# DESIGNING INDIVIDUAL PRODUCTIVITY MEASURES IN SERVICE SECTOR

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## ABSTRACT

*Productivity is the key success factor for all organizations. Improvements in productivity have been known to have a major impact on many economic and social phenomena. Companies must continuously improve productivity in order to stay profitable. Therefore, productivity should also be managed. This paper outlines the result of the authors' research and development efforts generally in performance measurement, and particularly in productivity measurement. It discusses how to design a productivity measure for single worker in service sector. The research was conducted on the productivity measurement of an individual workshop maintenance worker specifically the mechanic. The study was carried at Syarikat Pengangkutan Maju Berhad workshop which is one of the main public transport providers in Johor Bahru.*

*The Seven Steps methodology by Brinkerhoff and Dressler (1990) is applied to identify the productivity indices. The indices considered absenteeism, user satisfaction, timeliness, skill growth, and quality of deliverables in the productivity measurement. Five indices are constructed. They are productive hour for mechanics, customer satisfaction and communication, skill in conducting tasks, absenteeism and quality of deliverables. An Objective Matrix is then used to integrate all the indices and come out with a composite index. The overall score is produced from the matrix. The productivity score is formulated by the difference of the current productivity compared with previous productivity.*

*This paper is organized as follows. The first part is the overview of the paper. Second part is the methodology, starting with the flow of conducting the study, designing the measures and finally techniques apply to obtain the final productivity figure. Third part talks about the result base from the case study.*

Keywords : Productivity, measurement, Objective Matrix, performance, single productivity measure, benchmark.

## OVERVIEW

Productivity is the key success factor for all organizations. Improvements in productivity have been known to have a major impact on many economic and social phenomena. Companies must continuously improve productivity in order to stay profitable. Therefore, productivity should also be managed. Productivity measurement is one of the traditional and practical tools for managing productivity.

If at the level of the company, productivity is the fundamental to profitability and survival which means companies with higher productivity than the industry average tend to have higher profit margins, but at the personal level, increasing productivity in one's activities is an important aspect of self-fulfillment. To the individual, as a member of a firm or other organization, it serves as a key of advancement since it helps increase the productivity of the organization.

The objectives of this paper are to design an individual productivity measures based on the worker's personal performance and also taking into account numerous aspects such as work habits including absenteeism, tardiness and safety rule violations, skills, work climate and some others. The paper will go into detail of personal productivity of the maintenance worker as a case study.

### Individual Measures

With accountability for management and unit objectives separated, an individual can be measured also to assess where and how to improve the individual's performance. Shelby (2000) has stated five assessments of individual measurements which are; quality of deliverables, skill growth, timeliness of deliverables, customer communications and quantity of deliverables.

Riggs and Felix said in their book 'Productivity by Objectives' the measurement of productivity of individual employee should provide benefits like; developing individual abilities and confidence, enhancing employee communications and work attitudes, raise the quality of output and reduce waste, improve safety and reduce production costs, decrease absenteeism and grievances and finally increase job satisfaction and involvement.

## METHODOLOGY

### Methodology of the Study

This productivity measure is build according to several steps in order to achieve the objective which is measuring a single mechanic's productivity taking into account numerous aspects including attitude and not just measuring their performance in doing their work. First of all, the case and requirements are studied thoroughly. This is to make sure that this study is not measuring wrong feature and finally give futile outcome. After a deep revision of the problems and requirements has been captured, the next step is to identify what is the best technique to design the measurement. The Seven Steps of measurement design has been chosen in designing the productivity measures. The outcome of this design is the productivity indicators. All the indicators will then be incorporate using the Objective Matrix to produce one figure showing the weighted score of overall incorporated ratios. This figure finally will be calculated and benchmark with previous productivity score as a comparison of current performance to determine whether it is increasing or decreasing.

### Methodology of Designing Productivity Measures

#### *The Seven Steps of Determining Productivity Indices by Brinkerhoff and Dressler*

Brinkerhoff and Dressler (1990) was developed the Seven Steps for productivity measurement as a guideline to researchers in designing their own productivity measurement. They briefly name and define each step as:

