OPERATIONAL PERFORMANCE OF AUTOMOTIVE PARTS ASSEMBLY PROCESSES USING PRODUCTION CAPACITY LOSS EQUATION

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A thesis submitted
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DECLARATION

I declare that this thesis entitled “Operational Performance of Automotive Parts Assembly Processes Using Production Capacity Loss Equation” 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.

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Name : Amir Hamzah Bin Abdul Rasib

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 Doctor of Philosophy.

Signature :…….....

Main Supervisor Name : Dr. Zuhriah Binti Ebrahim

Date :…….....

Signature :…….....

Co-Supervisor Name : Prof. Datuk Dr. Mohd Razali bin Muhamad

Date :…….....

DEDICATION

I dedicated this dissertation to my beloved wife, Rupisah Binti Sedik, who has offered unwavering support and encouragement during the past four years of my doctorial journey. Thanks Sayang for your support and counsel! This work is also dedicated to my children (Muhammad Syafiq Aikal, Nurain Syafiqah, Nuramirah Haziqah, and Muhammad Arif Muzaffar). You have made me stronger, better and more fulfilled than I could have ever imagined.

ABSTRACT

Hidden Time Loss (HTL) occurs along the production processes that have a significant effect on productivity in the automotive industry. Currently, Overall Equipment Efficiency (OEE) is the most popular performance measurement tool used in the production line. In this regard, availability, performance, and quality are the parameters used in OEE. However, OEE is not really fit for measuring operation performance of the manual assembly process and the semi-auto assembly process. There would be a certain amount of HTL occurring along the manual assembly process and semi-auto assembly process. HTL becomes critical when an assembly process involves a high product variety in the same production line. The aim of this research is to provide a measure for HTL through the determination of Time Loss Measures (TLM) components known as: (i) Non-valued Changeover Time (NVCOT), (ii) Inefficient Processing Time (IPT), (iii) Unnecessary Overtime (UOT), and (iv) Non-conformance Time (NCT). A Framework of TLM had been developed through a thorough literature study on manufacturing operations. Then, an equation for Production Capacity Loss (PCL) was derived based on the structure of TLM components. Finally, the structure of TLM components and the PCL equation were validated by using case study at five automotive manufacturing companies in Malaysia. The results of the case study show that HTL did occur through the four TLM components that caused an amount of PCL. In economic view, PCL can be converted into Gross Profit Loss (GPL). A significant finding from this research is the effect of TLM components on HTL in the context of different assembly features: (i) Right and Left, (ii) Product Variety, (iii) Model Variety, and (iv) Front and Rear. HTL does exist in the manual assembly process and semi-auto assembly process, especially in the automotive industry. The results show that UOT contributes as the highest HTL from the aspects of Right and Left, Model Variety, and Front and Rear; and NCT contributes the highest HTL from the aspect of Product Variety. In conclusion, PCL can be used as a measuring tool for the manufacturing companies to monitor continuously the operational performance of the manual assembly process and semi-auto assembly process.

ABSTRAK

'Hidden Time Loss' (HTL) berlaku semasa proses pengeluaran yang memberi kesan penting kepada produktiviti dalam industry automotif. Terkini, 'Overall Equipment Effectiveness' (OEE) adalah merupakan alat pengukur prestasi yang paling popular digunakan dalam barisan pengeluaran. Dalam hal ini, kebolehsediaan, prestasi, dan kualiti adalah merupakan pengukur-pengukur di dalam OEE. Namun begitu, OEE tidaklah sepenuhnya lengkap untuk mengukur prestasi operasi terutama bagi proses pemasangan secara manual dan proses pemasangan secara separa auto. Berkemungkinan berlakunya HTL semasa proses pemasangan secara manual dan proses pemasangan secara separa auto. HTL menjadi kritikal apabila proses pemasangan melibatkan pelbagai produk dikeluarkan dari barisan pengeluaran yang sama. Tujuan penyelidikan ini adalah untuk menyediakan pengukuran HTL menggunakan komponen-komponen 'Time Loss Measures' (TLM) seperti: (i) 'Non-valued Changeover Time' (NVCOT), 'Inefficient Processing Time' (IPT), 'Unnecessary Overtime' (UOT), and 'Non-conformance Time' (NCT). Model TLM dibangunkan berdasarkan kepada kajian 'literature' yang terperinci terhadap operasi pembuatan. Seterusnya, formula untuk 'Production Capacity Loss' (PCL) dibangunkan berdasarkan kepada struktur komponen-komponen TLM. Struktur komponen-komponen TLM dan formula PCL disahkan melalui kajian kes terhadap lima syarikat pembuatan automotif di Malaysia. Keputusan kajian kes telah membuktikan bahawa HTL wujud menerusi empat komponen TLM berkenaan yang menyebabkan berlakunya PCL. Dari sudut ekonomi, PCL boleh diolah kepada 'Gross Profit Loss' (GPL). Penemuan penting daripada penyelidikan ini adalah kesan komponen-komponen TLM terhadap HTL dalam konteks 'assembly features' yang berbeza: (i) Komponen Kanan dan Kiri, (ii) Jenis Produk, (iii) Jenis Model, dan (iv) Komponen Depan dan Belakang. Terbukti, HTL sememangnya wujud dalam proses pemasangan secara manual dan proses pemasangan secara separa auto terutama dalam industri automotif. Di sini UOT adalah penyumbang tertinggi kepada HTL dari aspek komponen Kanan dan Kiri, Jenis Model, dan komponen Depan dan Belakang. Sementara NCT adalah penyumbang tertinggi HTL daripada aspek Jenis Produk. Kesimpulannya, PCL boleh digunakan sebagai alat pengukuran prestasi operasi bagi proses pemasangan secara manual dan proses pemasangan secara separa auto dimana pemantauan prestasi boleh dilakukan dari semasa ke semasa.

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