Faculty of Manufacturing Engineering

OPTIMIZATION OF DYNAMIC TRANSPORTATION TASK ASSIGNMENT IN A MANUFACTURING FACILITY

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OPTIMIZATION OF DYNAMIC TRANSPORTATION TASK ASSIGNMENT IN A MANUFACTURING FACILITY

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DECLARATION

I declare that this thesis named "Optimization of Dynamic Transportation Task Assignment in a Manufacturing Facility" is the consequence of my own research aside from as cited in the references. The thesis has not been acknowledged for any degree and isn't simultaneously submitted in candidature of some other degree.

Signature :……..

Name :Muhammad Najib bin Tugiman

Date :……...……

APPROVAL

I thusly declare that I have read this paper/report and as I would like to think this thesis/report is adequate regarding degree and quality as an partial fulfillment of Master of Manufacturing Engineering (Quality System Engineering).

Signature :…….

Supervisor Name : Profesor Madya Dr Muhammad Hafidz Fazli Bin Md Fauadi

Date :……

DEDICATION

In the name of Allah, The Most Beneficent, The most Merciful

Every challenging work needs self-efforts as well as guidance of elders especially those who were very close to our heart.

My humble effort I dedicate to my sweet and loving

Abah & Ibu,

Tugiman Bin Sajut & Siti Musalafah Binti Sairun

Whose affection, love, encouragement and prays of day and night make me able to have such success and honor.

Along with helpful and supportive

Beloved friend

Nurul Effa Farhana Binti Halim

ABSTRACT

In the present economy, manufacturing plants must have the able to work effectively and react rapidly to changes in the product mix and demand. Layout design significantly affects manufacturing effectiveness. At first, it was treated as a static decision yet because of progress in advances, it is conceivable to rearrange the manufacturing facilities in various situations. An extensive survey of the research work for dynamic layout planning has been embraced in this paper with an investigation of various algorithms to optimize it. Hybrid algorithm can likewise be utilized to improve the plant layout. An attempt has additionally been done to sort the writing with conceivable future research areas. This paper aims to manage the current and future patterns of research on facility layout issues dependent on past research including formulations, arrangement procedures, and the scope for utilization of hybrid algorithms. The utilization of new optimization procedures gives a point of view of future research in Dynamic facility layout issues and hybrid algorithms. A pattern toward multi-objectives approaches, developing facility layout software utilizing meta-heuristics, for example, simulated annealing (SA), genetic algorithm (GA), Anylogic Software and concurrent engineering to facility layout is observed. This paper is sorted out as follows; Chapter 2 gives a concise review of literature, on the Optimization of Dynamic Transportation Task. Segment 3, gives the procedure to this whole project.

ABSTRAK

Dalam ekonomi sekarang, kilang pembuatan mesti dapat berfungsi dengan berkesan dan bertindak balas dengan cepat terhadap perubahan campuran dan permintaan produk. Reka bentuk susun atur sangat mempengaruhi keberkesanan pembuatan. Pada mulanya, ia dianggap sebagai keputusan yang statis namun karena kemajuan dalam kemajuan, mungkin untuk mengatur kembali kemudahan pembuatan dalam berbagai situasi. Kaji selidik yang luas mengenai kerja penyelidikan untuk perancangan susun atur dinamik telah disertakan dalam makalah ini dengan penyelidikan pelbagai algoritma untuk mengoptimumkannya. Algoritma hibrid juga boleh digunakan untuk memperbaiki susun atur tanaman. Percubaan juga telah dilakukan untuk menyusun tulisan dengan bidang pencarian masa depan yang dapat dibayangkan. Makalah ini bertujuan untuk menguruskan corak penyelidikan semasa dan masa depan mengenai masalah tata letak kemudahan yang bergantung pada penyelidikan masa lalu termasuk rumusan, prosedur pengaturan, dan ruang lingkup penggunaan algoritma hibrid. Penggunaan prosedur pengoptimuman baru memberikan sudut pandang penyelidikan masa depan dalam masalah susun atur kemudahan Dinamik dan algoritma hibrid. Pola ke arah pendekatan pelbagai objektif, mengembangkan perisian susun atur kemudahan yang menggunakan meta-heuristik, misalnya, penyepuhlindapan simulasi (SA), algoritma genetik (GA), Perisian Anylogic dan kejuruteraan serentak ke susun atur kemudahan diperhatikan. Kertas ini disusun seperti berikut; Bab 2 memberikan tinjauan ringkas mengenai literatur, mengenai Pengoptimuman Tugas Pengangkutan Dinamik. Segmen 3, memberikan prosedur untuk keseluruhan projek ini.

