Implementation of milk run material supply system in vehicle routingproblem with simultaneous pickup and delivery

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ABSTRACT

The vehicle routing problem is a common central problem in operations research arise in various fields, required to optimally route a fleet of vehicle to several set of consumers with simultaneous pickup and delivery. Material handling is one of the most critical problem that should be considered importantlyfor eliminating waste and reducing the cost. In large scale industries various transportation systems are considered in order to material requirement of the system. However, it is very complicated especially dealing with large scale industries with enormous number of material need to be delivered at various locations. This paper reviews the most efficient methods (nonlinear method and heuristic approach) to solve related issues. The optimal method enhances the truck utilisation, cargo loading efficiency, inventory holding cost and total transportation cost. It helps to use operation research techniques to develop a mathematical model to solve a vehicle routing problem considering simultaneous pick-up and deliveries with time constraints. This optimal method reduces the number of trucks on road as well, which leads to decrease a traffic problem, so ultimately the burning of fossil fuel can be decreased and carbon dioxide emission in environment will be decreased.During the design of milk runnew routes will be developed and ultimately overall flexibility can be increased based on the demand of customer or suppliers.

Keywords:- Vehicle routing, Material handling, Kanban, Milk-run

1. INTRODUCTION

The material handling system required provision of large and medium scale production system for proper planning. It is not only focus on the production, but mostly effects on the supply chain and management of material. The prime aim of this paper is to review a technique, which leads to reduce transportation cost, reduced inventory holding cost and delivery of the materials to customers in right amountat right time and on right place. Milk run supply system is also known as the cyclic goods suppling system, where goods are either collected from the several supplier and deliver to the certain customer or goods are collected form the certain supplier and deliver to the several customer in cyclic manner.In this method good collection take place to differentsupplier in one truck following predefined route to collect parts or product to deliver them to the factory[1]. The aim of this paper to review the most efficient technique to develop a mathematical model and a heuristic approach, where the construction of routes and determination of the service period will be take place for vehicle routing problem by milk-run material supply system that works on just-in-time basis with simultaneous pickup and delivery considering time frame.The primary purpose ofestablishing a supply chain is to minimize the flow of row material at every point in order to improve the productivity and achieve a cost saving[9].Assembly lines must satisfy the customer demand neither late nor early, because early production incurs inventory holding cost and late production causes either lost sales or backlog. Therefore, parts supply to the point of use in the assembly line must be also achieved within just-in-time (JIT)[10]. Otherwise, either time losses may occur due to disorganized and insufficient material supply to the assembly line, or excess inventory accumulates. It has review that when dealing with major scale industries especially continuously changing the demand nonlinear mathematical model need to be formulate, which has to compare with the heuristic algorithm to get the optimal solution.

2. LITERATURE REVIEW

The vehicle routing problem (VRP) has been extensively studied in operations research since last five decades. Ben Peterson and Willem Hoeve presented that it is absolutely challenging to design a fixed set of truck routes depend on the various demand of the customer[4]. The concept of milk run logistics is a cover of transportation network, where all input and output material requirement of several station and according to several predefined schedules [1].Gurinder

International Journal of Application or Innovation in Engineering & Management (IJAIEM)
Web Site: www.ijaiem.org Email: editor@ijaiem.org
Volume 3, Issue 11, November 2014   **ISSN 2319 - 4847**

