Capacity planning and control: a review

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Abstract— Capacity planning and control is an issue which every operation is faced with. Furthermore it is an activity which can profoundly affect the efficiency and effectiveness of the operation. Capacity planning and control is the task of setting the effective capacity of the operation so that it can respond to the demands placed upon it.This usually means deciding how the operation should react to fluctuations in demand. In this strudy 58 articles in the field of "capacity planning and control" published during 2000-2014 have been reviewed. It is concluded that many of the articles on the subject of capacity planning and modeling have been investigated in various field though simulation and model analysis, while not focused on the issue of capacity.

Index Terms— Capacity planning and control, Capacity planning, Capacity control, Capacity.

1 Introduction

All operations are limited in terms of capacity. Therefore, we should be able to achieve organizational goals and objectives related to the supply chains by planning and controlling the capacity of these operations [1]. Therefore, capacity planning and control is an issue which every operation is faced with and it is an activity which can profoundly affect the efficiency and effectiveness of the operation and also, the capacity of which has various meanings in different parts and departments; It will be discussed in the next section.

The actual process of capacity planning will vary somewhat from one industry to the next. While there are factors unique to each industry that help to shape the approach to effective planning, there are a few basic elements that tend to apply in any situation. Many of these have to do with adjusting the amount of production based on anticipated demand for the products, both now and in upcoming production periods [2].
Capacity planning process is shown as a graph in Figure 1 [3].

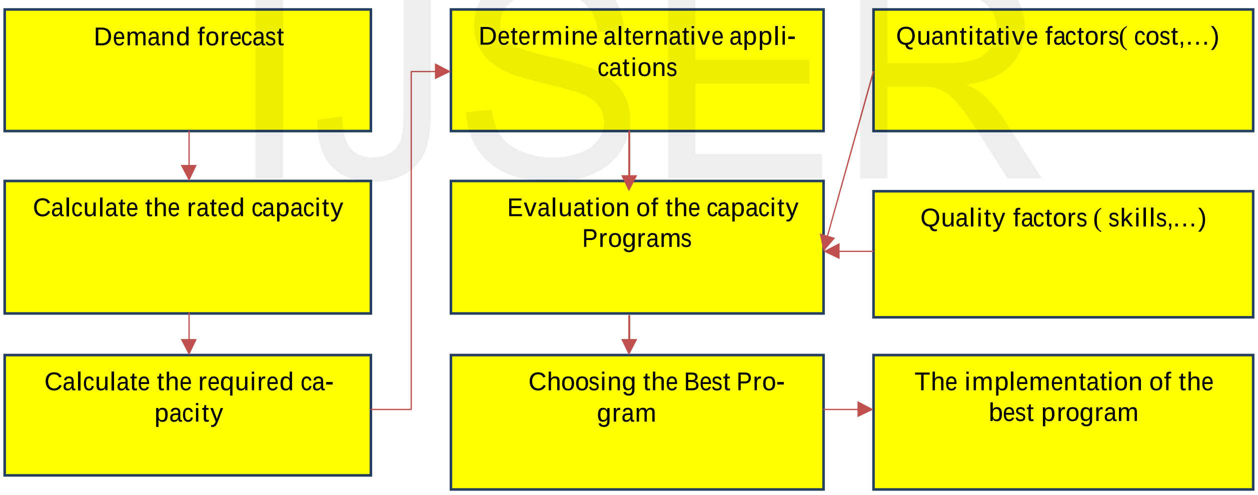

Fig.1. Capacity planning process

Available capacity management, includes demand management as well as capacity management .In demand management issues such as price variation, changes in methods of promoting the product, change over delivery time (for example due to items Returns) and order complementary products are under consideration ; In the capacity management issues such as, the staff diversity, changes in equipment and procedures, changes in methods and redesign product to accelerate the process are of importance [3] .
Capacity planning and control is concerned with making sure there is some kind of balance between the demand placed on an operation and its ability to satisfy that demand. If an operation has too much capacity at any point in time it will be underutilising it resources, paying out for machinery and facilities and often paying its staff but, because demand is lower than capacity, its costs are spread over two few customers. Therefore its costs per customer will be high. If it has too little capacity, its costs will be low (because its facilities will be fully utilised) but its customer service will be poor because it is either turning customers away or making them wait for their products and services. This will potentially undermine the

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company's success in the future. Therefore there are serious consequences of getting the balance between demand and capacity wrong[1] .

