DEPLOYMENT OF GROSS PROFIT LOSS FOR ATTENUATING TIME LOSS IMPACT IN AUTOMOTIVE INDUSTRIES

A. H. ABDUL RASIB, Z. EBRAHIM , M. R. MUHAMAD

Abstract: Time Loss (TL) occurs along the production processes that have a significant effect on productivity and able to influence the monetary loss in the manufacturing industry. TL becomes critical when an assembly process involves a high product variety in the same production line. The aim of this study is to provide a measure for Gross Profit Loss (GPL) based on Production Capacity Loss (PCL) result. Then, the equation for Production Capacity Loss (PCL) was derived based on the structure 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). The TLM had been developed through a thorough literature study on manufacturing operations. In economic view, PCL can be converted into Gross Profit Loss (GPL). Finally, the GPL equation were validated by using case study at five automotive manufacturing companies in Malaysia. The results of the case study show that GPL did occur through the four TLM components that caused an amount of PCL. In conclusion, GPL 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 in monetary unit.

Index Terms: Time Loss, Productivity, Operational performance, Profit.

1 INTRODUCTION

Normally, most companies always use financial performance measures to understand their achievements. Financial performance is measured in monetary units. According to [1], financial measures represent information and analyses in terms of monetary equivalents. Therefore, the advantage by using the financial performance measures is the organizations can understand their business results such as organization's revenues are not able to cover costs and the average return on investment is below the organization's cost of capital [2] and [3]. However, organisational performance is measured by using financial indicators only understand the past performance [4]. Purves et al. [5] agreed that financial statements are the historical results of the organization, when the organization fails, then this performance measures may not assist in the prediction of failure in a timely manner. In this study, Gross Profit Loss (GPL) is introduced in order to give more significant impact with a Ringgit Malaysia (RM) measure unit. GPL is defined as a loss incurred when the total cost of producing products exceeds the revenue. Gross Profit Loss (GPL) can be determined from the Production Capacity Loss (PCL) that represents a financial measure. GPL has been introduced in order to make TLM a more effective indicator of a company's profit in monetary units.

2 UNDERSTANDING OF PERFORMANCE MEASURES

Performance measures are essential to measure all activities which are related to operations in order to produce products. According to [6], without measuring something, it will be difficult to improve it. In the context of the Performance Measurement System, the approach of performance evaluation is suggested by means of financial and non-financial indicators, which authors consistently claim [7] and [8].

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The performance measurement function is to convert the current performance level to a better performance level for the next step of movement. Performance measurements are essential because they play a key part in the implementation of strategic plans, the evaluation of organisational objective accomplishment, and the development of administrative pay arrangements [9]. For a long time, managers have primarily used accounting-based measures, which are named as financial measures, to evaluate performance of organisations [10] and [11]. On the contrary, [12] suggest that to overcome potential shortcomings of traditional organisational performance systems, the traditional performance measurement systems shall be supported by non-financial categories. Van Der Stede et al. [10] also mention that financial and non-financial measures ought to be seen as complementing each other. Van Der Stede et al. [10] found that organisations with more extensive use of financial and non-financial measures have a higher level of performance in terms of financial, operating, employee-related and customer-oriented performance. Hence, instead of choosing either one, financial and non-financial measures should be viewed as complementary to each other [10]. Thus, performance measures are highlighted as a method for manufacturing operation improvement. According to [13], performance measurement is the way to enhancing productivity, and is an essential tool for diagnosing, trouble shooting and enhancing the manufacturing system. It can be noted that financial performance measures are all about performance measures which are based on monetary units. Performance of organisations is traditionally evaluated through financial performance measures in order to improve business levels. Overall, quality, delivery, and flexibility have significant effects on the production capacity in the assembly process. Besides, quality, delivery, and flexibility are the metrics of operational performance measures that cater to TL. However, these metrics are not really fit for measuring the operation performance of the assembly process, especially the manual assembly process and the semi-auto assembly process. Financial performance measures are important as a tool to ensure business survival by guiding a business organisation to move from one level to the next higher level. Normally,