and Gagan Saini analysed milk run logistics and give a directions of the trucks, whichcreate a route of the materials. During the review of JIT parts supply of materials studies,papers of two inter-related topics were reviewed: Kanban orpull production control papers and milk-run material supplypapers[5]. David Gyulai [2]consider layout of shopfloor define a set of routes and station in this point define a "route node", which helps to find an amount of transported goods and required to cycle time of transportation[2]. Theeratham and Manoj [3] made a critical reviewed on the auto manufacturing industry milk run operation, pickup truck and supply auto parts to suppliers. It creates a column generation technique exploits an important characteristics of most large scale linear program to solve branch and bound algorithm. One of the most benefit is that author can design a simple algorithm which generate column outside the branch and bound tree also reduced size problem. Swee Li Chee [5] studied the method on the production planning and control than the present a push system, which is analysed on the simulation model. This process created a number of Kanban card, which help to create a hybrid Kanban system to handle urgent order. Toshinori Nemoto [6] made a critical review of milk run logistics on the Japanese automobile manufactures in Thailand is perform to a maintain a small lot frequency delivery to assembly,which reduce a gap between transport frequency and production.Second JIT concept is also involve in paper[6]. Toshinori Nnemeto[6] reviewed the JIT concept on the assembly line, although create a nonlinear mathematical model to help in demand of the each stations. It will issue a Kanban card and help on the buffer stock areaand create a mathematical single warehouse serve the 20 various buyers from different area. The model reduced transportation cost and inventory cost. Padmanabha Raju n.[7] reviewed the supply chain system win-win process.It increases strong relationship between customers and supplier, satisfaction of the customer, reduce inventory, improve time to market,decrease cost and improve profitability. In addition, Junior and Filho [7] focused on special cases or variations of the Kanban systems developed to overcome the problems occurring due to the unfavourable conditions of use. The authors reported that most of the proposed systems follow the original Kanban logic. In addition, Hao and Shen [8] reviewed the studies considering Kanban systems and concluded that these relevant papers did not consider the material handling issues at the shop floor level, though it affects the system performance considerably [8]. Macro Dewitz and Stefan Galka[9] research on the drive through concept in milk run or tugger train is an efficient way to supply the production area at higher frequencies. In this process it is fully automated storage system. It can also analysed on outputpoint of ASRS concept cost effective. Zhenlai You and Yang Jiao[10] reviewed that milk run scheme can help to find shortest distance and lowest cost. Milk run model can improve the load factor, advance time efficiency fulfil transport demand. In this studied environment issue and time constraints also studied.Swee Li Chee [5] analysed the milk-run material delivery system of an electronics company using the simulation technique.In addition, Nemoto et al. [6] explained JIT external milk-run applications of the Toyota automobile assembly factories located in Thailand. Some studies considered time windows and VRPSPD (vehicle routing problem simultaneous pick-up and delivery).Zhenlai You and Yang Jiao[10] formulated a mixed-integer non-linear model of the VRP (vehicle routing problem) with time windows and simultaneous pickup and delivery. The term of "time windows" means that the material handling vehicle's pickup and delivery service at a supplier must be started and completed between the predefined time points. Based on this review, milk run logistic utilise the trucks efficiently in terms of the truck space utilisation becomes very high. Its result in less environment impacts, including carbon dioxide emission. It can also deliver parts to supply line at the right time on the demand of the customer.

3. FEATURES OF MILK RUN MATERIAL SUPPLY SYSTEM

Milk run supply system can be further divided into the two categories, the one of that is called as external milk run logistic and the other one is called as internal milk run logistic. Internal milk run logistic run for the delivering the goods within the plant or specified are like an assembly line. On the other hand external milk run logistic run between the warehouse to the distribution centres. Now a days the business environment is becoming increasingly competitive as supply-chain business customers expectations ratchet ever upwards and the capability of competing companies to deliver consistent quality at low prices continues to develop. The major organisation spend lot of capital towards the transportation cost. Therefore it is inevitable to implement a proper transportation system to cut the total cost of product to sustain in the competitive globe. Milk run material supply system is not only being used by automobile industries but also many other industries has accepted the cost cutting material supply system. Milk run has been accepted and implemented by the small scale industries as a frequent part procurement supply system, especially in developing countries. Milk run material supply system is secure logistics system which means it reduces transportation related concerns at an extent level. Standard material handling system can minimize the total material handling and inventory holding cost to the extent level.It is will mainly focus on quality and speed of the transportation with below mentioned features.

- Design of a milk-run material supply system, that will enable to determine routing and scheduling of vehicle, period of the delivery and pick up service.
- The objective of this model is to construct the routes, scheduling of vehicle and determine the service period.
- Milk run material supply system can minimize the total material handling and inventory holding cost.

- Reduction of exhaust gas emission of pollutant in environment by constructing cyclic routes and efficient utilisation of no. of vehicle.

4. CONCLUSION

In this paper, we mainly concentrate on the milk run vehicle routing problem with simultaneous pick-ups and deliverieswith time frame for determining the effective milk run plan for minimum transportation cost in minimum time duration. Milkrun method either delivers materials from suppliers to the factory or factory to the customers. Implementation of milk run material supply system successfully will improve loading rates and reduce number of trucks utilities and travel distance. Vehicle routing problem can be solved by mainly two method first one is algorithm and second method with the help of the operation research techniques (nonlinear methods). As a result it can find a minimum transportation cost and exhaust gases emission can be reduced due to less vehicle utilisation.To address the problem of having route construction algorithm for milk-run supply system, we need to develop a mathematical model and heuristic approach that constructs the routes and determines the service period on just-in-time basis to minimize material handling and total inventory holding cost. As in real world large scale problem, due to continuous demand of material non-linear model may not go through the high accuracy. It is inevitable to implement the heuristic approach.Milk run process will decrease transportation cost, reduce inventory and decrease global warming problem in environment.

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