1-1 Importance of the issue in the point of Capacity planning and control
Capacity planning and control is the task of setting the effective capacity of the operation so that it can respond to the demands placed upon it .

1-2 Importance of the issue in the point of Capacity planning
Operations managers, with an unstable and uncertain demand forecasts are faced.
There are several steps to meet these demands:
the first step will be to measure the aggregate demand and capacity levels for the planning period. The second step will be to identify the alternative capacity plans which could be adopted in response to demand fluctuations. The third step will be to choose the most appropriate capacity plan for their circumstances[2].
For gathering information, the Science Direct database via the advanced search and use of keywords capacity planning and control, capacity planning, capacity control, capacity as well as demand was under consideration to review articles related to the topic ; The conference papers were considered and a Search in Sites and books related to the subject was conducted to create a global view of the subject.
The paper is structured as follows: the basic concepts and definitions related to the capacity planning and control is given in Section 2. The literature review on capacity planning and control are discussed in Section 3. The paper concludes with a discussion of potentials for future work in Section 4.

1-3 Importance of the issue in the point of capacity control
Capacity control is essential for any production shop. If too many orders are sent to the shop floor, lead-time increases as parts sit in queue waiting to be run and promises to customers are broken. Orders are released even earlier in hopes of making the desired completion date. The overall utilization of the formal system begins to break down and the informal system resumes control .To cover shortages, substantial dollars are invested in safety stocks of raw materials before they are really needed , adversely impacting cash flow . In order to deal with this issue, there are two tools in capacity control, one of which is the input/output control that can be used to keep the amount of work in progress on the shop floor constant that the focus of this input/output control should be on the main bottleneck of the plant. Another tool in capacity control is analyzing future needs for capacity and scheduling orders to smooth future lumpy demands[4].

2 Inerconnection between Capacity and Demand

An important feature of control and planning is that it is related to configuration of capacity levels over the short and medium term with contiguous demand. Fig. 2 shows the number of published papers in the field of capacity planning during the years 2000 - 2014. It should be noted that in this figure, "0" is the symbol of the year 2000.

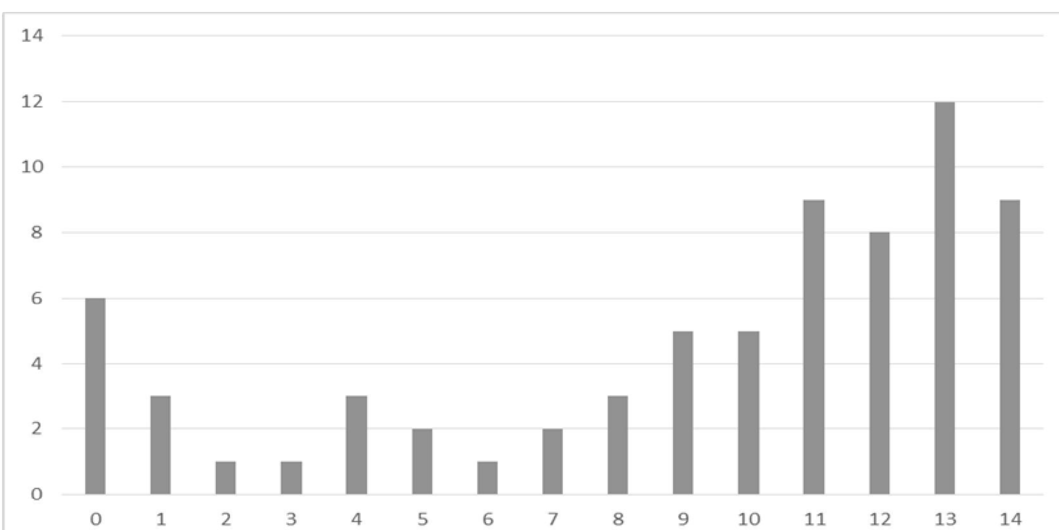

Fig. 2. The number of published papers in field of capacity planning

Fig. 3 shows the number of published articles in the field of capacity control in the years 2000-2014. As it can be seen in the

Fig. 3, capacity control is relatively young research field and there is a lot of work to do on it , that because of its importance, it should be addressed in future articles.

