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ENHANCEMENT OF ANALYTICAL MODEL FOR ASC UTILISING ANN FOR EFFICIENT SUPPLY CHAIN MANAGEMENT IN THE AUTOMOBILE SERVICE INDUSTRY.

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Abstract: Every production and service system is under intense pressure to operate at maximum efficiency in the current climate of global competition in order to maintain low product prices. Customers today desire a choice of products. It is common knowledge that growing product variety adds complexity and reduces system efficiency. The manufacturing system deals with a wide range of products and is extremely productive. Due to the wide range of models, expensive infrastructure, and demanding clients, the automotive industry is one of the primary contributors to the Indian economy. As a result, the management of automobile service centres is becoming more difficult. Each vehicle that enters the automobile service centre has a unique set of repair and maintenance requirements, and it also has characteristics of a job shop production system. The automobile service centre shares a number of characteristics with supply chain management, maintenance management, and service management. The goal of this study is to construct models that depict how key success elements interact utilising approaches like Artificial Neural Networks (ANN), Analytical Hierarchy Processes (AHP), and Analytical Network Processes (ANP). Among others, similar job shops, such as mobile phones, two-wheelers, and laptops can use it.

Keywords: - Manufacturing system, productivity, job shop system, supply chain management, service management

Introduction: In twenty-first century there are radical changes taking place that are reshaping the industrial landscape of economies. Most companies have much wider product ranges, are introducing new products more quickly, and are focus their marketing. All these trends the fundamental ideas of mass production that have served industry so it lead to the increased use of Job shop production (JSP) system. Job shop production (JSP) is production process in which the manufacturer receives all engineering specifications from the customer and utilizes intermittent production methods due to limited customer demand. Automobile industry is one of the rising manufacturing industries. After sales, service plays vital role for automotive industry in maintaining the brand image and customer loyalty; and acts as relevant source of revenue.

In today‘s economy, service is play vital role in business world where the economies of developed countries like India and China being shifted towards the service sector. Increase competition as well as increase customer demands also leads to faster implementation of new technologies in vehicles. The development towards a highly diversified automotive market is accompanied by a continuous acceleration of product cycles and growing product complexity. As the customer expects high product availability, increase product complexity requires an appropriate service offer. As every car enter different repair and service needs, the system handles large job variety and hence ASC

resembles to job shop system. Since automobile repair shops are service shops so many service management are applicable to this type of facility. Along with job shop and service issues, several dimensions of supply chain need to be looked while managing service centres. Hence efficient management of ASC involves integrated features of JSP system, maintenance management (MM), service management(SM) and supply chain management (SCM).

