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Survey on Different Techniques in Supply Chain Management

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***Abstract*A supply chain network by nature is a large and complex, engineering andmanagement system. Oscillations occurring in a supply chain because of internal and/or external influences and measures to be taken to mitigate/minimize those oscillations are acore concern in managing the supply chain and driving an organization towards acompetitive advantage.A supply chain is a network of facilities that procure raw materials/services/technologies,transform them into intermediate goods and final products/services, and deliver the products/services to customers through a distribution system. The purpose of supplychain management is to provide the right quantity of the right product at right time to the right customers at an optimal cost. In this survey paper we have discussed various techniques used for getting optimal solution in SCM which can maximize the profit of industry.**

Keywords—Image inpainting

I. INTRODUCTION

Most of the organizations today are forced to increase their global market share in order to survive and sustain growth objectives. At the same time, these same organizations must defend their domestic market share from international competitors. The challenge is how to expand the global logistic and distribution network, in order to ship products to customers who demand them in a dynamic and rapidly changing set of channels. Strategic positioning of inventories is essential, so that the products are available when the customer wants them [1][2] also claims that supply chain should actually be efficient and effective. In this case, efficient means to minimize resource use to accomplish specific outcomes; and effective, in terms of designing distribution channels. Efficiency is measured by delivery performance, product quality, backorders and inventory level, whereas effectiveness is measured by service quality and the service needs. Long-term competitiveness therefore depends on how well the company meets customer preferences in terms of service, cost, quality, and flexibility, by designing the supply chain, which will be more effective and efficient than the competitors'. Optimisation of this equilibrium is a constant challenge for the companies which are part of the supply chain network, shown in Figure 1. To be able to optimise this equilibrium, many strategic decisions must be taken and many activities coordinated. This requires careful management and design of the supply chain.

The design of supply chains represents a distinct means by which companies innovate, differentiate, and create value [3]. The challenge of supply chain design and management is in the capability to design and assemble assets, organizations, skills, and competences. It encompasses the team, partners, products, and processes.

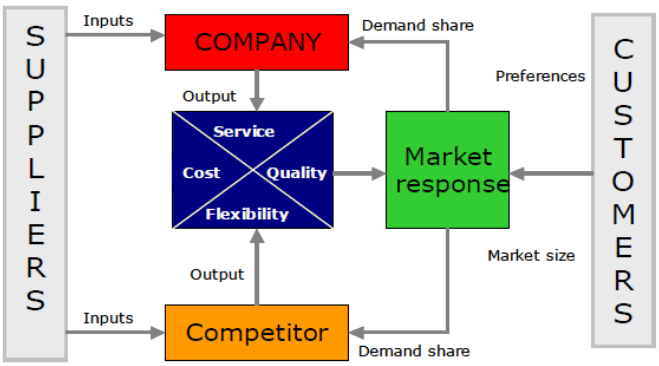

Figure 1: Competitive Framework in the Supply Chain [5]

To understand the term of supply chain management in depth, first the term of supply chain will be explained, than management and the role of management as a base for complete definition of supply chain management. According to [4] the definition of "supply chain" is more consolidated as definition of supply chain management. In his paper, he tried to make a common definition of a supply chain, based on a comprehensive research study conducted by several co-authors. They came up with the following definition: "A

supply chain is defined as a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer". The supply chain may include internal divisions of the company as well as external suppliers that provide input to a focal company. A supplier for this company has his own set of suppliers that provide input (also called second tier suppliers). Supply chains are essentially a series of linked suppliers and customers until products reach the ultimate customer [5]. Supply chain of a company consists of an upstream supplier network and its downstream distribution channel (see Figure 2). Organizations can be part of numerous supply chains. Danfoss for example, is part of a supply chain for districtheating components, district-heating stations, and HVAC components. On the other hand, Alfa Laval can find Danfoss to be a supplier in one supply chain, a partner in another (developing components for their substations), a competitor in the fourth supply chain of stations, and as a customer in the heat exchangers supply chain. Depending on how complex the supply network is, [5] has defined three types of supply chains: 1. Direct supply chain, which consists of a company, a supplier, and a customer. 2. Extended supply chain, which includes suppliers of the immediate supplier, as well as customers of the immediate customer. 3. Ultimate supply chain, which includes all the organizations involved in all the upstream and downstream flows.