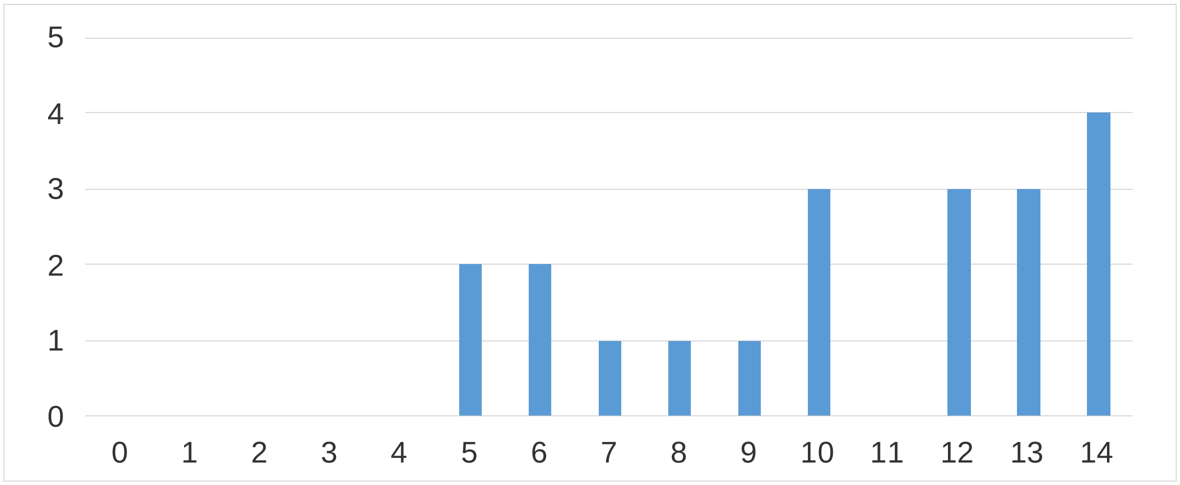

Fig. 3. The number of published papers in the field of capacity control during the years 2000-2014

3 Literature Review

To provide readers with an overview about operations research models and applications Volling et al. (2013) identified current and future research issues based on the review of 49 works. To bridge the gap between conceptual works on the one hand and quantitative contributions on the other, they provided a framework for the structuring of planning tasks. For data collection, a bibliographic database of research and the relevant articles were reviewed. Amongst the works that they considered have been 26 from the German speaking community and this provides evidence that approaches for production management in the automotive industry are particularly well developed in this community [8] .

Fulemová , Bicova (2014),described an efficiency increasing of the monitoring activities in the manufacturing workshop laboratory at the university , where is required the operational capacity planning of machines management and ensuring necessary number of a human resources according to ISO 9001 requirements . They showed that scheduling with the help of MS Project software will be solved only for the external laboratory (VTP) ,which is more used by partners and there is not so difficult to schedule the contracts for a certain period[9] .
Georgiadis, Athanasion (2013), dealt with long-term demand-planning problem on the basis of mathematical programming and simulation analysis that consists of three phases, each of which contains its own importance and functions. Specifically, the proposed solution methodology includes three stages: i.e., the case mix planning phase, the master surgery scheduling (MSS) phase and the operational performance evaluation phase. They showed that the planning problem can be extended over a hospital network in a certain area , and the tactical case mix and capacity planning can be combined with the operational patient scheduling to form an efficient health care driven capacity planning in the reverse channel of closed-loop supply chains (CLSCs) with remanufacturing, under high capacity acquisition cost coupled with uncertainty in actual demand , sales patterns , quality and timing of end-of-use product returns . They used the integration method Euler and the integration time-step was equal to 1 week (equal to or shorter than the shortest time constant in the model). The model is solved by using the Powersim 2.5c simulation software package. The study also revealed that flexible policies can effectively cope with overinvestment phenomena in remanufacturing facilities, detected in near-optimal policies [10] .

Huang et al. (2012) , developed an interval-parameter chance-constrained dynamic programming (ICDP) method for the capacity planning of an integrated municipal solid waste (MSW) management system under uncertainty. They used data envelopment analysis (DEA) technique to identify the optimal capacity-expansion scheme under different system costs and constraint-violation levels. This study is the first attempt for planning waste management system through integrating the ICDP and DEA techniques, the results suggest that the developed method is an effective tool for decision makers for the long-term capacity planning [11] .
Demeulemeester , Ma (2013) presented a multilevel integrative solution approach to a hospital case mix and capacity production framework [12] .
To address two common production planning problems in SMI's, which are warehouse space allocation and production capacity planning , Lim et al. (2014) , proposed a simple novel graphical approach. These methods are then illustrated with two actual industrial case studies, where it is shown that the newly developed tools provide good quantitative understanding of production planning problems. Two novel graphical tools called the production planning pinch diagram (PPPD) and production planning grand composite curve (PPGCC)

were proposed. They showed that when mathematical programming tools are used , the proposed tools are user friendly and can be performed by using simple spreadsheet software[13] .