**TABLE 1 : SEVEN STEP OF MEASUREMENT (BRINKERHOFF & DRESSLER 1990)**

| Step | Step Name | Details |
|---|---|---|
| 1 | **Mission Statement** | Write a mission statement for the unit that identifies the major goals and customer of the unit. The mission statement must be complete and compatible with the mission of the larger organization. |
| 2 | **Expectations** | Identify for each customer the unit's services. Expectation must be clearly identified and explaining quality needs and expectations held by each major customer groups for the unit's services. |
| 3 | **Key Outputs** | Identify outputs that are important to the unit's mission, responsive to the customer needs and expectation and account for the majority of the expenditures of the unit's resources. |
| 4 | **Major Functions** | Identify and describe the major functions of the unit. This must be clearly represents unit operations and inputs and explain how key outputs are produced. |
| 5 | **Output Measurement Selection** | Construct measurement techniques for one or more key outputs that will produce the most practical and useful quality and productivity information. |
| 6 | **Input Measurement Selection** | Construct measurement techniques for one or more key inputs that are critical to the production of the outputs selected in Step 5. |
| 7 | **Index Construction** | Construct one or more productivity measures to incorporate the output and input measures into a sensitive, practical, and useful index. |

This methodology is used in this research because of its compatibility and simplicity in designing productivity measure. It gives a clear picture on scheming individual productivity measures for maintenance worker in the workshop environment.

#### *The Objectives Matrix*

The Objectives Matrix is another form of measurement system that usually used in order to measure a department or process but this paper will use this method to measuring individual productivity. This method is more comprehensive as well as being flexible. It can be used to derive a composite index for the entire organization but in this case it will be apply to individual productivity measures taking into account numerous aspects. The indices used are based from the indices that have been constructing earlier using Seven Steps by Brinkerhoff and Dressler.

**TABLE 2 : EXAMPLE OF AN OBJECTIVES MATRIX**

| Post Issue Error Rate | Cycle Time Routine Reports | Special Reports Index | Documentation Index | Total Audit Cost per Year | Indicators |
|---|---|---|---|---|---|
| 5.0 | 4.1 | 75 | 86 | 21.3 | Performance |
| | | | | | |
| 3.0 | 2.5 | 90 | 95 | 10.0 | 10 |
| 3.5 | 2.8 | 89 | 94 | 11.2 | 9 |
| 4.0 | 3.1 | 87 | 92 | 12.4 | 8 |
| 4.7 | 3.4 | 85 | 90 | 13.8 | 7 |
| 5.4 | 3.8 | 83 | 88 | 15.4 | 6 |
| 6.3 | 4.2 | 81 | 86 | 17.2 | 5 |
| 7.3 | 4.7 | 79 | 84 | 19.2 | 4 |
| | | | | | |
| 8.5 | 5.3 | 77 | 82 | 21.3 | 3 |
| 10.0 | 5.9 | 75 | 80 | 23.5 | 2 |
| 11.7 | 6.6 | 73 | 78 | 27.0 | 1 |
| 13.5 | 7.5 | 70 | 75 | 30 | 0 |
| *6.6* | *5.2* | *2.0* | *5.0* | *3.0* | *Score* |
| 25 | 25 | 30 | 10 | 10 | Weights |
| ***165*** | ***130*** | ***60*** | ***50*** | ***30*** | ***Value*** |

Total weighted score: 435

A

B

C

D

E

F

G

H

**TABLE 3 : DESCRIPTION OF OBJECTIVE MATRIX COMPONENT**

| | Name | Description |
|---|---|---|
| **A** | Indicator | Indicator is the aspects of measurement. All the aspects taking into account to derive composite index. Each indicator contains the ratio of output into input, $\left(\frac{Output}{Input}\right)$ which is basically produce productivity score for that particular aspect. |
| **B** | Score-range | Score-range is some kind of table lookup to refer the position of each indicator based on their actual score. The score range are proposed by management staff which is in this case the maximum achievement will assign to largest number of score (10) and the worst will tend to have smallest number (0). The formula of constructing this palette is : $\left[\frac{(Maximum\ achievement - Minimum\ achievement)}{10}\right]$ |
| **C** | Score | Score is the value of range according to actual score. |
| **D** | Actual Index | Actual Index is the exact figure achieve by each indicator based from the calculation of the data. |
| **E** | Actual Score | Example: Documentation Index has actual score of 86 : based from the palette, the score is 5. |
| **F** | Index's Weight | Index's Weight shows the weight of each indicator. This is assigned by management staff based from which ratio they want to emphasize more. Larger number means the aspect is stressed more. |
| **G** | Value | $Value = (Actual\ score * Index's\ weight) = (E * F)$ |
| **H** | Total Weighted Score | $Total\ weighted\ score = \sum(Value) = \sum G$ |