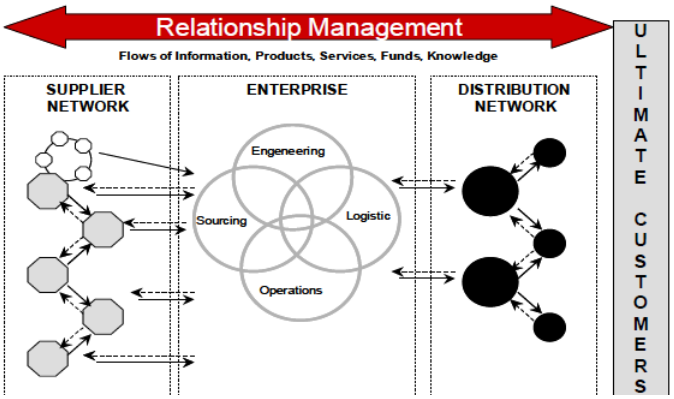

Figure 2: Supply Chain or Supply Chain Network [5]

II. SUPPLY CHAIN MANAGEMENT

Supply chain management is increasingly being recognized as the integration of key business processes across the supply chain. Implementation is carried through by three primary elements: the supply chain network structure, the supply chain processes, and the management components. In terms of supply chain network structure, it is important to integrate decisions related to purchasing, manufacturing, stocks, warehousing, and distribution, as well as define goals and strategies how to achieve it. On the other hand, it is important to design a set of standard processes which will assure rational behaviour of the individuals or companies that are part of the supply chain. Last but not at least, it is necessary to define control mechanisms to be able to audit performance of supply chain according to the plan, by coordinatingactivities and processes in order to build links between supply chain members andmaking the right decisions. There are several organizations trying to set cross-industry standard processes such as Global Supply Chain Forum (GSCF), SCOR (Supply-Chain Operations Reference Model), CPFR (Collaborative Planning, Forecasting & Replenishment), and RossetNet, which can help members of a supply chain integrate efficiently. Further, Cryand SCOR frameworks will be explained. The Global Supply Chain Forum defines supply chain management as "the integration of key business process from end user through to original suppliers that provide products, services and information that add value for customers and stakeholders" [5] The following eight key supply chain management processes are included in the framework [4].

1.Customer Relationship Management.
2. Customer Service Management.
3. Demand Management.
4. Order Fulfilment.
5. Manufacturing Flow Management.
6. Supplier Relationship Management.
7. Product Development and Commercialisation.
8. Returns Management.

The eight key business processes run along the supply chain and cut across firms and functional silos within each firm. Although functional expertise remains in place, implementing supply chain management requires making a transition from afunctional organization to one focused on business processes, first within a company and then across the companies in a supply chain. While management teams of all firms in each supply chain should consider these eight processes, the relative importance of each process and the specific activities included may vary.The Supply Chain Council developed another framework called Supply-Chain Operations Reference-model (SCOR). This process model is designed for effective communication among supply-chain partners. The scope of the SCOR model is defined as "From company's supplier's supplier to company's customer's customer" (Supply Chain Council, 2005). It is based on five distinct management processes shown in Table 1. This definition is more useful also from Danfoss point of view as the processes that were implemented there are actually based on this model.

Table 1: Distinct Management Processes

SCOR Process	Definitions
Plan	Processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production, and delivery requirements.
Source	Processes that procure goods and services to meet planned or actual demand.
Make	Processes that transform a product to a finished state to meet planned or actual demand.
Deliver	Processes that provide finished goods and services to meet planned or actual demand, typically including order management, transportation management, and distribution management.
Return	Processes associated with returning or receiving returned products for any reason. These processes extend into post-delivery customer support.

Source: Supply Chain Council, SCOR Version 7, 2005, p. 7

Each of these processes is implemented in four levels of detail. Level one defines the number of supply chains as well as what

metrics will be used. Level two defines the planning and execution process in material flow. Level three defines the inputs, outputs, and flow of each transitional element [4-5]. Each process analysed and implemented around three components: business process reengineering, benchmarking, and best practice analysis.

