

# Chapter 8

## Modeling Maintenance Productivity Measurement

**Christian A. Bolu**  
Federal University Oye-Ekiti, Nigeria

### ABSTRACT

*Modeling and simulation of industrial information communication systems and networks is one of the major concerns of productivity engineers for the establishment of productivity standards in virtually all functional areas of an industrial organization. Maintenance function is one of such areas that have always engaged the attention of engineering productivity practitioners. However, one of the basic problems is the difficulty in setting up integrated but easy and practical measurement schemes. Even where the measures are set up, the approaches to measurement sometimes are conflicting. Therefore the need for an integrated approach to optimize the basket of parameters measured remains.*

*In this chapter the author attempts to identify approaches in integrated and systematic maintenance productivity measurement and create models for optimising total productivity in maintenance systems. Visual yardstick, utility, queuing systems and simulations approaches for measurement of maintenance productivity are all discussed with a particular focus on markov chain approach for stochastic breakdowns in repairable systems.. The chapter also shows how understanding the impact of plant failure and repair/service distributions assists in providing measures for maintenance productivity using discrete event system simulation.*

### INTRODUCTION

Modeling and simulation of industrial information communication systems and networks is one of the major concerns of productivity engineers for the establishment of productivity standards in virtually all functional areas of an industrial

organization. Maintenance function is one of such areas that have always engaged the attention of engineering productivity practitioners. However, the basic problem, and indeed the most important one, is the difficulty in setting up integrated but easy and practical measurement scheme. Even where the measures are set up, the approaches to

DOI: 10.4018/978-1-4666-2208-1.ch008

measurement sometimes are conflicting. There is therefore the need to optimize the basket of parameters measured.

The overall objective of the maintenance function should be to support the operating department by keeping facilities in proper running condition at the lowest possible cost. In judging the productivity of the maintenance department one must consider not only the efficient use of manpower and material, but also how well production losses due to maintenance problems are controlled. The performance of the maintenance department is influenced by various factors such as business condition (e.g low and high profit times), maintenance philosophy (crises maintenance versus planned), extraneous factors (location, availability of skills and spare parts), and so forth.

This chapter discusses approaches in systematic maintenance productivity measurement and creating models for optimising productivity in maintenance systems. It discusses defects accumulation, the manual visual yardstick, queuing systems and simulations approaches and highlights markov chain approach solution for stochastic breakdowns in repairable systems. Also it shows how understanding the impact of plant failure and repair/service distributions assists in providing measures for maintenance productivity using the simulation approach.

## **APPROACHES TO MODELING MAINTENANCE PRODUCTIVITY**

The word productivity is used in a variety of sense some of which are conflicting or very qualitative (namely, “efficiency”, “overall effectiveness”, etc). Similarly, the definition of “productivity” is varied. Productivity is often confused with “output” or “profitability”. Whilst a good total productivity implies profitability, the converse

does not hold. Profitability is affected by market prices and accounting practice. Productivity is defined simply as a relationship of output to input.

In sharp contrast to production, the performance of maintenance activity does not lend itself easily to expression in simple or unified figures. However, in the last two decades, the measurement of maintenance performance and productivity has engaged the attention of productivity engineers. (Priel, 1974) has written on maintenance organization particularly on performance ratios. He has identified twenty of such maintenance ratios. Some of the ratios are useful in establishing the basis for incentive scheme for maintenance personnel. (Hamlin, 1979) has shown various methods and (Alli, Ogunwolu, & Oke, 2011) applied same to measure maintenance productivity through their case studies. (Chan, Lau, Ip, Chan, & Kong, 2005), applying total productive maintenance approach to the electronics industry, (Eti, Ogaji, Probert, 2004) to the manufacturing industries in a developing country, (Lilly, Obiajulu, Ogaji, & Probert, 2007) to the petroleum-product marketing company and (Ahn & Abt, 2006), to the sawmills and planning mills industry provides examples of total productivity measurements in industry.

Another interesting point of view is provided by (Nanere, M, Fraser, I, Quazi, A, & D’Souza, C, 2007), who critically examines various methods for estimating productivity incorporating environmental effects and shows that adjusting for environmental impacts can result in higher and lower productivity depending on the assumed form of the damage. Although this was applies to the agriculture sector, this could be applicable to industrial environment, where work place hygiene and design could impact negatively or positively to productivity.

It can be seen that there are several ways of expressing maintenance productivity or performance. The problem is how to model a working

14 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

[www.igi-global.com/chapter/modeling-maintenance-productivity-measurement/79663](http://www.igi-global.com/chapter/modeling-maintenance-productivity-measurement/79663)

## Related Content

---

### Business Process Modeling with Services: Reverse Engineering Databases

Youcef Baghdadi and Naoufel Kraiem (2014). *Uncovering Essential Software Artifacts through Business Process Archeology* (pp. 177-200).

[www.irma-international.org/chapter/business-process-modeling-with-services/96620](http://www.irma-international.org/chapter/business-process-modeling-with-services/96620)

### Automated Star Rating Generation for Analyzing the Performance of Public Department

Mangalapriya Sakthivel, S. Vennila, S. R. Ilakkiya and S. V. Malini (2024). *Spectrum and Power Allocation in Cognitive Radio Systems* (pp. 53-62).

[www.irma-international.org/chapter/automated-star-rating-generation-for-analyzing-the-performance-of-public-department/353245](http://www.irma-international.org/chapter/automated-star-rating-generation-for-analyzing-the-performance-of-public-department/353245)

### Social Structure Based Design Patterns for Agent-Oriented Software Engineering

Manuel Kolp, Stéphane Faulkner and Yves Wautelet (2009). *Software Applications: Concepts, Methodologies, Tools, and Applications* (pp. 773-796).

[www.irma-international.org/chapter/social-structure-based-design-patterns/29421](http://www.irma-international.org/chapter/social-structure-based-design-patterns/29421)

### Eliciting Policy Requirements for Critical National Infrastructure Using the IRIS Framework

Shamal Faily and Ivan Fléchais (2013). *Developing and Evaluating Security-Aware Software Systems* (pp. 36-55).

[www.irma-international.org/chapter/eliciting-policy-requirements-critical-national/72197](http://www.irma-international.org/chapter/eliciting-policy-requirements-critical-national/72197)

### Combining Indexing Units for Arabic Information Retrieval

Souheila Ben Guirat, Ibrahim Bounhasand Yahya Slimani (2016). *International Journal of Software Innovation* (pp. 1-14).

[www.irma-international.org/article/combining-indexing-units-for-arabic-information-retrieval/166540](http://www.irma-international.org/article/combining-indexing-units-for-arabic-information-retrieval/166540)