S.Pimental et al. (2013) , presented the Stochastic Capacity Planning and Dynamic Network Design Problem, which integrates facility location, network design and capacity planning decisions under demand uncertainty. An application to the Global Mining Supply Chain served as a background for the analysis of the features and complexity of the model. In order to deal with such complexity , they proposed a Lagrangian Heuristic. Assessing the dual information provided by the Lagrangian multipliers could provide us with some indication so as to decide initial capacities, as discussed above, or even other supply chain structural features[14].

To explain the gap between the practice and the academic models of production planning ,Tenhiälä (2011) , employd the contingency theory of organizations . Arguments on the contingency effects of process complexity led to a hypothesis that expects simple capacity planning methods to be most effective in certain production processes. The method of interviews and questionnaires were used to collect data. The results of this study give tentative support for a contingency theory of capacity planning[15] .

To study the stochastic factors' influences on capacity planning decision, Ren-qian (2007) built a stochastic capacity expansion model. For solving this model, the constraints of uncertain demand are transformed into equivalent deterministic constraints and a heuristic algorithm that combines the Genetic Algorithm (GA) and the Primal-Dual algorithm of Nonlinear Programming, is produced. Taking the stochastic and dynamic factors into account is important to consider uncertainty in the future , which also helps to develop an aggregate production plan that needs the least adjustment [16] .

To analyze the performance of multimedia service systems, which have unreliable resources, and to estimate the capacity requirement of the systems, Kim , Park (2002) developed a capacity planning model using an open queueing network. By acquisition of utilization, queue length of the resources and packet delay, and reliability of the systems, they derived the service capacity of the systems along with the arrival rates of clients and the failure rates of the resources.They demonstrated that large-scale multimedia service systems with feedback are unreliable operation[17].

Hwang et al. (2010) , studied the demand and capacity management problem in a restaurant system. Markov processes and (congestion) dependent demand rate function were considered . A queueing based optimization model with underlying quasi birth-and-death process and state-dependent functions developed to address the dynamic and nonlinearity difficulties. They showed that neither strategy is ideal for most casual restaurants with the goal of profit-maximization. Instead, a joint strategy that balances both marketing and operations perspectives should be embraced[18].

Martnez-Costa et al.(2014) , offered an up-to-date review on strategic capacity planning in manufacturing companies, with two main objectives: (1) to describe and analyze the strategic capacity planning problems; and (2) to review the mathematical programming models proposed in the literature for dealing with these problems. The main search was conducted in the Web of Science using critical keywords and was complemented by using other search engines. They concluded that decisions such as resource allocation and production scheduling have been considered widely in the literature[19].

A.Duffie , Kim(2005) , described a model that represents the dynamics of a multi-workstation production system that incorporates closed-loop production planning and control. They used methods of control engineering to make the analysis tractable, as well as improve understanding and control of complex dynamic behavior and the frequency response method was used to find the limits for stable response . They showed that the tools of control engineering can be effectively applied in the analysis of multiworkstation systems[20] .

Spicar (2014), described how system dynamics play a major role in capacity planning and what problems occur when neglected to account for, and constructed casual loop diagrams and stock and flow diagrams for the examples and the systemsare simulated using the Vensim PLE software. The results confirmed that insufficient capacity may cause the entire production system to wildly and unpredictably fluctuate even though all input parameters are held constant[21].

Koch et al. (2014) , proposed an approach that systematically increases the revenues of flexible products when solving the DLP and performing capacity control .They determined the function′s parameters using a standard simulation-based optimization method . Numerical experiments showed that the benefits of the approach are biggest when low value demand arrives early [22].

To support decision making in production planning Peters ,Lanza (2012) developed a method by combining a queueing theory model with a stochastic, dynamic optimization approach . Hereby, they solved a Markovian Decision Process to find cost minimal policies as reactions to volatile market demands for minimizing costs due to capacity adaptations, changes in process steps, and locations. The method was able to react to market changes by adapting capacities and changing process alternatives referring to technologies, locations and machine types [23].

By integrating the simulation discipline and the feedback control theory into a dynamic consideration of recycling networks Georgiadis (2013), proposed a System Dynamics (SD) model for strategic capacity planning in the recycling industry . The simulated CLRN generates the dynamics of the system as endogenous consequences of the embedded operational feedbacks and provides an ''experimental'' tool for planning, testing and revealing economically-viable capacity planning decisions for the production line (forward channel) and collection centers (reverse channel) [24].