Table 2: Comparison of Supply Chain Management Frameworks (GSCF, SCOR)

Criteria		GSCF	SCOR
Scope	Strategic driver	Corporate and functional strategies	Operations strategy
	Breath of activities	All activities related to the successful implementation of the 8 business processes	All transactional activities related to demand-supply planning, sourcing, production, distribution and reverse logistic
Intra-company connectedness		Organization-wide cross-functional integration	Cross-functional interaction and information sharing
Inter-company connectedness		Relationship management	Transactional efficiency
Drivers of value generation		Economic value added	Cost reduction and asset utilization

Source: Lambert, 2005, p. 37

Both frameworks suggest implementation of standard cross-functional business processes, but as Lambert says, only these two include business processes specified in enough detail to be used by management to achieve cross-functional integration. The key differences between the two approaches are shown in Table 2.

III. Literature Survey

Image The management of the supply chain is one of the classical business problems. A supply chain is a network of facilities that procure raw materials/services/technologies, transform them into intermediate goods and final products/services, and deliver the products/services to customers through a distribution system. The purpose of supply chain management is to provide the right quantity of the right product at right time to the right customers at an optimal cost. A typical supply chain comprises of five elements: suppliers, manufacturers, distributors, retailers and customers. The process of integrating all these elements involves the coordination and cross-functioning of production planning, purchasing, material management, production, distribution, transportation, customer service and sales forecasting.SCM has received much attention in academic and business circles because of its innovative approach to business. The classical way of managing a supply chain was to observe and analyse the sales, demand and inventory values at the end of certain predefined time and fill the required gap in it. This methodology was based on the assumption that the supply and demand would remain linear and no drastic fluctuations would occur. Above that, this methodology was good for previous decades where supplier based market dominated the consumer-based market. However, with the increased competition, this supply-based market got replaced by consumer-based market where there were plenty of suppliers to satiate the consumers' demand. Above that, the push manufacturing concepts got replaced by pull manufacturing concepts and the importance of quality and service in time increased manifolds. Added to these changes, as time passed by, with the latest advancements in information technology, corporations started using computerized systems to manage their supply chains. Enterprise Resource Planning (ERP), advanced web-based technologies and information systems have changed the way companies do their business and manage their supply chains. More and more attention now focused on gathering real-time data and managing the supply chains through real-time networks. [1-5] are used for introduction of supply chain management and are researches involves in job shop scheduling in supply chain management.

[6].In this work, the optimal solution of the job-shop scheduling problem is obtained by using the non-traditional techniques such as genetic algorithm. The major advantage of using these algorithms is that even though the number of possible sequences for 20 operations is very high, an optimal solution is obtained within few minutes while running on a standard PC. The effectiveness of these algorithms is tested through computer simulation for various real life problems and is found to be very effective. The results obtained shows that the GA approach not only satisfies the customer's requirements and capacity restraints, but also offers near minimum cost. The best individual of each generation is steadily converging to a near optimal solution with the process of generations. Finally supply chain network was analyzed and optimized the component and products distribution with optimal total cost of supply chain.

[7].This paper proposed an innovative and efficient methodology that works with the aid of Genetic Algorithms in order to facilitate the precise determination of the most probable excess stock level and shortage level required for inventory optimization in the supply chain such that minimal total supply chain cost is ensured. MATLAB 7.4 was utilized to implement the proposed approach and to evaluate the performance. The genetic algorithm performed well as anticipated. Thus the proposed work proffers a better prediction of stock levels amid diverse stock levels at various members of the supply chain. Henceforth the stock level obtained is the optimal value that is necessary in order to determine the stock levels needed to be hoarded at the holding points in order to ensure minimal supply chain cost.

[8].In this work, multi-objective evolutionary algorithms are used to model and solve a three stages supply chain problem for Pareto Optimality. Typically all supply chain problems are characterized by decisions that are conflicting by nature. Modeling these problems using multiple objectives gives the decision maker a set of Pareto optimal solutions from which to choose. This paper discusses some literature in supply chain optimization and proposes the use of multi-objective evolutionary algorithms to solve for Pareto-optimality

in supply chain optimization problems. This work specifically deals with the implementation of the Non-dominated Sorting Genetic Algorithm–II (Deb et al, 2002) (NSGA-II) to a hypothetical but realistic supply chain problem having three stages. It is followed by a discussion on evolutionary algorithms and performance of NSGA-II for this application.