managers fundamentally utilise accounting-based measures, which are named as financial measures, to evaluate performance of organisations [14]; [10]; [11]. Sholihin et al. [15] stipulate that financial performance is related to annual profits, return on assets, and return on sales. On the other hand, non-financial performance measures are used to measure the current and predict the future conditions. Therefore, this is considered as an advantage by using the non-financial performance measures. As explained by [16], non-financial performance measures are useful in these aspects: more forward-looking, able to predict future performance, more adequate to measure intangible assets, and less subject to manipulation than financial metrics. However, non-financial measures represent reports and analyses that are not expressed in monetary equivalents [17]. Therefore, organizations tracking their key success factors through non-financial performance measures should have superior financial results. In this regard, both financial and non-financial performance measures are required to measure the operation performance. Chenhall [18] has claimed that an integrative performance measurement system, which includes financial and non-financial measures, significantly affects a range of strategic outcomes. Figure 1 shows the types of performance measures and their relationships.

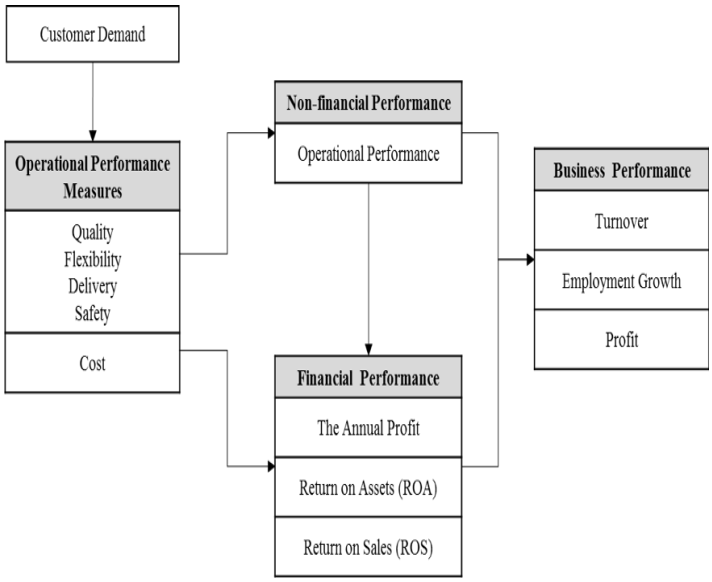


***Figure 1**: Types of Performance Measures and their Relationships*

In this study, important to develop the PCL equation. PCL is defined as the Time Loss (TL) according to the maximum amount of items produced by an assembly line, a mathematical equation is used for that purpose as shown in Equation 1. The equation for PCL was derived based on the structure 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) as shown in Figure 2. The PCL equation is validated through case studies in the fieldworks. In the meantime, Gross Profit Loss (GPL) is introduced in order to give more significant impact with a Ringgit Malaysia (RM) measure unit. GPL is defined as a loss incurred when the total cost of producing products exceeds the revenue and the equation as shown in Equation 2.

$$PCL = NVCOT + IPT + UOT + NCT \quad (1)$$

Where,
NVCOT is Non-valued Changeover Time.
IPT is Inefficient Processing Time.
UOT is Unnecessary Overtime.
NCT is Non-conformance Time.
In this regard, PCL ≥ 0.

$$GPL = \text{Gross Profit (GP)} \times PCL_{(pieces)} \quad (2)$$

Where,
GP is difference between sales and the cost of goods sold.
PCL(pieces) is amount produced in pieces by an assembly line due to TL.
In this regard, GPL ≥ 0.