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LIST OF ABBREVIATIONS

UTeM	-	Universiti Teknikal Malaysia Melaka
AGVS	-	Automated Guided Vehicle System
FMS	-	Flexible Manufacturing System
WIP	-	Work In Progress
RV	-	Random Vehicle Rule
NV	-	Nearest Vehicle Rule
FV	-	Farthest Vehicle Rule
LIV	-	Longest Idle Vehicle Rule
LUVR	-	Least Utilized Vehicle Rule
ST	-	System Throughput
MFTP	-	Mean Flow Time of Parts
AGVIT	-	AGV Travel Full
AGVTF	-	AGV Travel Full
AGVTE	-	AGV Travel Empty
AGVLT	-	AGV Load Time
AGVUT	-	AGV Unload Time
MQL	-	Mean Queue Length
MQW	-	Mean Queue Waiting
EDT	-	Earliest Due Time
SD	-	Shortest Distance

CHAPTER 1

INTRODUCTION

This section clarifies the background, objective, statement of problem, scope of the master project and tracked by the organization of the report. The background deliberates about the general idea of how to optimize the dynamic transportation task in manufacturing and performance enhancement for the transportation in FMS environment. Afterward, the objective specifies about the task desired to be attained for this project. Last of all, the scope declares about what is invented to be accomplished in this project.

Automated Guided Vehicle System (AGVS) has become a crucial strategic tool for automated warehouses, (Sai-nan,L. 2013). In an exceedingly very competitive business situation, they can increase productivity and scale back prices of FMS (Flexible producing System) transportation systems. The AGV System provides economical material flow and distribution among workstations at the correct time and place. Besides that, the applications AGVS in production and logistical is within the storage and distribution additionally within the line application. This AGVS used for the transportation of raw materials, add method (WIP) or finished merchandise. This paper deals with the systems of multiple AGVS used for automatic works logistical whereby the simulation-based vehicle demand analysis for multi-load MTS square measure planned.

In order to style associate AGVS, there area unit many demand which require to be thought of. The necessary think about coming up with AGVS is style factors and operational factors. In design factor concerned fleet size, loading capability and guide path style. Besides that, in operational factors embrace vehicle dispatching and routing, utilization rate, conflict resolution approach and positioning of associate idle vehicle. the quantity of vehicles heavily influences the performance of AGV system (Yi fei, 2010). an upscale of AGVS is that the factors cause range of vehicles required during a plant is vital to be determined.

1.0 Research background

An AGV is acquired to own functionalities of way arranging, planning, execution work and higher psychological cycle. Frequently this capacity turns into a potential issue that must overcome with an ideal arrangement. By advancing the framework control approach, it's faster to work out the courses, dissolving the contentions and gathering data. By experience the AGV control issues, the framework picking up in finished the transportation demand during a fast route with strife free among AGVs.

Scientists have given huge consideration in examining different AGV related issues, which are task issue, vehicle dispatching issue and vehicle booking steering (Sulle B. et al., 2015). The vast majority of the AGV related problems that practice in the execution of actualize framework look at with the standard method and additionally the majority of them are for multi-limit AGV. However, it's becoming more normal in industrial facilities environment, supported studies (Ho Y.C. et al., 2006) which distinguished the usage of numerous heap AGV are often done by a straightforward rule and have numerous points of interest. The modern environment may be a suitable environment to use a bearing method

with the headway of the structure by making framework plausible in execution, data plan and programming burden. They're important to work out the parts of the AGV framework usage, which are the proficiency of errand plan and directing arrangement of transportation so as to reduce the time development and maintaining a strategic distance from halt and impact.

Another aspect is that the estimation of AGV amount, required for the errands task (Vivaldini K.C.T. et al., 2016). Moreover, (Rifai A.P. et al., 2016) proposed an adjusted GA to work out the ideal arrangements with an appropriate solution of times. This methodology utilizes on swarming separation based to switch the people with nearness. This investigation explores the problem of streamlining and execution improvement for the transportation in FMS condition. Therefore, to boost AGV control problem, the mixture of assorted dispatching rule to a unique AGV related issue with multi-limit AGV are gotten. The examination proposes a Genetic Algorithm (GA) to work out the ideal enhancement for the FMS design.