[9].This paper provides a review on bio-energy plant supply chain management and it showed that the use of effective optimization approaches is of great importance. The traditional mathematical methods (such as linear, integer, and mixed-integer programming) frequently fail to find optimal solutions for non-convex and/or large-scale models whereas metaheuristics are efficient approaches for finding near-optimal solutions that use less computational resources. This paper presents a comprehensive review by studying and analysing the application of metaheuristics to solve bioenergy supply chain models as well as the exclusive challenges of the mathematical problems applied in the bioenergy supply chain field. The reviewed metaheuristics include: (1) population approaches, such as ant colony optimization (ACO), the genetic algorithm (GA), particle swarm optimization (PSO), and bee colony algorithm (BCA); and (2) trajectory approaches, such as the tabu search (TS) and simulated annealing (SA). Based on the outcomes of this literature review, the integrated design and planning of bioenergy supply chains problem has been solved primarily by implementing the GA. The production process optimization was addressed primarily by using both the GA and PSO. The supply chain network design problem was treated by utilizing the GA and ACO. The truck and task scheduling problem were solved using the SA and the TS, where the trajectory-based methods proved to outperform the population-based methods.

[10].In this paper, ACO algorithm is applied to solve incapacitated Facility Location Problem. This problem had also been solved using another meta-heuristic method Particle Swarm Optimization technique. As the future scope of that work, to get better result, the same UFL problem is tried to be implemented with the same data set using this Ant Colony Optimization technique which is giving almost same result for some data set in comparison with PSO technique. But as this is the first approach to solve this kind of problems using Ant Colony Optimization, various modifications can be done to get better result in comparison to PSO technique. These modifications can be the value of the heuristics, the range of the initial weight of the nodes, the greedy method to get the initial solution or the termination condition.

[11].This paper is to plan a single-product, multi-echelon, multi-period closed-loop supply chain for high-tech products (which have continuous price decrease). Ultimately, considering components related to procurement, production, distribution, recycling and disposal, the final decisions are made. To solve the mixed integer linear programming model for closed-loop supply chain network plan of the paper, four heuristics-based methods including genetic algorithm, particle swarm optimization, differential evolution, and artificial bee colony are proposed. Finally, the computational results of these four methods are compared with the solutions obtained by GAMS optimization software. The solution reveals that the artificial bee colony methodology works well in terms of quality of solutions.

[12].Radio Frequency Identification (RFID) is a dedicated short-range communication technology. The term RFID is used to describe various technologies that use radio waves to automatically identify people or objects. RFID is a method of remotely storing and retrieving data using RFID tag. Radio Frequency Identification (RFID) technology has been attracting considerable attention with the expectation of improved supply chain visibility for consumer goods, apparel, and pharmaceutical manufacturers, as well as retailers and government procurement agencies. RFID technology is used today in many applications, including security and access control, transportation and supply chain tracking. Supply Chain Management (SCM) is now at the centre stage of Manufacturing and service organizations. According to the strategies in markets, supply chains and logistics are naturally being modelled as distributed systems. The economic importance has motivated both private companies and academic researchers to pursue the use of operations research and management service tools to improve the efficiency of Transportation. Referring to such scenario, in this work RFID Technique adopted with hybrid algorithm to optimize supply chain distribution network.

[13].This paper addresses design of network model for facility location and capacity allocation where in a set of customer locations with demands and a set of candidate facility locations will be known in advance. If a facility is located at a candidate site, a known fixed location cost is incurred. There is a known unit shipment cost between each candidate site and each customer location. The problem is to find the locations of the facilities and the shipment pattern between the facilities and the customers to minimize the combined facility location and shipment costs subject to a requirement that all customer demands be met. To optimize this, the distribution network model is mathematically represented and solved using hybrid PSO algorithm.