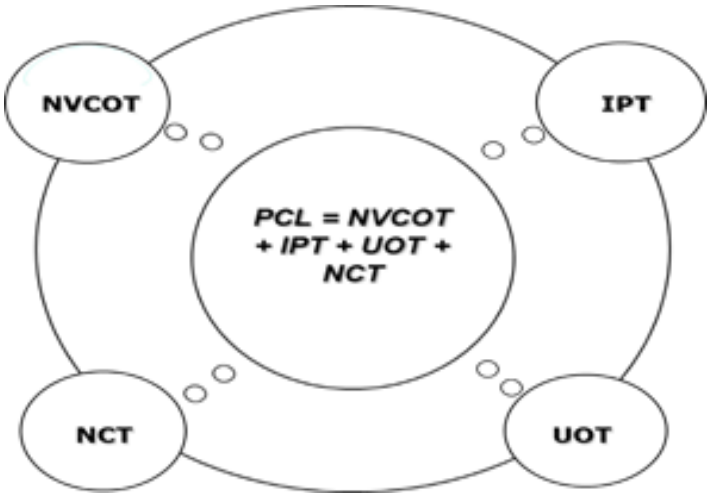


***Figure 2:** PCL and TLM Components Relationship*

3. DEVELOPMENT OF PCL AND GPL

In this study, PCL has been defined as the total Time Loss (TL) contributed by the TLM components. The method used in the development of PCL equation is based on TLM components. Figure 3 shows the development of the PCL equation.

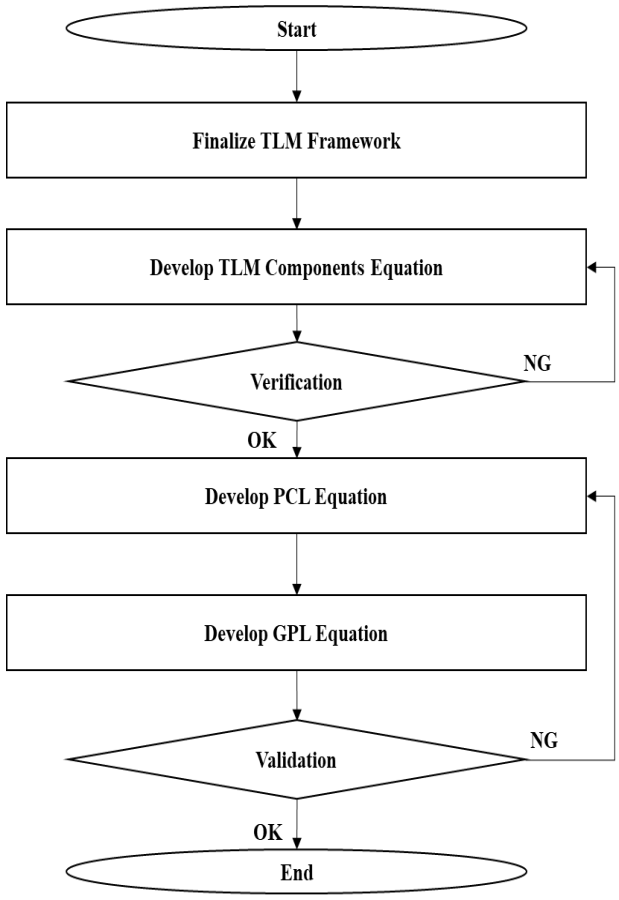


Figure 3: *Development of PCL and GPL Process Flow*

3.1. Finalize TLM Framework

The results are analysed using the majority rule. The majority rule is one of the decision rules; it chooses an alternative which has a majority, that is, more than half of the total votes [19]. According to [20], this rule is modelled by utilising the conflict analysis model. Three conditions are used in determining the result of verification [21]:

(i) If ≥ 50% are appropriate, the proposed fundamental items and their components will remain in the isolated model.

(ii) If ≥ 50% are partly appropriate, the proposed fundamental items and their components will be improved in terms of their descriptions.

(iii) If ≥ 50% are not appropriate, the proposed fundamental items and their components will be taken out from the isolated model.

3.2. Development of TLM Components Equation

In this study, the focus is on measurable items in the Process phase. The Process consists of Pre-process, In-process, and Post-process stages. The Process phase has a name for group activities or TL components (i.e. Changeover, Processing Time, and Non-conformance) involved during those three stages (i.e. Pre-process, In-process, and Post-process). In detail, Changeover has a Setup and Run-up as TL items. Processing Time has Internal Move and Unnecessary Overtime as TL items. Non-conformance has a Rework and On-hold/KIV as TL items. As has been explained earlier, TLM components are the name of a cluster for measuring TL items and will be used to formulate the equation for TL measures. Therefore, the TLM components present a performance measure to measure TL. Hence, TLM components have an effect on Existing Performance Measures such as Agility, Leanness, Sustainability, Fitness, Flexibility, and Responsiveness.