Especially, this methodology employs a big task task for AGV to locomotion the format. The member of AGV to travel and direct a conveyance or pickup task is tended to by altered calculation following which best answer for the system. the mixture of conveyance errand and pickup task by utilizing various standards among different substances will cause headway in numerous heaps AGV.

1.2 Problem statement

Factory logistic couldn't bring its advantages into its full capability transportation system. A decent material transport system in logistic activities will contributes to the logistic potency, minimize operation cost, and promote top quality of services. A dynamic system makes logistic activities becomes a lot of versatile by thought of its issue. Simulation approach could be a one smart method to look at the system performance. Material transport system and supply systems have mutual relationships that supply management wants transportation to perform its activities and in the meantime, a booming supply system may facilitate to enhance traffic surroundings and transportation development. During this cases, material transport system got to be optimized, so as to satisfy demand of consumers and produce profit to the service quality and conjointly to company aggressiveness. While not linking of every transportation and also the right variety of vehicles required in supplying space, a strong supplying strategy cannot bring its capability in a very full play..

According to (Rifai A.P. *et al.*, 2016) The combination of delivery task and pickup task by using different rules among various entities will cause advancement in multiple loads AGV. Therefore, it is important to improve the optimization method in order to solve the problem effectively. Thus, AnyLogic Software is used in this research to discover the optimal the dynamic transportation task in manufacturing facility.

1.3 Objectives

In the direction to accomplish the foremost objective, the three sub-objectives are outline:

(a) To study the factors needed to optimize decentralized material transportation system.

(b) To purpose the method to determine material transportation based on the factor required.

(c) To optimize and validate the complex systems and process of the industry by using AnyLogic Simulation Software.

1.4 Scopes of the research

This study focused on simulation supported System Dynamic Modeling where this method is perspective and set of conceptual tools that enable the organization to grasp the structure and dynamics of complex systems. The thought in applying system dynamic during this study is to design effective logistic material transportation development. In System Dynamics the real-world processes are represented in terms of stocks (e.g. of fabric, knowledge, people, money), flows between these stocks, and knowledge that determines the values of the flows.

1.5 Significance/ Important of Study

The rational of research as follows:

(a) From this project, the knowledge about the ways to optimize the dynamic transportation task assignment and the importance of optimization can be gained further since there's a lot of articles, journals and reference books that need to be studied and referred in order to complete this research.

(b) Learn about AnyLogic software method where the simulation use a sequence of designed experiments to obtain an optimal response.

(c) Scientific learn on how to conduct the software and the layout of the manufacturing facility to ensure a safe and high quality transportation system.

1.6 Organization of report

(a) Chapter 1 is an introduction part which explains about the background of this project where the objective need to be achieved by following the scope of this project that have been identified.

(b) Chapter 2 is a literature review part explains about all things which interrelated to this project.

(c) Chapter 3 is a methodology part which is an overview of study that explains on how the project been done by following the process and method to be used that have been specified.

CHAPTER 2

LITERATURE REVIEW

In this chapter, section 2.1 will explain the application of AGV system as installation in various manufacturing environment. Section 2.2 covered about optimization of AGVs that associated with number of AGV required, walking route of AGV and transporting capacity of AGV in job shop dispatching. Section 2.3 regarding to method utilized in AGV system where dispatching rule and simulation approach is studied further.

2.1 AGVs as Material Transport System

Proficiency of moving item is controlled by the activity of transportation. In investigation of Warangal, (2011), through the method and the board rule, it can improves a moving burden, administration quality, conveyance speed, activity costs, the utilization offices, and vitality sparing. AGV gives an adaptability in directing parts among component present in the framework (Mehdi, K. and Venkatesh, K., 1993). The material flow is the primary task for the entire operational framework in the assembling framework. It incorporates operational units, likes machines, plants and work territories. The issue face in material stream may cause a material under supply or material hold up. AGVs is a transportation framework that can decrease the issue identified with the material stream

since AGVs was demonstrated for a long time they are appropriate for a wide scope of undertakings in the territory of material stream. That applies similarly to move indoor in structures and open air in the plant territory (Schulze, L., and Wullner, A, 2006).