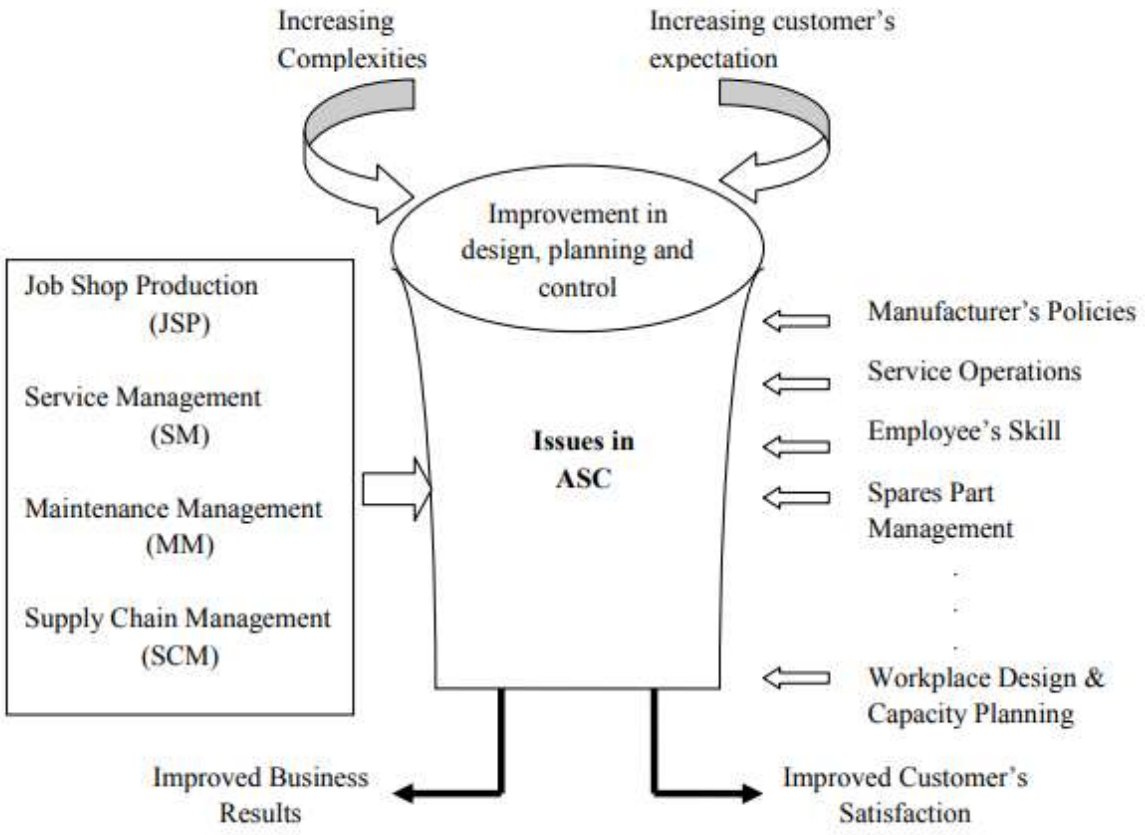

Fig.1. Layout of ASC

Laslo et al (2008) focus the virtual job shop problem of sequenced n jobs on m outsourced machines, where the job operation processing times have independently random durations which help to determine in advance the machine booking schedule that maximizes an economic gain. **Ozguven et al** (2010) focus flexible job shop scheduling problems that routing and sequencing problems with process plan flexibility. **Vinod et al** (2011) Study on the interaction between due-date setting methods and scheduling rules in a job shop system used for all the performance measures. Xia and Chen **et al** (2010) studied dynamic nature of supply chain risk management and developed strategic decision making model with operational process cycle and product life cycle. **Wong et al** (2011) identified various factors like Supplier Relation, Customer Relation and Employee's Mental State along the supply chain and used ANN to find to quantify the importance of predicting the critical factors. **Hartley et al** (2008) focus on supplier quality management that directly related to product/service design and process management which provide QM practices on firm performance. **Deshpande et al** (2011) role of inventory in deciding the nature of a supply chain as a cost effective or a responsive supply chain by changing the inventory policy as the supply chain can be configured

to changing needs. **Moradi et al** (2010) investigates integrated flexible job shop problem with preventive maintenance activities under the multi-objective optimization approaches which minimization for the production part and system unavailability for the maintenance part**. Bashiri et al** (2011) optimum maintenance strategy using interactive fuzzy linear assignment method which uses both qualitative and quantitative measures.

Research Methodology: The analysis of this paper is based on automobile service centres (ASC) are the authorized repair shops responsible for repair and servicing of cars after its purchase. It is observed that ASC closely resembles the features of job shop production (JSP), supply chain management (SCM), service management(SM) and maintenance management (MM). Five issues are taken in automobile service centres. The first issue involves the capacity planning of workstations and buffers to meet demand variability conditions. The parameter optimization is taken as next issue using Taguchi DOE where the impact of the decision and system parameters on the assumed ASC's performance measure are found. Spare parts management is done to find reorder point and order quantity for spare parts for ASC. The foundation for developing the strategies for performance improvement is presented in this work using ISM by finding the inter relationship between various critical success factors. On the basis of strategies developed by Interpretive structural modeling (ISM), analytical network process (ANP) along with Kaplan –Norton balanced score card approach is used to select the best operational strategy for performance improvement in ASC environment.