[14].This paper focuses on the development of an optimization mathematical model for a reverse supply chain network that contains forward and reverse logistical plans in the multi-echelon system. In the reverse process, the defective products are returned to the original manufacture/supplier (specified returns) to

be produced again. The next period covers the quantity of defective products for the present period, as well as the demands for the new period. To solve the mathematical model efficiently, a particle swarm optimization (PSO) solution is proposed, called PSOsm. The PSOsm introduces the saltation mechanism into the procedure of the original PSO to increase the search area, which prevents the solution being laid on the local solution. Finally, to illustrate the performance of the PSOsm, the original PSO and a genetic algorithm (GA) are employed to find the solution for the proposed problem and the performance of both methods is compared. The results show that the PSO provides a better solution.

[15].As a novel optimization technique, particle swarm optimization (PSO) algorithm works as an evolutionary computation technique and has been applied to solve non-linear problems in many domains. But this algorithm always works as problem-depended so that the application method analysis always attracts researchers' interests. In this paper we address the research on solving a kind of programming problems-mixed integer programming (MIP) that usually occur in operation or management regions. Following the way of standard PSO algorithm, we give a general formula for MIP and emphasize on constructing a feasible pattern which can be used in PSO so that the constrained condition which most MIP problems happen to are transformed into unconstrained condition by request of PSO algorithm. Finally, we give a practical case to prove such methodology and the testing result verifies its validity.

[16]. In this paper author consider deterioration effect in a three-stage supply chain deteriorated network with a mathematical model. A novel artificial intelligence algorithm named Simplified Swarm Optimization (SSO) is adapted in the above problem to minimize the total operating cost. Extending local search (ELS) is attached to enhance the performance of the original SSO. A numerical example network system is presented to compare the proposed algorithm with Genetic Algorithm (GA) and Particle Swarm Optimization Algorithm (PSO). Results indicate that SSO-ELS provide a better solution than its competitors on the problem.

[17]. In this paper Dynamic Virtual Bats Algorithm (DVBA) introduced, which is tested on several benchmark functions for global optimization. In this paper DVBA has been applied to minimize the supply chain cost with other well-known algorithms, Particle Swarm Optimization (PSO), Bat Algorithm (BA), Genetic Algorithm (GA) and Tabu Search (TS). Optimization of supply chain is considered as a real challenge by researchers because of its complexity. Big number of parameters to be controlled and their distributions, interconnections between parameters and dynamism are the main factors that increase the complexity of a supply chain. The result of the case study showed that the DVBA is much superior to other algorithms in terms of accuracy and efficiency.

[18].In this paper author discussed optimal design of agri-food supply chain network (ASCN) which is critical to reduce the sum of production cost and transportation cost. A mixed integer programming (MIP) model is presented to handle facility location and production capacity selection as well as choice of transportation mode for ASCN design (ASCND) problem. Due to the complexity of the design problem for the multi-echelon and multi-product ASCN, an improved particle swarm optimization (PSO) approach is proposed. For binary decision variables, local search within the neighbourhood of best solution is embedded into PSO to enhance the exportability. Given binary variables, LINGO is adapted to solve the linear programming problem derived from the MIP. Case study illustrates the effectiveness of the proposed improved PSO approach. The computational results of case study further show that improved PSO is superior to original binary PSO for ASCND problem.

[19].In this paper authors evaluate metaheuristic optimization methods on a partitional clustering task of a real-world supply chain dataset, aiming at customer segmentation. For this purpose, they rely on the automatic clustering framework, named henceforth DAK framework, by testing its performance for seven different metaheuristic optimization algorithms, namely: simulated annealing (SA), genetic algorithms (GA), particle swarm optimization (PSO), differential evolution (DE), artificial bee colony (ABC), cuckoo search (CS) and fireworks algorithm (FA). An in-depth analysis of the obtained results is carried out in order to compare the performances of the metaheuristic optimization algorithms under the DAK framework with that of standard (i.e. non-automatic) clustering methodology.

[20].The paper presents the concept and the outline of the implementation of a hybrid approach to supply chain optimization. In this approach, integration of two environments of integer programming (IP) and constrain logic programming (CLP) is proposed. The idea behind the new solution is to use the strengths of both environments, in which optimization constraints are differently treated and different methods are used to solve them. This is particularly important for models in which there is the objective function and various constraints that sum many discrete decision variables. To verify the proposed approach, the optimization models and their implementation in traditional (IP) and hybrid approaches are presented.