To meet the future demand based on optimistic and pessimistic economic projections Suryani et al.(2012), established a method for developing model to forecast air cargo demand and scenarios related to planned capacity expansion. The implications of foreign direct investment (FDI) and gross domestic product (GDP) was used. From the results of some experiments of 2^k factorial design, they concluded that GDP Growth has a very strong effect to air cargo demand compared to other factors such as FDI, import, and transit growths [25] .

(Becher ,2009) ,His objective was to identify the revenue potential of a rule-based implementation of revenue management as a method for simultaneous capacity and price control. First, the general conduction of this integrated method was described based on the available literature. Second, the limitations and constraints in the use of the underlying model especially in terms of the applicability in practice and the impreciseness of information were illustrated. Third, a solution concept was established that is able to cope with these limitations. Necessary stability and robustness of a fuzzy control system was developed by a simulation tool that was able to performing a large number of fuzzy systems with changing parameters and analyze changes in the solution due to changes in the system. Showed that one of the most compelling reasons for this kind of solution, in addition to significant improvements in income, was the ability to use the rule set for CPC and also for the SCPC [26] .

Miglionico et al. (2014), addressed restaurant revenue management from both a strategic and an operational point of view. They proposed formulations of the so-called ''Tables Mix Problem'' by taking into account several features of the real setting. The results showed that all the booking control policies ,on average ,perform better than the simple First-Come First-Served policy and than the policy obtained in the case of perfect knowledge of the demand realized [27].

To maximize expected revenues over a finite horizon Karaesmen et al.(2013), formulated a Markov Decision Process (MDP) that explicitly models the current environment. They observed that the benefit from the environment-based model is significant if the conditions in different environments are distinctively different [28] .

Ceryan, Koren(2009) formulated Optimal capacity selection problem using mixed integer programming and numerical studies performed to provide insights about how these decisions are affected by investment costs, product revenues, demand forecasting scenarios and fluctuations in the planning periods .They showed that optimal investment strategies include greater participation of flexible systems under lower flexibility investment cost, high product revenues as well as high products uncertainties within the time periods [29].

For multi-period and multi-echelon ethanol supply chains Giarola et al.(2013), developed and implemented a general Mixed Integer Linear Programming modelling framework supporting strategic design and planning decisions . They addressed the source of uncertainty through a scenario-based two-stage stochastic approach. Results showed the effectiveness of the modelling framework as a decision making-tool to steer decisions and investments in the long term horizon among different ethanol fuel configurations [30] .

Giarola et al.(2012), developed a general mixed integer linear programming modelling framework to assess the design and planning of a multi-period and multi-echelon bioethanol upstream supply chain under market uncertainty and aiming at the maximization of the financial performance of the business (expected net present value, eNPV) and complying with environmental sustainability criteria (minimum GHG emissions savings). Results showed the effectiveness of the model as a decision making-tool to steer long-term decisions and investments [31].

Moussawi-Haidar et al. (2010) developed a discrete-time dynamic capacity control model for a cruise ship characterized by multiple constraints on cabin and lifeboat capacities. They developed several heuristics and thoroughly test their performance, via simulation, against the optimal solution, well-crafted upper bounds, and a first-come first-served lower bound and found that single-dimensional heuristics based on decoupling the cabins and lifeboat problems perform quite well in most cases and the opportunity cost of accepting a customer is not always uniform in time or the level of reservation [32].

Giarola et al.(2012) addressed the design of bioethanol supply chains where both corn grain and stover are considered as suitable biomass. They proposed a Mixed Integer Linear Program to simultaneously optimize the environmental and financial performances by taking into account a wide number of technological options. The system boundaries have been set according to a Well-to-Tank (WTT) approach and Modeling framework was formulated as a problem MOMILP. They showed that in general first generation technologies, although more economically competitive, are not a sustainable answer to the energy supply question, particularly if the latest EU legislation is taken into account [33] .

Xie et al.(2014),studyed a multi-channel distribution system in which a manufacturer sells its product via an independent service provider and a direct selling market simultaneously. They expanded the information sharing issue for a case with three partners and multi-channel distribution .The decision-making mechanism developed by the paper is effective in solving the manufacturing capacity planning and allocation problem[34] .