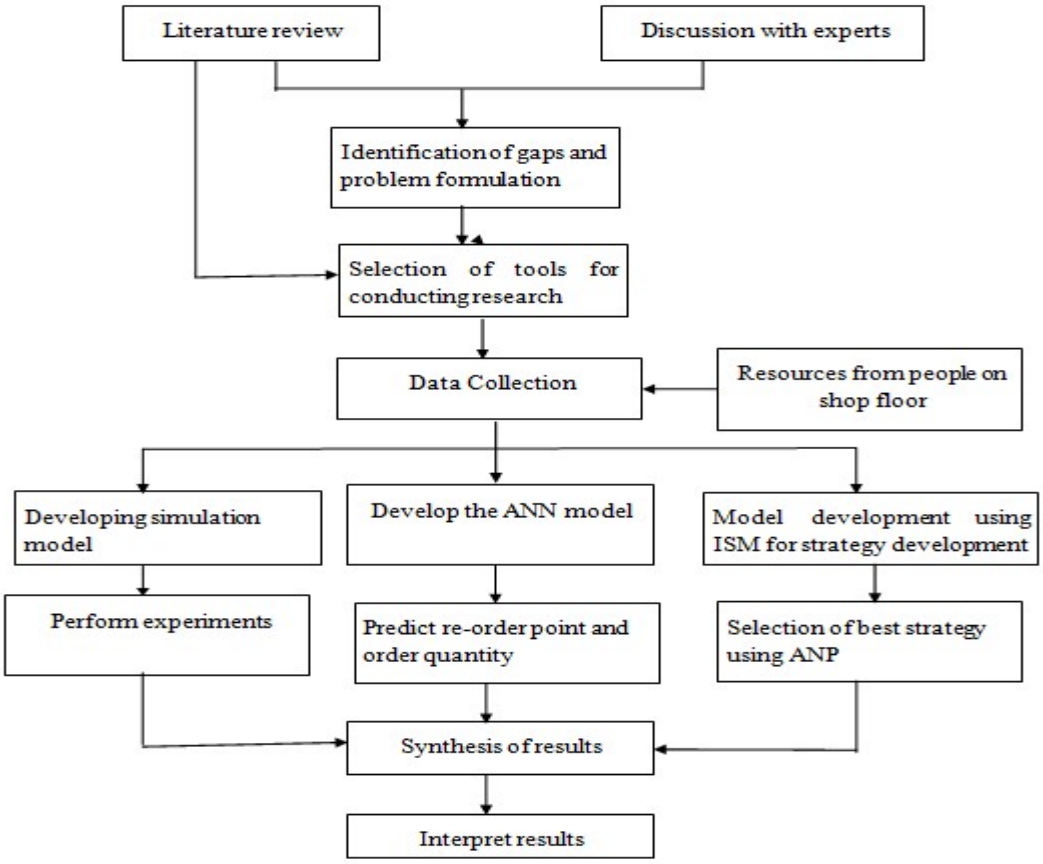

Fig.3: Flowchart for research strategy

Supply Chain Management under demand variability: Based in the fields of capacity planning and demand variability, two objectives. The first objective is to understand the aspects of capacity planning in a real system and design proper capacity schedule to meet the demand of the customers which helps proper resource planning to meet the fluctuations of demand. The second objective is to study the impact of demand variability on the system performance and to develop a framework for system design to proactively incorporate consideration of variability in all forms at the design stage. Using tool for experimentation, the study focuses to investigate the perform capacity planning of resources for an ASC.