[21]. In this paper Fuzzy optimization models introduced as powerful decision support tool for optimization models in fuzzy environment. In this paper fuzzy goal programming (FGP) is integrated with the fuzzy analytic hierarchy process (FAHP) to determine optimal

plant and distribution centre locations in a supply chain with special focus on the operational efficiencies of the distribution centres. The integrated FGP-FAHP model incorporates multiple conflicting objectives as demanded by the decision process. The concept of fuzzy logic is utilized to model the variation of demands at retails centres that makes the model more sophisticated to the real SCM problem. The FAHP is used to model the decision maker preferences and to handle information ambiguities in the comparison judgment by introducing a linguistic variable, and to find the relative weights of multiple objectives in FGP. In addition to, the proposed FGP-FAHP provides a risk management decision support tool in SCM problem associated with information ambiguities.

[22]. In this paper, authors investigated a two-echelon supply chain system, in which retail franchising has been applied in its distribution channel, we proposed a Genetic optimization algorithm in supply chain coordination mechanism decision making process through retailer selection, and numerical example has been implemented to demonstrate the efficiency of our method.

IV. Conclusion

In this survey paper we have discussed various techniques implemented by researchers for getting optimal solution in supply chain management. It is found that optimization algorithms are day by day becoming popular in supply chain management scenario. As management is a large type of engineering or vice versa, so techniques used in engineering optimization yield good results in finding optimal solution in management also.

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Comparison Table

Reference	Work
[1-5]	Introduction and background of SCM
[6]	Job-shop schedulingproblem using GA in SCM
[7]	Genetic Algorithms in order to facilitate the precise determination of the most probable excess stock level and shortage level required for inventory optimization in the supply chain such that minimal total supply chain cost is ensured
[8]	multi-objective evolutionary algorithms are used to model and solve a threestages supply chain problem for Pareto Optimality. Non-dominated Sorting Genetic Algorithm–II (NSGA-II)
[9]	bioenergy plant supply chain management using bee colony algorithm (BCA)
[10]	ACO algorithm is applied to solve incapacitated Facility Location Problem
[11]	single-product, multi-echelon, multi-period closed-loop supply chain for high-tech products.Four heuristics-based methods including genetic algorithm, particle swarm optimization, differential evolution, and artificial bee colony are proposed
[12]	RFID Technique adopted with hybrid algorithm to optimize supply chain distribution network
[13]	the distribution network model is mathematically represented and solved using hybrid PSO algorithm
[14]	development of an optimization mathematical model for a reverse supply chain network that contains forward and reverse logistical plans in the multi-echelon system using GA and PSO.
[15]	Introduced general formula for MIP (mixed integer programming) and emphasize on constructing a feasible pattern which can be used in PSO so that the constrained condition which most MIP problems happen to are transformed into unconstrained condition by request of PSO algorithm
[16]	novel artificial intelligence algorithm named Simplified Swarm Optimization (SSO) is adaptedin a three-stage supply chain deteriorated network with a mathematical model.
[17]	Dynamic Virtual Bats Algorithm (DVBA) introduced, which is tested on several benchmark functions for global optimization
[18]	optimal design of agri-food supply chain network (ASCN) which is critical to reduce the sum of production cost and transportation cost
[19]	automatic clustering framework tested using simulated annealing (SA), genetic algorithms (GA), particle swarm optimization (PSO), differential evolution (DE), artificial bee colony (ABC), cuckoo search (CS) and fireworks algorithm (FA).
[20]	hybrid approach to supply chain optimization. In this approach, integration of two environments of integer programming (IP) and constrain logic programming (CLP) is proposed
[21]	fuzzy goal programming (FGP) is integrated with the fuzzy analytic hierarchy process (FAHP) to determine optimal plant and distribution center locations in a supply chain with special focus on the operational efficiencies of the distribution centers
[22]	two echelon supply chain system, in which retail franchising has been applied in its distribution channel using GA

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