Despite the fact that the material handling care of doesn't include an incentive in the product, it encourages the production flow ,(Heilala, J., 1999). Material handling care of additionally influences decidedly on laborers more than some other region of work plan and ergonomics other than gaining the adaptability in productivity of production. Figure 2.1 shows the connection between manufacturing system. By having the successful schedule of material transportation system, the correct sort of parts can be conveyed in the correct amount, at the ideal spot, at the opportune time and in the correct way.

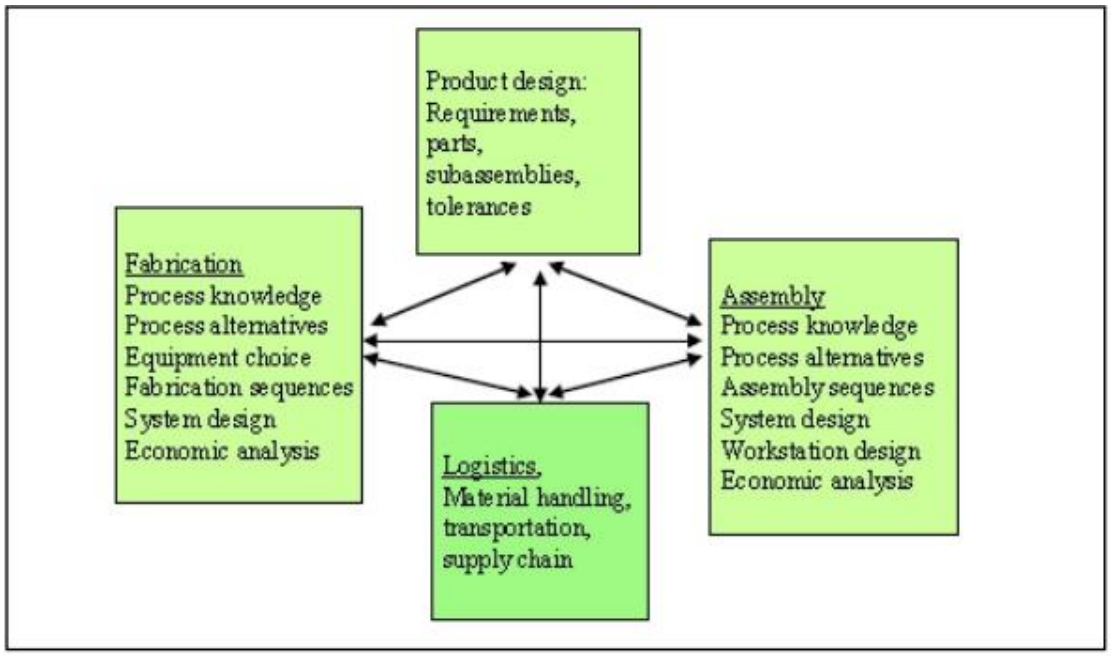

Figure 2.1: Connection between product design, fabrication, assembly and logistic system. (Heilala, J. 1999)

AGV or it is known as a driver-less system which ready to choose its own way or route to arrive at destination. There are two essential classifications of AGV control framework which is static and dynamic (Steve et.al, 1985). The static control system gives

a similar route for AGV to run constantly and stops at every pickup or conveyance station until the activity is stacked or emptied. It is considered as the conventional material dealing with framework, for example, conveyor or tow lines, however it will gives a simplicity in building up the various courses later on. The dynamic system is the most applicable to a job shop condition where the vehicle can be directed to various stations utilizing various ways.

2.2 AGVs Optimization

In automated warehouse system, AGV as a significant part to improve the productivity of the system. Because of the high productivity of a system, the scheduling arranging ought to be more optimize and to stay away from stop and lower effectiveness. Typically one way travelling path consistently prompts gridlock despite the fact that it quit straightforward. As indicated by Sai-nan, L. (2013), on thought of bidirectional AGV traveling path, an elective way strategy is proposed to dodge gridlock. The bipartite chart and a task allocation are utilized to build transportation task of AGV dependent on maximum weight coordinating in bipartite diagram.