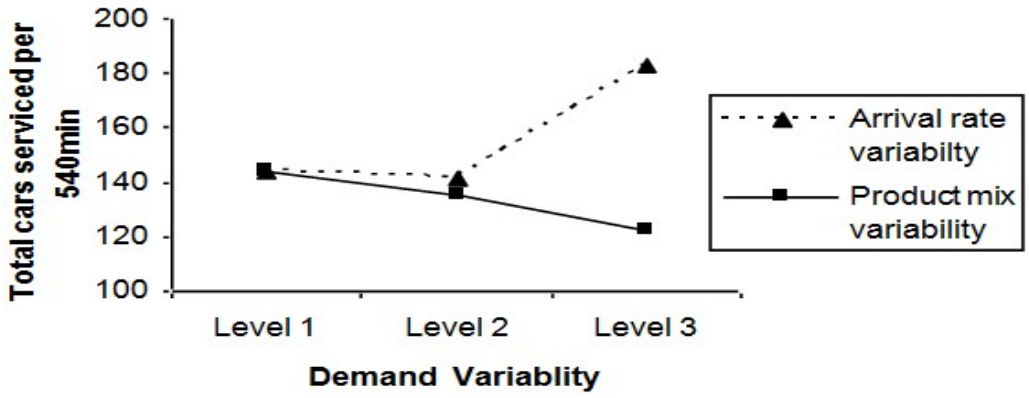

Fig. 4: Cars serviced against demand variability conditions

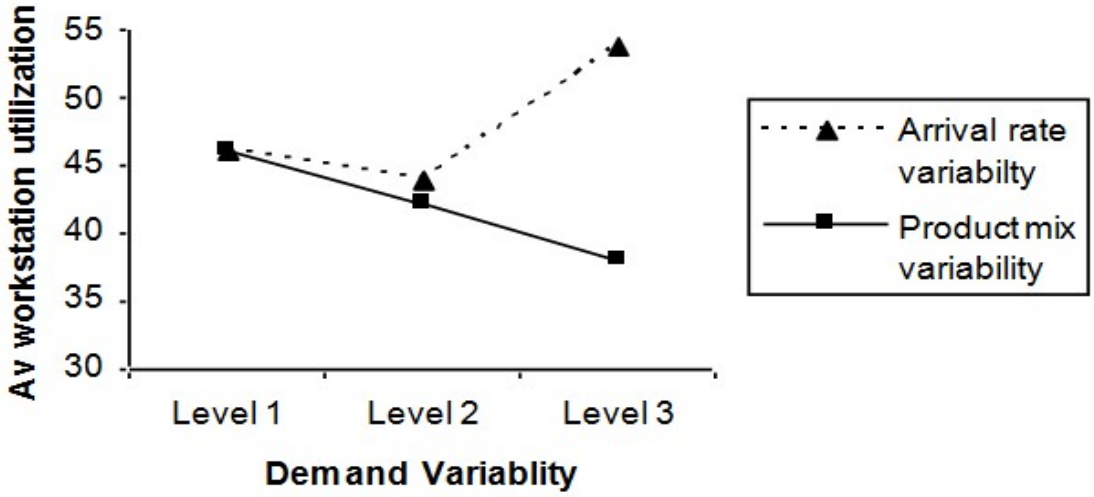

Fig.5: Average workstation utilization against demand variability conditions

It is found that shop with zero buffers is not meeting the required demand. It is also found from the analysis that demand variability has a strong effect on system agility whereas the efficiency index is not much affected. Both the factors of demand variability inter arrival time and product mix, are strongly affecting the agility parameters. The study can be extended in many ways. It would be interesting to remove the hypotheses of zero move time and the study can be explored further by including other factors like job scheduling methods and set-up to processing time ratios.

Performance Optimization Using Taguchi Approach: Based on Taguchi DOE for the impact of varying levels of decision and system parameters on the performance of ASC. The two decision

parameters are scheduling rule and buffer size and the two system parameters are product mix variation and arrival rate variation.