3.3. Verification of TLM

The purpose of verification is to make the initial TLM framework more reliable and suitable to be used as a guideline for formulating the TL measures equation. Janice et al. [22] mentioned that verification is the procedure of checking, affirming, verifying, and being sure. The verification of the TLM framework will be carried out through face-to-face interviews with the focus group. The focus group refers to the practitioners who are related to the manufacturing assembly process from the automotive industry. Here, the verification is done for the TLM components and it includes descriptions.

3.4. Development of GPL

In the second stage, Gross Profit Loss (GPL) is determined through the derivation of PCL. In this case, the units of PCL are converted from time to pieces. Then, GPL presents the loss in monetary value that refers to PCL in pieces.

3.5. Validation of PCL and GPL Equation

The validations of equations for TLM components and PCL are conducted through case studies at the assembly operations of the automotive manufacturing companies. Figure 3 presents the process flow of TLM components Equation and PCL Equation validation. According to [23], it is useful to present a case study for creating new tools in order to resolve inefficient processes in manufacturing. In this study, the five case studies are based on five automotive manufacturing companies in Malaysia: Companies A, B, C, D, and E. The purpose of case studies is to validate the equations of PCL and GPL. The case studies are divided into three major sections: (i) Data collection, (ii) Data analysis, and (iii) Results and discussion. In this regard, the structure for each section is based on TLM components. In the meantime, the data will be analysed based on the collected of sourced. The purpose of data analysis is to determine the value of each individual TLM component for each automotive company. In this case, the Microsoft Excel Software is used as a tool for analysis of the data. The results will shows the impact of the TLM components on PCL and GPL. The impacts of the TLM components on PCL and GPL are used to ascertain the amount of TL based on the values of PCL and GPL for each company.

a. Data Collection

Relevant data are extracted from the assembly process. They are categorised into two types: (i) Primary Data and (ii) Secondary Data. Sources of data are mainly related documents (i.e. Production Schedule, Changeover Time Record, Actual Process Cycle Time Record, Standard Process Cycle Time, Overtime Record, and Monthly Quality Record).

b. Data Analysis

In the meantime, the data will be analysed based on the collected of sourced. The purpose of data analysis is to determine the value of each individual TLM component for each automotive company. In this case, the Microsoft Excel Software is used as a tool for analysis of the data.

4. results and discussion

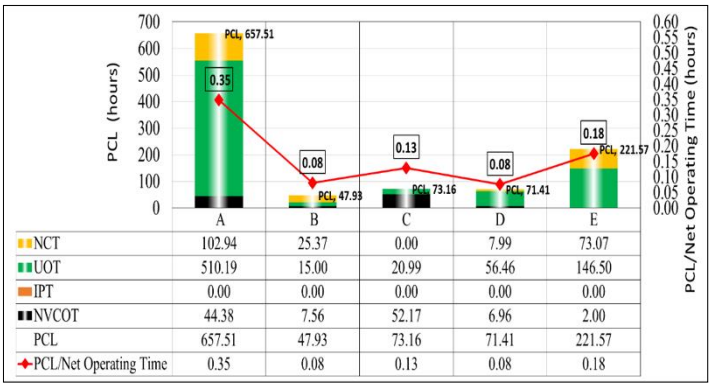
This section presents the data collected from five case studies in determining the Non-valued Changeover Time (NVCOT), Inefficient Processing Time (IPT), Unnecessary Overtime (UOT), and Non-conformance Time (NCT). In this study, the five case studies are based on five automotive manufacturing component suppliers named as company A, B, C, D, and E. Results of the five case studies are presented in the TLM components. In addition, discussions regarding the Production Capacity Loss (PCL) derived from the TLM components are discussed according to the five manufacturing companies.

4.1. Production Capacity Loss (PCL)

The PCL results of all the five companies (A, B, C, D, and E) are based on three months' results. Hence, the total of three months' results of each company is shown in Figure 4. For Company A, the five-year results of PCL are calculated and adjusted to become a three-month average. The PCL values of all companies are based on four TLM components (NVCOT, IPT, UOT, and NCT). The PCL result of each company is determined from the sum of NVCOT, IPT, UOT, and NCT. As can be seen in Figure 4, the highest PCL is that of Company A and the lowest PCL is that of Company B. As PCL is presented in a unit of time, the comparison of the five companies can be done based on a PCL index. In this study, the PCL index is determined by PCL over Net Operating Time of a company. For example:

Company A
PCL = 657.51 hours
Net Operating Time = 1,889.39 hours
Therefore,
PCL index = 0.35

Based on the above computation, Company A has the highest index; Company E is in the second position, Company C in the third position, and Companies B and D in the fourth position. Through observation in Figure 4, the PCL index presents the total of three-month results of each company. Overall, the main issue is UOT. Thus, a difference in PCL value does not mean a different PCL index.