Fang, Ho (2013) ,raised issues related to the consultation on allocation of capacity for multiple products. They used general reduced gradient method to obtain an optimal solution and modified it for the algorithm related to nonlinear model with constraints, that can obtain the optimal solution by random selection of a practical solution. They showed that marginal benefit , inventory holding cost, shortage cost, lack of surplus production and the market demands in an effort to explore the optimal allocation of capacity associated with various products should be considered [35] .

Steele et al.(2001) provided a resource modeling structure that integrated the analysis of product with behavior of the physical productive resources (Embedded in the software applications methods) for product design, process planning, production cost, quality control, resource acquisition, planning and production scheduling and implementation of shop-floor activities .This structure was based on a set of production resources classes that determine the structure of a resource modeling database . These classes are used for building object-oriented software package which implements various functions of engineering design [36] .

Koenig, Meissner(2010) considered the problem of a firm selling multiple products that consume a single resource over a finite time period and analyzed the difference between a dynamic pricing policy and a list-price capacity control policy.

The differences between the policies showed that list pricing can be a useful strategy when dynamic pricing is costly or impractical[37].

Feng, Xiao (2006), proposed a continuous-time model that integrates pricing and inventory control decisions for perishable products and the supplier serves multiple customer classes with the same products. Demand is a non-homogeneous Poisson process whose intensity is a function of price and time.They showed that the optimal price for each active class may not be the highest one among the alternatives[38] .

After formulating the capacity planning and two-machine scheduling problems integrately, Mokhtari et al.(2013) presented an analytical solution approach. The proposed algorithm was coding in MATLAB, 2008a and run using a personal computer .The result showed that depth first search strategy in all three lower bound in terms of computing time and the number of nodes in the branch and bound tree ,has better efficiency than the first level strategy [39] .

Volling et al.(2012), addressed the capacity control problem in MTO revenue management under stochastic demand. BPU-NN was implemented with neural networks using one hidden layer and non-linear sigmoidal type transfer functions .They used neural networks to update prices. According to the analysis, the proposed BPU-NN approach dominates the examined traditional bid-price policies in risk and expected contribution margin [40] .

Akamatsu, Wada(2013) , first discussed the impossibility of applying the VCG mechanism to the trading markets due to NP-hardness and to avoid such computational infeasibility, they constructed a day-to-day auction mechanism that is readily implementable .They showed that the network permit allocation pattern under this mechanism converges to an approximation of the socially optimal state in the sense that the achieved social surplus reaches its maximum value when the number of users is large [41] .

Graf, Kimms(2013) , studied the revenue management capacity control problem in the presence of two airlines building a strategic alliance. The optimal transfer price were determined by the negotiation process . The booking limits were improved with simulation-based optimization in an iterative process. The survey showed that the results of the OBP&SPSA+Prices approach are very promising overcoming the drawback of a first-come-first-served scenario in all considered instances [42].

Steinhardt, Gonsch (2012), addressed the problem of integrating revenue management's capacity control with upgrade decision making as well as used DP , DPD-D , DPD-S, SUCC , FCFS and EX Post method .They showed that the proposed approaches are tractable for real-world problem sizes and outperform those disaggregated, successive planning approaches that are used in revenue management practice today [43].

G¨onsch et al.(2013), considered the revenue management problem of capacity control with integrated upgrade decision-making and proposed a heuristic approach that generalizes the idea behind the well- known single-leg EMSR-a procedure to multiple resource types. Their approach can significantly outperform existing methods in terms of the total achieved revenue, including dynamic programming decomposition approaches which are proposed in literature, as well as successive planning approaches that are widely used in commercial revenue management systems [44] .

Laínez et al.(2012) ,Studied applications that have actual or potential communicate with the pharmaceutical industry .They developed particular attention to three key stages in the life cycle of an innovative pharmaceutical product ,namely the product development pipeline management, capacity planning and supply chain management .Scope of the SCM problems, typically were surrounded by means of PSE methods of a strategic component and an operational / tactical planning component [45] .

Kaundinya et al.(2013) , developed a GIS (geographical information system)-based data mining approach for optimally selecting the locations and determining installed capacities for setting up distributed biomass power generation systems in the context of decentralized energy planning for rural regions.They used a k-medoid clustering algorithm to divide the total region into clusters of villages and locate biomass power generation systems at the medoids and showed that the current approach can be applied to all areas where there is the potential for energy production from biomass [46] .

Nazemi , Modarres(2005), developed an approach to the problem of capacity and price management in manufacturing on a Yield management framework through a set of principles. They found such dilemma of unsatisfied capacity demand in many manufacturing areas has made the cost of production higher than expected [47] .