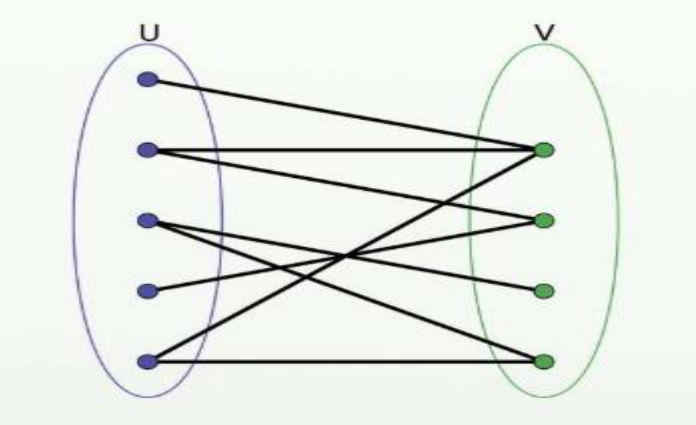

Figure 2.2: A bipartite graph is construct based on AGV task (Liu, S.,2012)

In the semiconductor fabrication bays, AGV are utilized as transportation systems for dust-less operation. In limit of production development, the quantity of vehicle additionally expanded and this situation required to the produce a crash free route planning inside a couple of seconds. In Nishi, T., and Maeno, R. (2010) paper's, it gets an operational issue derive a collision free route planning for AGVs to limit the total transportation time for productive activities in late semiconductor manufacture sounds. Petri Net (PN) is regularly used to analyze or plan AGV systems to avoid from collide among AGVs. The reasons for colliding is because of conflict and interactions between the sources which is utilized by AGVs. At the scheduling and routing planning level, the routing selection is executed from various number of alternative routes to maximize the total system performance. To solve the routing issue for various AGVs, dispatching rules, meta-heuristic and information based handling system were utilized. The whole PN model for AGVs route planning issues into subnet for each AGV system is decomposed to get the last evaluation.

Other than that, in keeping up the reliability of material transportation system in producing activity, checking the whole system to get the ideal maintenance is required (Pang and Lodewijks, 2012). Ache and Lodewijks (2012) utilizing the agent technology collecting and coordinating the information to optimize the huge scope consistent material transport.

Job shop dispatching by AGVs is concentrated by Liu, S. (2012). The genetic algorithm is utilized for the optimization issue of AGV in automated warehouse system. Through the simulation approach dependent on coding and determination of change, the strategy came about a decent reasonable path for optimization issue in automated warehouse system.

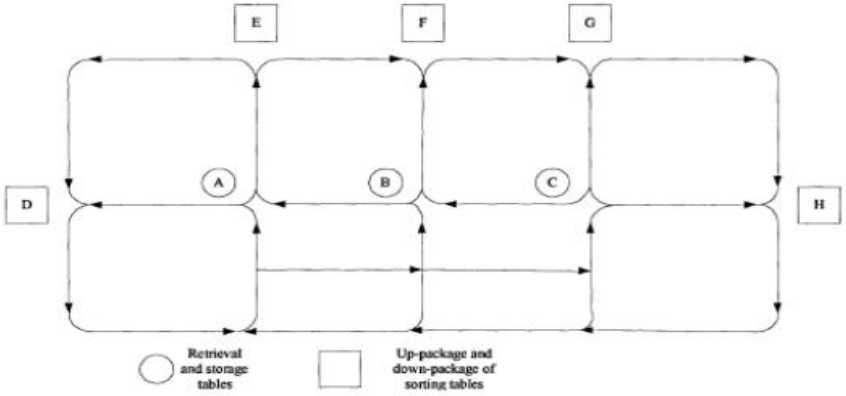

Figure 2.3: Direct graph of AGV walking route between retrieval, storage, and sorting

2.3 Dispatching vs. Scheduling

As indicated by Vivaldini, Rocha, Becker, and Moreira (2015), the significant design challenge of an AGV system is to guarantee that vehicles productively arrive to the ideal place at the ideal time inside profoundly powerful situations so traffic clashes, machine over-burdens, starvation, and other unpredictably occasions will be avoided. The most widely recognized ways to deal with the coordination among AGVs are dispatching and scheduling. Original AGV dispatching was characterized as a function that relegates transportation tasks to vehicles, where scheduling decides the time at which vehicles should enter and leave the guide-way route to maintain a strategic distance from clashes (Langevin, Lauzon, and Riopel, 1996). In any case, lately, scheduling turns into a task allocation process for AGVs thinking about the time and cost of tasks (Corréa, Langevin, and Rousseau, 2007). A scheduling system can choose when, where, and how a vehicle performs tasks including the path it should take (Le-Anh and De Koster, 2006). With an on-line scheduling system, these choices are indicated and updated after a period time (Yang, Jaillet, and Mahmassani, 2004).