***Productivity Calculation***

Basically, when calculating the productivity, it is actually happen to be benchmarking between the current performances compared to previous. To attain the final figure in productivity which is in percentage, the formula is as follows:

$$\text{Productivity Index} = \left[\frac{V_2 - V}{V_1}\right]_1 * 100\%$$

where,

$V_1$ = weighted score this period

$V_2$ = weighted score previous period

## RESULTS

**Case Study: Maintenance Worker (Mechanic)**

***The Maintenance Worker Environment***

A review of the maintenance work environment reveals some unique characteristics which is end up with a low volume of work. A maintenance technician often does many different jobs in a single day unlike the production counterpart who does high volume of work. The maintenance technician has much longer cycle work while the production worker has shorter cycle work. These significant differences led to major problems in early attempts to measure maintenance work. Breaking long jobs down into elements resulted in a large number of elements because the job duration was very long. Each element required further studies followed by application of detailed stopwatch time study or a predetermined time system analysis to determine the time for each element from the method identified.

There are bunch of different jobs, or tasks, in each of every skill in maintenance work. As in the case study, the workshop itself consists of seven distinct units; service, JPJ, air-condition, welder, tire, maintenance and electrical. The combination of many elements, many different maintenance tasks and many skills results in the need to develop, apply and maintain a library of lots of standards. One of the most difficult activities was applying the standards to the daily maintenance workload. Another approach

is needed to calculate personal productivity that finally will contribute to the overall company's productivity.

***The Workshop's Mechanics***

This paper will focus on measuring an individual productivity of maintenance worker in general and the workshop's mechanic in particular. The workshop tasks are maintaining and repairing their company's buses. All the repair task has assigned with their own controlled time and the mechanics should able to complete the task during the given time.

**Productivity Measurement Design**

***Implementation of Seven Steps in Constructing Productivity Indicators***

Step 1 : Mission Statement

The maintenance worker is responsible to maintain and repair all company's buses in sufficient time to meet customer needs, achieve suitable profits for the company and the individual worker should perform better than before.

Step 2 : Expectations

The customer of this workshop is the owner of all the buses. When a bus is sent for maintenance or repairing, the expectation is returning the bus in a good condition and safe to use. This is because they pay for the job as they expect something in return. On the other hand, the workshop itself have their own expectation which is they hope the fixing and maintaining job can be done during the given time. This is because they are paid base on the time which means if the task is delayed so they will loss in profit.

Step 3 : Key Outputs

The potential candidates for the key output which is finally will be indexed to provide the productivity figures are as follows:

i. *Number of buses fixed*. : This means the total number of buses have been fully maintain/service and starting to operate.
ii. *Number of buses partially fixed*. : The total number of buses that have been service but did not complete and cannot operate.
iii. *Number of buses unfixed*. : Total number of buses that have not been fix at all.
iv. *Number of complain or return*. : Number of bus that fixed, sent to owner, but returned back because of unsatisfying of the service.
v. *Number of buses in queue*. : Sum of the buses that still waiting to be service in a day.

Step 4 : Major Functions

One major reason that a function analysis is conducted is to identify key inputs. It is important to have a clear listing of all the key inputs that have very high potential to be measured. Based from the research made at the site and brainstorming session, the potential key inputs are as follows:

i. Key Inputs
    a. *Labor hours*. : Total working hours for each mechanics for a day (9 hours/day)
    b. *Controlled time for each task.* : Each task of service has been assigned to a specific controlled time.

A second major reason for conducting an analysis of the functions by which key outputs are produced is to identify potentially key throughputs. The probable throughputs identified for this measurement are as follows:

ii. Throughput
    a. *Productive labor hours*. : Total time that mechanics is productive which means they committed to work.
    b. *Time taken for completing a task.* : The actual time taken by mechanics in completing such task.
    c. *Overtime hours.* : Sum of all hours working out of normal working hour.

Step 5 : Output Measurement Selection

It is important to choose the best key outputs for constructing measurement system. This is because, if the wrong key output is chosen, it will resulting inappropriate productivity index. The outputs that have been chosen for the measurement are as follows:

i. No. of bus fixed or partially fixed
ii. No. of fixed bus rejected or returned
iii. Time taken to completing a task
iv. Days absent
v. Overtime hours

Step 6 : Input Measurement Selection

Same goes with identifying the best input to be measure. In this case, the following inputs have been chosen to be measured.

i. Total Labor hours
ii. No. of fixed bus fixed
iii. Time Scheduled on completing a task
iv. Total man days available
v. Straight-time hours

Step 7 : Index Construction

The final step involves creating productivity indices (ratios) that incorporate the measurement of key outputs and inputs.