To assist in providing procedures for implementing input and output control Kingsman(2000) , provided a theory for workload control in a mathematical form. The theory showed that attention should be concentrated on controlling the differences between the cumulative inputs and outputs over time, and not the period individual inputs and outputs ,and Lead time management using input/ output workload based on the hierarchical control of work loads, are better than anticipated lead times [48] .

Huang et al.(2009), developed a mathematical model for the workforce capacity planning problem, where the uncertainty of the demand was handled by the safety stock concepts .They suggested a number of practical planning alternatives and assignment rules based on information from IBM. The designed program to emulate the dynamics of a company's workforce for Planned and non-Planned activities , in modular approach, became conceptual and organized as far as facilitate the combination of labor laws and planning different models [49].

Caccetta et al.(2004), considered the problem of establishing an aggregate production plan for a manufacturing plant. They proposed a dynamic discrete-time model of capacity planning utilizing concepts arising in positive linear systems (PLS) theory and analyzed its controllability property. They showed that controllability is a fundamental property of the system with direct implications not only in dynamic optimization problems but also in feedback control problems [50].

For multi-site capacity planning under the uncertainty of the TFT-LCD industry Chen,Lu (2012), presented a stochastic optimization model and efficient decomposition algorithm. They developed a two-stage scenario-based stochastic mixed integer programming model that extended the deterministic multi-site capacity planning model proposed by Chen et al. (2010) to discuss the multi-site capacity planning problem in the face of uncertain demands and expected shadow-price based decomposition, an algorithm for the stage decomposition approach ,was developed to obtain a near-optimal solution efficiently through iterative procedures and parallel computing .The proposed algorithm outperformed the plain use of the CPLEX MIP solver as the problem size becomes larger and the number of demand scenarios increases [51].

Hartmann et al.(2014) studyed a robust formulation for strategic location and capacity planning considering potential company acquisitions under uncertainty. Minimizing the expectation of the relative regrets across scenarios over multiple periods was the objective that achieved by dynamically assigning multi-level production allocations, locations and capacity adjustments for uncertain parameter development over time .They showed that robust mixed-integer linear programming model achieves superior results to the deterministic configurations in exhaustive computational tests [52].

Mokhtari et al.(2011) presented an integrated model between a production capacity planning and an operational scheduling decision making process . Based on the concept of nondelay timetabling (employed by VNS and GASA) and enhanced timetabling (adapted by CLM),they developed an improved hybrid timetabling by relaxing the permutation constraints and using inversed problem. They implemented a two-phase genetic algorithm approach for the crashing and sequencing problems. They used heuristics and two meta-heuristics (VNS and GASA) methods. Experimental results supported the effectiveness of suggested sequencing approach against other methods [53] .

Gebhard et al(2013) studied a strategic capacitated facility location problem with integrated bi-directional product flows through a network of multiple supply stages, including production allocations, uncertain data development, facility locations and flexible capacity adjustments .They showed that the approach supports practitioners in assessing the flexibility of their supply chain, independent of its product flow direction, when operating under uncertainty [54].

Chou et al.(2007) examined a business model of capacity planning and resource allocation in which consists of two profit-centered factories. They proposed an ant algorithm for solving a set of non-linear mixed integer programming models of the addressed problem with different economic objectives and constraints of negotiating parties. Experiment results revealed that near optimal solutions for both of isolated (a single factory) and negotiation-based (between the two factories) environments are obtained [55].

To analyze the cost-effectiveness of capacity planning and its relationship to suppliers Wang et al.(2013) applied a novel fuzzy multi-objective linear programming model. Considered factors were order quantity allocation, due dates, manufacturing quantity, capacity, defect rates, back-log, and the purchasing discount. Implementation results demonstrated the potentials for cost-effective capacity planning and outsourcing, and identify the applicability of these fuzzy theories to a specific mold-manufacturing case [56].

To eliminate drawbacks of MRP systems and provide solutions for large-scale instances Öztürk, Örnek(2012) proposed a heuristic method called Capacity Allocater and Scheduler, CAS. The CAS procedure, based on iteratively solving relaxed Mixed Integer Programming (MIP) models, was built on a lot sizing and scheduling framework, which considered both supply alternatives and lot size restrictions simultaneously. They showed that the quality of obtained solution from CAS strictly depends on replenishment lead-times and a well-defined build [57].

