Faculty of Manufacturing Engineering

DESIGN AND SIMULATION OF AUTOMATED MATERIAL HANDLING SYSTEM FOR AUTOMOTIVE ASSEMBLY PROCESS

Seha binti Mohd Saffar

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DESIGN AND SIMULATION OF AUTOMATED MATERIAL HANDLING SYSTEM FOR AUTOMOTIVE ASSEMBLY PROCESS

SEHA BINTI MOHD SAFFAR

A thesis submitted
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DECLARATION

I declare that this thesis entitled "Design and Simulation of Automated Material Handling System for Automotive Assembly Process" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature	:	....
Name	:	....
Date	:	....

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Science in Manufacturing Engineering.

Signature	:……………...
Supervisor Name	:……………………………………….........
Date	:……………………...................................

DEDICATION

To my beloved mother and father,

My beloved family,

To my beloved husband,

Who believed in me.

ABSTRACT

Improvement of process parameters for effective and efficient material handling system in manufacturing industry has been studied extensively lately in view of observed increases in demand for high technology to increase production and profit. This thesis investigates an actual industrial problem relating to improvement in material supply system in production line and inventory system in a warehouse. A case study was selected as a method to collect data in actual industry situation. The study aims to assess the influence of automated material handling system in an automotive industry by proposing a new integrated system design by mean of numerical analysis on significant effect and influence on the system. The system performance of the proposed integrated design was measured and compared to the current system. The system design and analysis were performed using Quest software. The methodology consisted of six phases. Firstly, data were gathered from actual industry as a case study. These data served as guideline and offer input on design limitation of the proposed integrated system. Secondly, a design concept was proposed using standard principle of design consideration for manufacturing. A full factorial design with two levels of three factors was applied as the design of experiment to analyze the performance measure of the integrated system and the current system. This thesis concludes that the overall result shows that the bottleneck for transport system was reduced by about 87% and 85% reduced was observed for the storage system. The transport equipment was utilized 4 times greater than the current transport system. Due to increment in utilization, the production output increased four times from the current system. Overall result showed decrement in cycle time of 63% for model 4 compared to model 1. The constraint for this research work was the preparedness of manufacturing industry towards flexibilities and leans. For future improvement, the simulation clock can be set in order to establish appropriate environment and the transition distance of entities between movement and distance of each resource to the others are properly premeditated. Also, in-depth study on Quest software and additional study on Delmia v5 as alternative simulation tool can be considered for virtual 3D simulation with ergonomic human movement results and analysis.

ABSTRAK

Sejak kebelakangan ini, penyelidikan dalam peningkatan sistem pengendalian bahan yang berkesan, cekap dan permintaan teknologi terbaru telah meningkat untuk mendapatkan satu peningkatan pengeluaran keuntungan dalam industri pembuatan. Isu-isu semasa telah diperkenalkan oleh ramai penyelidik. Tetapi, masih terdapat kekurangan dalam mengenal pasti punca masalah sebenar. Penyelidikan ini cuba untuk mengkaji salah satu daripada masalah sebenar di dalam sistem integrasi antara sistem bekalan bahan dalam barisan pengeluaran dan sistem inventori dalam gudang. Kajian kes dipilih sebagai satu kaedah untuk mengumpul data dalam keadaan industri yang sebenar. Matlamat kajian adalah untuk menilai pengaruh pengendalian bahan secara automatik dalam proses pemasangan industri automotif dengan mencadangkan satu rekabentuk baru sistem integrasi menggunakan simulasi dan analisis kesan utama yang mempengaruhi prestasi sistem. Termasuk juga, menganalisis prestasi sistem integrasi baru dengan sistem semasa dalam kajian kes. Kaedah pendekatan menggunakan perisian CAD (Delmia & Quest). Terdapat 6 fasa dirancang untuk mencapai matlamat. Pengumpulan awal data dilaksanakan di fasa 1 untuk mengumpul semua data yang berkaitan dari situasi industri yang sebenar di kilang terpilih untuk kajian kes. Ia memberikan garis panduan dan batasan dalam merekabentuk sistem integrasi baru nanti. Yang ke-2, idea atau konsep reka bentuk yang akan dilakukan menggunakan piawaian prinsip pertimbangan reka bentuk untuk pembuatan. Rekabentuk dengan faktoran penuh, 2 aras 3 faktor akan digunakan sebagai reka bentuk eksperimen untuk menganalisis pengukuran prestasi sistem integrasi dengan sistem semasa dalam kajian kes. Kesimpulannya, hasil keseluruhan tesis in menunjukkan hasil yang lebih baik di mana kesesakan sistem pengangkutan dikurangkan kira-kira 87% dan 85% dikurangkan dalam sistem storan. Sistem pengangkutan juga digunakan 4 kali ganda dari model 1. Disebabkan kenaikan penggunaan, pengeluaran juga meningkat 4 kali ganda dari model 1. Hasil keseluruhan menunjukkan penurunan masa kitaran model 4 adalah 63% dari model 1. Halangan untuk penyelidikan ini adalah kesediaan sistem pembuatan ke arah fleksibiliti dan ‘lean’. *Beberapa penambahbaikan boleh dilakukan seperti penetapan jam waktu simulasi dan jarak untuk setiap entiti dan sumber yang lebih teliti. Untuk analisis simulasi, kajian mendalam untuk perisian Quest dan penambahan penyelidikan pada Delmia V5 sebagai alat simulasi juga diperlukan untuk menghasilkan simulasi 3D maya dengan gerakan manusia ergonomik.*

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MHS	-	Material Handling System
AGV	-	Automated Guided Vehicle
EMS	-	Electrical Monorail System
AS/RS	-	High Rise Storage Retrievel System
MH	-	Material Handling
MHIA	-	Material Handling Industry of America
RFID	-	Radio Frequency Identification
VMI	-	Vendor Managed Inventory
SADT	-	Structure and Analysis Design Technique
AMR	-	Autonomous Mobile Robots
FUMAHES	-	Fuzzy-Attributes Material Handling Equipment
JIT	-	Just In Time
LIM	-	Linear Induction Motor
LCD	-	Liquid Crystal Display
WIP	-	Work in Process
PATH	-	Posture, Activities, Tools and Handling
MMH	-	Manual Material Handling
ANOVA	-	Analysis of Variance
HTA	-	Hierarchical Task Analysis
DoE	-	Design of Experiment

AMHS	-	Automated Material Handling System
DR	-	Dispatching Rule
DF	-	Degree of Freedom
SS	-	Sum of Square
MS	-	Mean of Square
F	-	Factors of the total deviation
P	-	Null Hypothesis
RSM	-	Response Surface Method
PC	-	Polycarbonate
FMS	-	Flexible Manufacturing System
MESA	-	Manufacturing Enterprise Solutions Association
DPE	-	Digital Process Engineering
DPM	-	Digital Process Manufacturing
APMP	-	Assembly Process Micro-Planning
PSL	-	Process Specification Language
CAAP	-	Computer Aided Assembly Process
CAD	-	Computer Aided Drawing
TT	-	Tugger Train
OL	-	Old Layout
NL	-	New Layout
PL	-	Picking List
PTL	-	Pick-To-Light
m	-	meter
hr.	-	hour
SCL	-	Simulation Control Language