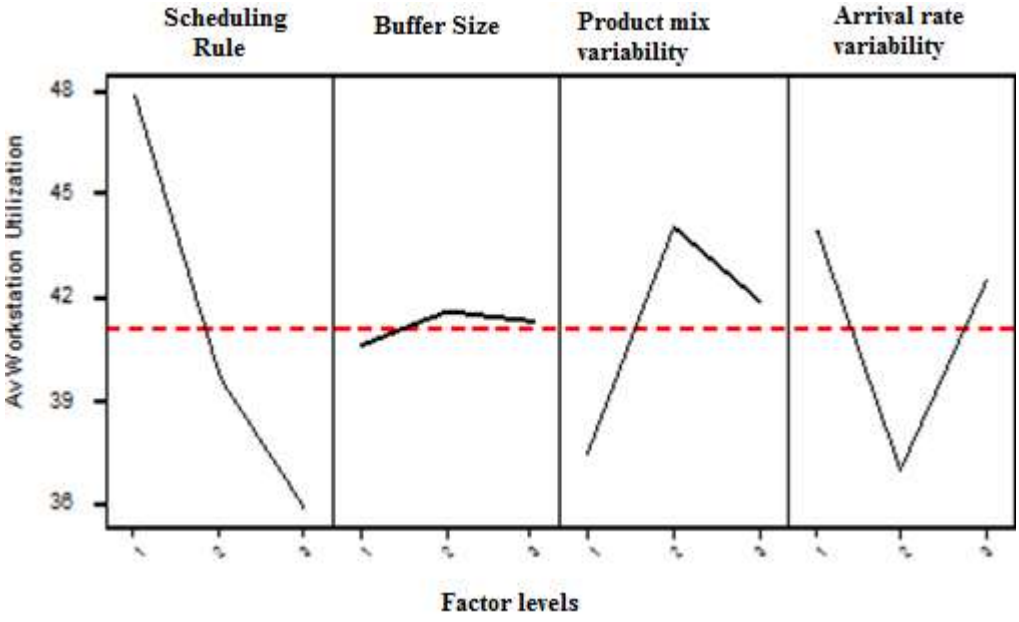

Fig.5: Analysis of mean plot for main effect

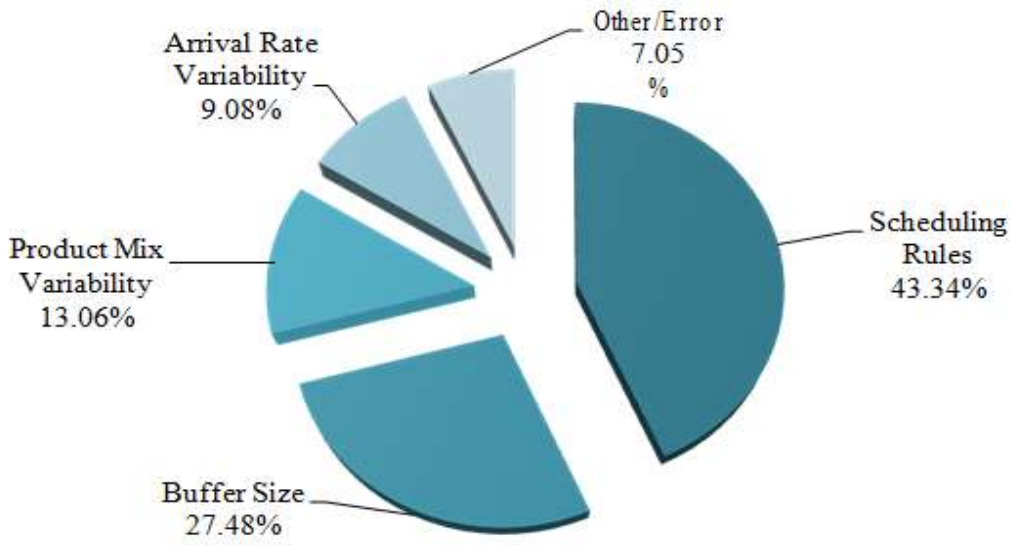

Fig.6: Average % contribution of each factor to the ASC performance measures

Fig.6 shows the average percentage contribution of each factor on the performance measure. The percentage contribution of scheduling rule is found greatest, 43.34% with those of buffer size and product mix variability being 27.48% and 13.06% respectively.

Spare Parts Management Using Artificial Neural Network: Shortage of spare parts leads to delay in service whereas excessive inventory will increase the cost of operations. Spare parts inventories at an automobile service center (ASC) supply chain plays important role in improving the service level and on time delivery of vehicles. Higher customer choice and responsiveness to changing

demand has imposed needs to integrate and collaborate across supply chain with manufacturing environments like automobiles with considerable after sales service network and huge impact on spare part function. ANN is used in two phases, first to determine the inventory policy and second to determine the parameters of the policy i.e. reorder point and order quantity.