	A	B	C	D	E
NCT	102.94	25.37	0.00	7.99	73.07
UOT	510.19	15.00	20.99	56.46	146.50
IPT	0.00	0.00	0.00	0.00	0.00
NVCOT	44.38	7.56	52.17	6.96	2.00
PCL	657.51	47.93	73.16	71.41	221.57
PCL/Net Operating Time	0.35	0.08	0.13	0.08	0.18

Figure 4: *PCL and PCL/Net Operating Time Results Across Companies (Average for Three Months)*

4.2. For Gross Profit Loss (GPL)

The GPL results of all the companies (A, B, C, D, and E) are based on three months' results. Hence, a total of three-month results are used as shown in Figure 5. For Company A, the five-year results of PCL are calculated and adjusted to become a three-month average. The results of GPL are based on PCL (pieces). Hence, the GPL result is determined through the Gross Profit (GP) and PCL (pieces). The PCL (pieces) is determined through the PCL which is converted from time to quantity by Actual Process Bottleneck. As can be seen, in Figure 5, the highest GPL is that of Company A and the lowest GPL is that of Company B. Through observation, it is necessary to see the implication of GPL in terms of monetary value. Every company has a different monetary value because of different PCL index. For an individual company, it can be concluded the GPL is linear with PCL index. Therefore, the GPL can be estimated based on PCL index. For example:

(a) Company B
PCL index = 0.08.
GPL = RM906.00.
Therefore,
Estimates GPL, if PCL index = 1.00

(b) Company D
PCL index = 0.08.
GPL = RM2,396.00.
Therefore,
Estimates GPL, if PCL index = 1.00

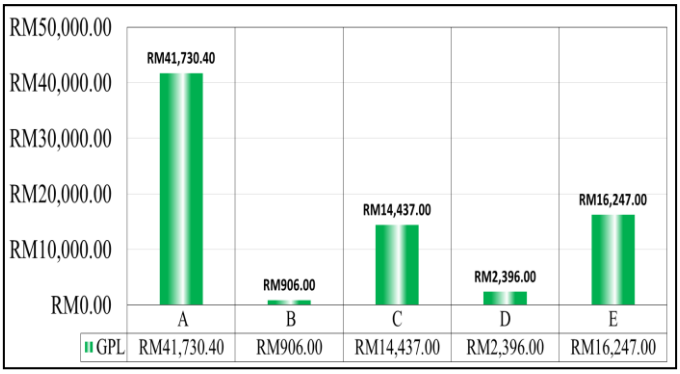


Figure 5: *GPL Results Across Companies (Three Months)*

5. CONCLUSION

In this study, Production Capacity Loss (PCL) and Gross Profit Loss (GPL) are measured based on the components of Time Loss Measures (TLM). There are four components of TLM (Non-valued Changeover Time, Inefficient Processing Time (IPT), Unnecessary Overtime, and Non-conformance Time. The PCL measures are a combination of a number of strategic operational performance measures. The PCL measures can be used as a validation tool for production performance in the short-term and long-term periods (daily, weekly, annually). The results of PCL measures can determine GPL which is considered as a financial performance measure. Moreover, GPL has a linear relationship with PCL. However, PCL index has no linear relationship with PCL. The impacts of the TLM components on PCL and GPL are used to ascertain the amount of TL based on the values of PCL and GPL for each company. This study introduces a PCL that consists of TLM components (i.e. NVCOT, IPT, UOT, and NCT). The aim is to provide a measure for GPL which can be applied as an application tool for decision makers in assessing a company's financial performance as well providing information for the future plan improvement. In this way TL can be minimised, especially in the manual assembly process and semi-auto

assembly process.

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