1. $\left[\frac{\text{No. of Bus Fixed or Partially Fixed}}{\text{Total Labor Hours}}\right]$

- This indicator is taking into account because this company wanted to have a look of the growth in their effort. This ratio will show the performance of the mechanics in handling their work in daily, weekly and monthly basis. The ratio also shows the quantity of deliverables as well as skill growth.

2. $\left[\frac{\text{No. of Fixed Bus Rejected or Returned}}{\text{No. of Bus Fixed}}\right]$

- This indicator indicates customer satisfaction and communication in response of the mechanic's work.

3. $\left[\frac{\text{Time Taken to Completing a Task}}{\text{Time Scheduled on Completing a Task}}\right]$

- This ratio is emphasized more because the company's main objective is to see the performance of their mechanics in the time given on completing task specified.

4. $\left[\frac{\text{Days Absent}}{\text{Total Man Days Available}}\right]$

- The fourth ratio point is the attitude of the single mechanic. This is to assess whether the mechanics is serious in having their job and also whether they deserve their monthly salary according to their attendance.

5. $\left[\frac{\text{Overtime Hours}}{\text{Straight time Hours}}\right]$

- This final ratio show the working duration of mechanics and it will be integrated with all four other ratios to see if their working hour is appropriate with their deliverables.

***Implementation of the Objective Matrix***

**TABLE 4 : PERSONAL OBJECTIVE MATRIX**

| **1** | **2** | **3** | **4** | **5** | |
|---|---|---|---|---|---|
| No. of bus fixed or partially fixed / Total Labor hours | No. of fixed bus rejected or returned / No. of bus fixed | Time taken to completing a task / Time Scheduled on completing a task | Days absent / Total man days available | Overtime hour / Straight-time hours | **Indicator** |
| **0.64** | **0.30** | **0.80** | **0.12** | **0.09** | **Performance** |
| **0** | **0** | **0-0.2** | **0** | **0** | **10** |
| **0-0.2** | **0-0.1** | **0.2-0.4** | **0-0.1** | **0-0.1** | **9** |
| **0.2-0.5** | **0.1-0.2** | **0.4-0.6** | **0.1-0.2** | **0.1-0.2** | **8** |
| **0.5-1.0** | **0.2-0.3** | **0.6-0.8** | **0.2-0.3** | **0.2-0.3** | **7** |
| **1-2** | **0.3-0.4** | **0.8-1.0** | **0.3-0.4** | **0.3-0.4** | **6** |
| **2-3** | **0.4-0.5** | **1.0-1.2** | **0.4-0.5** | **0.4-0.5** | **5** |
| **3-4** | **0.5.0.7** | **1.2-1.4** | **0.5.0.7** | **0.5.0.7** | **4** |
| **4-5** | **0.7-0.8** | **1.4-1.6** | **0.7-0.8** | **0.7-0.8** | **3** |
| **5-6** | **0.8-0.9** | **1.6-1.8** | **0.8-0.9** | **0.8-0.9** | **2** |
| **6-7** | **0.9-1.0** | **1.8-2.0** | **0.9-1.0** | **0.9-1.0** | **1** |
| **Over 7** | **Over 1** | **Over 2.0** | **Over 1** | **Over 1** | **0** |
| **7** | **6** | **7** | **8** | **9** | ***Score*** |
| **20** | **20** | **40** | **10** | **10** | ***Weight*** |
| **140** | **120** | **280** | **80** | **90** | ***Value*** **<u>710</u>** |

***Implementation of Personal Productivity Index Calculation***

Productivity Index = $[(V_2-V_1) / V_1] * 100\%$

where

$V_1$ = weighted score this period
$V_2$ = weighted score previous period
Assume previous period index was 680
Productivity Index = [(710-680)/680]*100%
= **4.41%**
Productivity gain of 4.41% has been recorded during the period measured.

## DISCUSSION

This paper outlined how a measurement system could be developed in general and how individual measures application in particular. This paper studied the productivity measures for individual specifically ones in service sector which in this case is maintenance worker of a workshop's mechanics. The Seven Steps by Brinkerhoff and Dressler was used in order to design the measurement system and after that, the objectives matrix was applied in order to incorporate all the productivity indices that have been constructed. Even if the objective matrix usually used for team measurement, it also appropriate to use for individual measure because of the multi factor productivity. Productivity measurement practitioners should be able to develop measurement systems with given guidelines while researchers could use data from new applications for further research.

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