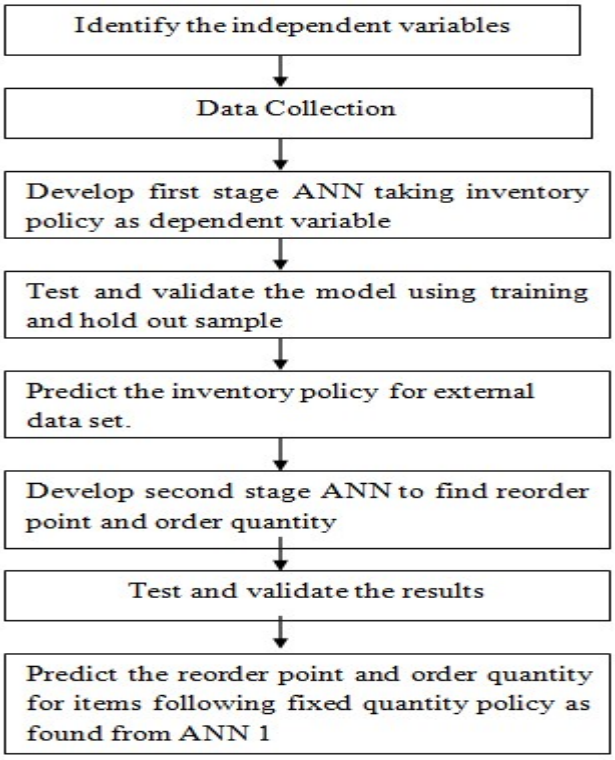

Fig.7: Flowchart for developing ANN model

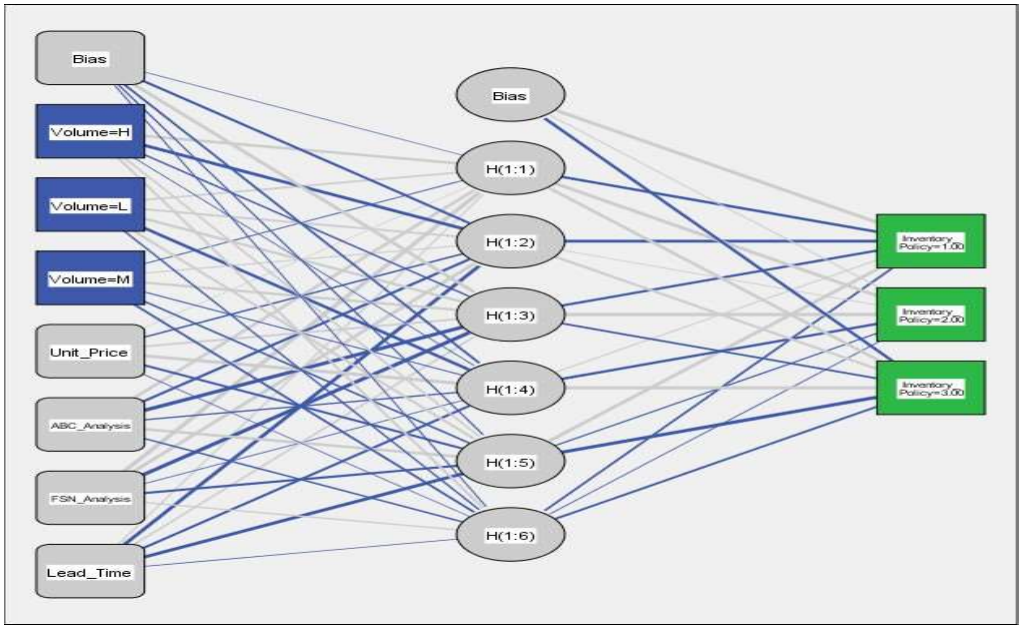

Fig.8: Architecture for ANN 1

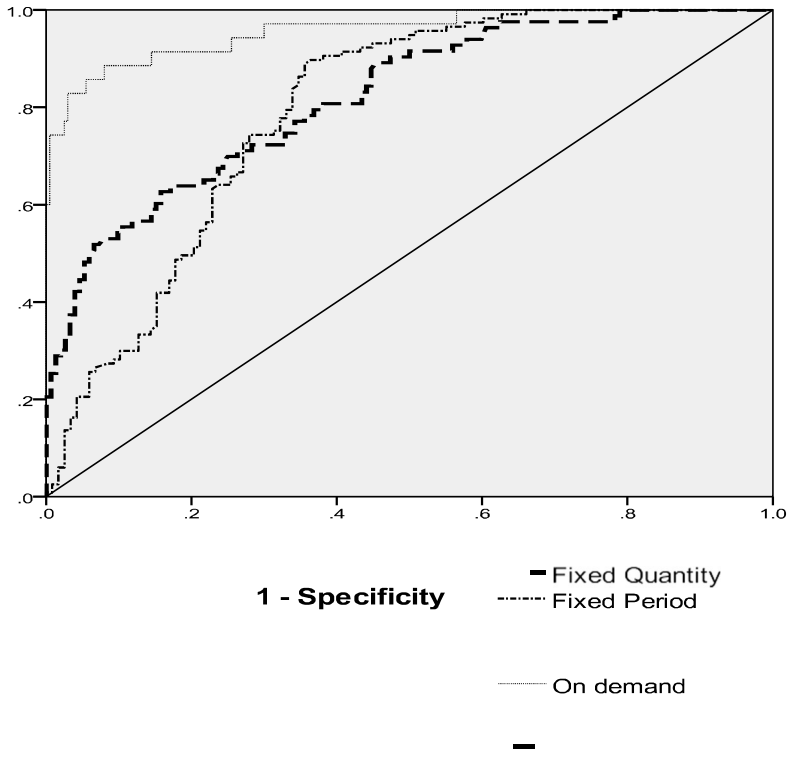

Fig.9: Characteristics curve

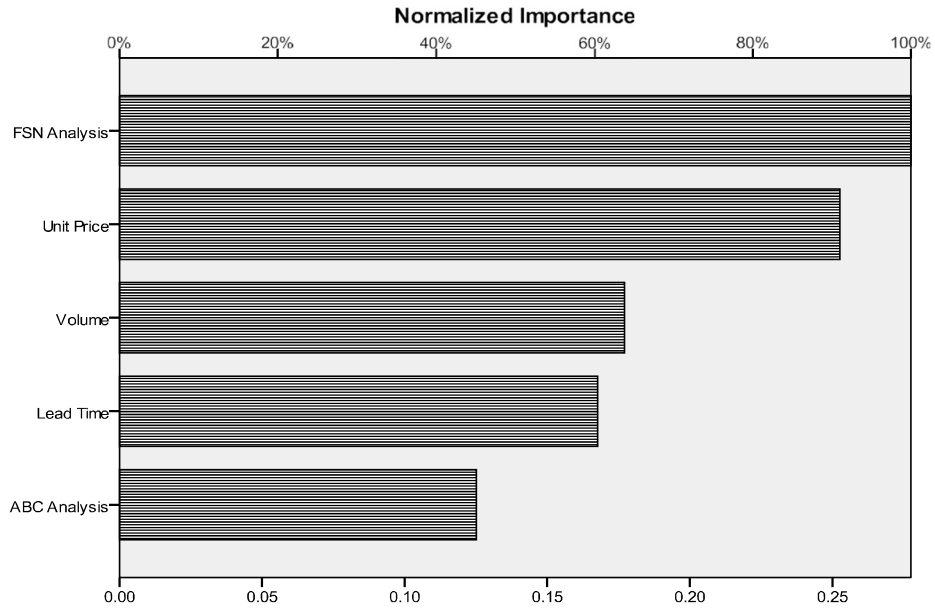

Fig.10: Normalized Importance Plot for Independent Variables in ANN 1

It concluded that the degree of correctness includes independent variables like annual demand, workshop size, inventory carrying cost, holding cost etc. The network gave information about the importance of independent variables on dependent ones which help to find the parameters for better

considerations are needed on these.

