling in Service Centre's. Their main objective with SWPSP is to quickly obtain a feasible plan of action satisfying maximum established dates and timetable worker constraints. Secondary their objectives deal with the urgency levels imposed by the criticality task levels, to obtain well-balanced worker workloads and an efficient assignment of specialists to tasks.

3. Supply of finished parts in inventory

Ostertagová et al (2011), prepared a theoretical base for calculation and application of the simple exponential smoothing method. The simple exponential smoothing model is one of the most popular forecasting methods that we use to forecast the next period for a time series that have no pronounced trend or seasonality. [47]

Sheikh et al (2012), suggest Load forecasting is the technique for prediction of

electrical load. In a deregulated market it is much needed for a generating company to know about the market load demand for generating near to accurate power. If the generation is not sufficient to fulfill the demand, there would be problem of irregular supply and in case of excess generation the generating company will have to bear the loss. Neural network techniques have been recently suggested for short- term load forecasting by a large number of researchers. This work studies the applicability of this kind of models. The work is intended to be a basis for a real forecasting application. First, a literature survey was conducted on the subject. Most of the reported models are based on the so- called Multi- Layer Perceptron (MLP) network. There are numerous model suggestions, but the large variation and lack of comparisons make it difficult to directly apply proposed methods. It was concluded that a comparative study of different model types seems necessary. [48]

Albertson et al (2003), approach on forecasting levels of stocks held by manufacturing industry is problematic. Stocks are the most volatile component of GDP. The data itself is subject to chronic revision. Yet, forecasting inventory changes in the supply chain is crucial for firms trying to manage output. The paper reports a successful approach to forecasting UK manufacturing stock behavior sponsored by a leading European metals manufacturer. The model exploits the seasonality of stock build-ups and run-downs. (Existing econometric approaches rely on seasonally adjusted data.) The forecasting performance of our model is compared to alternative time series approaches. [49]

Rahman et al (2010), impede the inventory replenishment during the peak sale season. Due to the extreme situations, sales may not occur and demand may not be recorded. This study focuses on forecasting of intermittent seasonal demand by taking random demand with a proportion of zero values in the peak sale season. Demand pattern for a regular time is identified using the seasonal ARIMA (S-ARIMA) model. The study proposes a Bayesian procedure to the ARIMA (BS-ARIMA) model to forecast the peak season demand which uses a dummy variable to account for the past years intermittent demand. To capture uncertainty in the BS-ARIMA model, the non-informative prior distributions are assumed for each parameter. Bayesian updating is performed by Markov Chain Monte Carlo simulation through the Gibbs sampler algorithm. [50]

Pradip Kumar Bala, (2012), approaches to accuracy in demand forecasting is the key to the performance of inventory management. There is no dearth of techniques used for forecasting demand in retail sale. Advances in data mining application systems have given rise to the use of business intelligence in various domains of retailing. The current research captures the knowledge of purchase dependency in the form of association rule for improved forecasting. The model developed in this work suggests a technique for forecasting of demand which results in improved performance of inventory. [51]

Fred C. Lunenburg (2012), Human resource planning begins with a forecast of the number and types of employees needed to achieve the organization's objectives. Planning also involves job analysis, which consists of the preparation of job descriptions and job specifications. [52]

Saidane et al (2010), Managing spare parts inventories are a challenging task and can benefit considerably from any information on the failure rate of the parts. It has often been considered in the stock control literature that parts' failures are only random, caused by external events which results in the assumption of constant failure rate and therefore the consideration of the Poisson process to represent spare parts

demand. This is obviously a restricted and an unrealistic modeling assumption.[53]

4. Gap Analysis

The gap associated with staff, equipment, facilities utilization and customer waiting time, Inventories, Processing time minimization are presented By Scheduling, assign a particular time for completing a particular job. A job should not visit the same machine more than once. There are no precedence constraints on operations of different jobs. Operations ones started can't be interrupted. Each machine is capable of processing one job at a time and each job must be processed through a particular predefined sequence of operations. There is a flow shop scheduling problem in which all the parameters like processing time, due date, refixturing time, setup time are given. The value of the make span of batch-processing machines in a flow shop based on comparison of Gupta's heuristics, CDS heuristics are proposed. Analytic solutions in all the heuristics are investigated. Gantt chart was generated to verify the effectiveness of the proposed approaches. Here the heuristics approach for planning problems are proposed which provides a way to optimize the make span which is our objective function. Inventory management has become more and more relative issues for companies, due to the ongoing globalization. A FJSP is more troublesome than the established JSP, because it adds a level of decision yet beside that sequencing i.e. job routes. Towards job route decides appropriate machine to process a particular operation among the available machines.

a) Need to assign a job to a machine/resource to process it.
b) Loading.
c) Need to decide how many jobs can be assigned to each machine.
d) Scheduling.
e) Need to decide on a starting time for each job at each workstation.
f) Sequencing.
g) Need to order processing of individual jobs at each workstation.

5. Conclusion

The main conclusion of work is to arrive at a position where will get minimum processing time and maintain the inventory cost. The various assignments associated with staff, equipment, facilities utilization and worker waiting time, Inventories, Processing time minimization are:

1. To deal with the production planning problem of a flexible manufacturing system. I model the problem of a drilling flow shop scheduling with the objective of minimizing the make span.
2. To provide a schedule for each job and each machine. Schedule provides the order in which jobs are to be done and it projects start time of each job at each work center.
3. To select appropriate heuristics approach for the scheduling problem through a comparative study.
4. To solve FMS scheduling problem in a flow-shop environment considering the comparison based on Gupta's heuristics, RA heuristic's.
5. To forecast the inventory demand and supply for maintain the finished products in drilling shop.

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