Liu et al.(2013), tackled the container planning problem from the carrier’s perspective in a two-echelon container shipping service chain (CSSC), which includes one carrier and one upstream rental company. Numerical examples showed that the proposed decision strategies with option contract cannot only effectively increase the container trading quantity between the rental company and the carrier, but also significantly reduce the carrier’s container capacity risk while increasing its profit [58].

Dellaert et al.(2011) assumed that the capacity shortage cost function to be either linear or quadratic with the amount of shortage, which corresponds to different market structures or different types of services. Compared to existing budgeting models, this paper explicitly considers a budget constraint. Under the assumption of a restricted budget, the objective was to minimize capacity shortages. Numerical results showed that the quadratic cost function leads to smooth and moderate capacity shortages over the time periods, whereas all shortages are either avoided or accepted when the cost function is linear [59].

Srivastava (2012),Their article focused on the optimum selection of the treatment and disposal facilities, their capacity planning and waste allocation under uncertainty associated with the long-term planning for solid waste management. The fuzzy parametric programming model was based on a multi-objective, multi-period system for integrated planning for solid waste management.They showed that it is possible that a marginal change in waste quantity could increase the total cost / risk substantially [60].

Mínguez et al. (2011) presented a method that was based on mathematical programming decomposition procedures and first-order reliability methods, and constitutes an efficient method for optimizing quantiles in high-dimensional settings. The solution provided by the method allows us to make informed decisions accounting for uncertainty [61] .

Ramezanian et al.(2012) wanted to minimize costs and instabilities in the work force and inventory levels .The paper concentrated on multi-period, multi-product and multi-machine systems with setup decisions .They developed a mixed integer linear programming (MILP) model for general two-phase aggregate production planning systems. Due to NP-hard class of APP, they implemented a genetic algorithm and tabu search for solving this problem. The results showed that these proposed algorithms obtain good-quality solutions for APP and could be efficient for large scale problems [62].

Wong, Lai(2011) presented an article that its objectives was to identify the research trends in and publication outlets for the applications of the fuzzy set theory technique in production and operations management (POM). The major findings indicated that (1) the most popular applications are capacity planning, scheduling, inventory control, and product design, (2) some application areas make more use of particular types of fuzzy techniques, (3) the percentage of applications that address semi/unstructured types of POM problems is increasing, (4) the most common technologies integrated with the fuzzy set theory technique are genetic/evolutionary algorithms and neural networks, and (5) the most popular development tool is C Language and its extension [63] .

One of the most important dimensions of the supply chain network is to determine its optimal operating conditions incurring minimum total costs. In order to resolve these complexities and to identify the optimal operating condition Tiwari et al. (2010) proposed a hybrid approach incorporating simulation, Taguchi method, robust multiple non-linear regression analysis and the Psychoclonal algorithm .They showed that their research makes it possible for the firms to understand the intricacies of the dynamics and interdependency among the various factors involved in the supply chain [64].

Kempf et al.(2009) presented a non-linear programming formulation of the integrated problem using clearing functions that determines a work release schedule guaranteeing a specified service level in the face of stochastic demand. They introduced an iterative heuristic solution procedure that solves a relaxed LP approximation of the original NLP at each iteration to determine the lead-time profile to set safety-stock levels. Computational experiments suggested that their proposed iterative procedure performs well relative to conventional LP models that assume fixed, workload-independent lead-times [65] .

4 Conclusion

All operations are limited in terms of capacity. Therefore, we should be able to achieve organizational goals and objectives related to the supply chains by planning and controlling the capacity of these operations. Therefore, capacity planning and control is an issue which every operation is faced with as well as it is concerned with making sure there is some kind of balance between the demand placed on an operation and its ability to satisfy that demand. Surveys conducted in this field show that there is a close relationship between capacity and demand and many papers have addressed this issue and it is concluded that many of articles on the subject of capacity planning and modeling have been investigated in various field though simulation and model analysis ,while not focused on the issue of capacity control . Whereas we know that there is a close affiliation between planning and control and according to many experts, the planning system without control is meaningless because managers use planning to smooth the activities path to achieve the organizational goals and control is a process that is used to determine if the organization has achieved its goals as well as they say that no system without monitoring and control can reach their highest capacities.

Therefore, in future studies, it is recommended to consider capacity control and in fact, see these two views together and consider capacity planning and control in various fields and modeling in this field as well as implement models in a large area so that the results will have high credit and can be applied in issues of the day and this will potentially ensure the company's success in the future.

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