ISM (Interpretive Structural Modeling) for performance improvement: Interpretive Structural Modeling (ISM) is adopted as the tool for establishing structural relationship between critical success factors. It aims to formulate the strategies for performance improvement of automobile service centre (ASC).

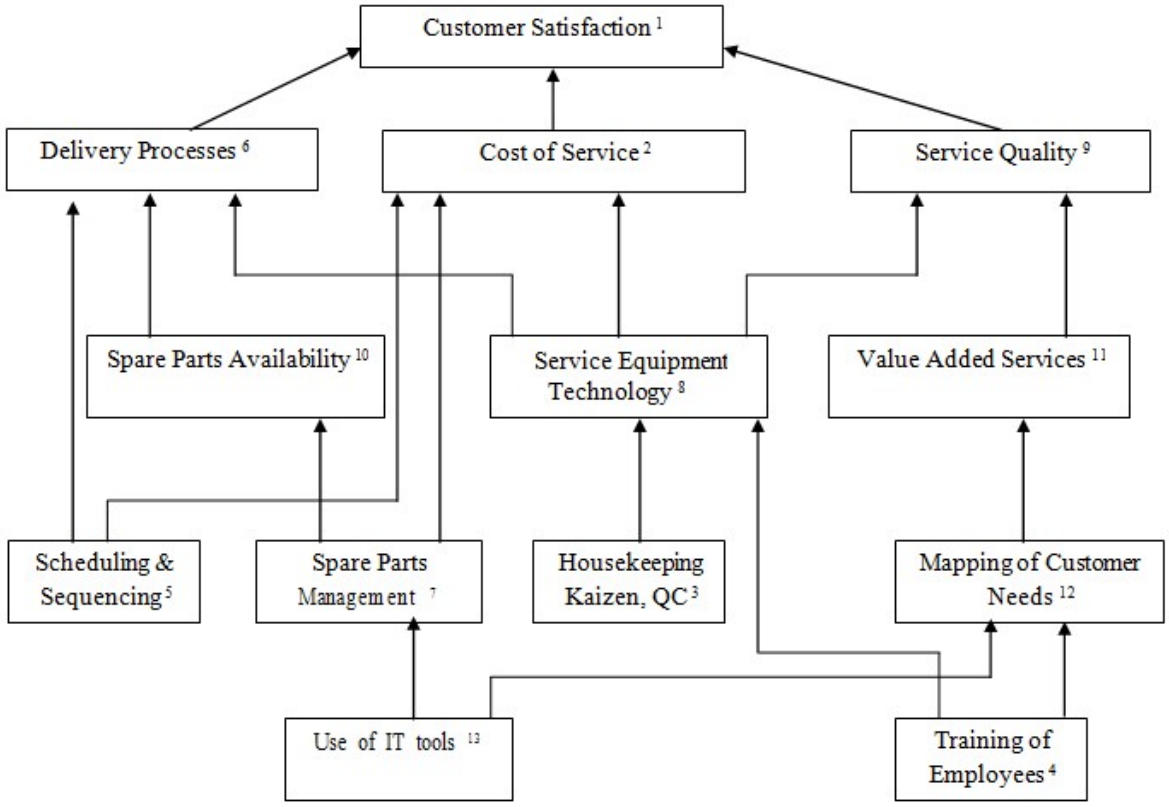

Fig.11: ISM of enablers to customer satisfaction for ASC

Conclusions: It concluded that the factors of demand variability inter arrival time and product mix, are strongly affecting the agility parameters. Decision and system parameters optimal job shop performance by Taguchi experimental for conducting the analysis of percentage contribution of each factor to the ASC performance measures. The network gave information about the importance of independent variables on dependent ones which help to find the better job shop parameters. It identifies the hierarchy of actions to be taken for improving the performance of ASC.

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