



Data management in maintenance outsourcing



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ABSTRACT

Most businesses view maintenance as tasks carried out by technicians and the data collected is mostly cost related. There is a growing trend towards outsourcing of maintenance and the data collection issues are not addressed properly in most maintenance service contracts. Effective maintenance management requires proper data management - data collection and analysis for decision-making. This requires a proper framework and when maintenance is outsourced it raises several issues and challenges. The paper develops a framework for data management when maintenance is outsourced and looks at a real case study that highlights the need for proper data management.

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1. Introduction

Businesses need engineered objects (product, plant or infrastructure) to produce goods and/or services. Every object is designed and built to some performance requirement and comprised of several components (or elements). The performance of the object depends on the performance of its components. Components degrade with age and/or usage and this, in turn, affects their performance and the performance of the object. A component is deemed to have failed when its performance falls below a specific pre-defined level. The failure of an object is due to the failure of one or more of its components.

Maintenance actions are of two types—preventive maintenance (PM) actions to control the degradation processes and reduce the likelihood of failure of an item (component or object) and corrective maintenance (CM) actions to restore a failed item to a specified operational state, involving either repair or replacement of the item. Maintenance is a combination of technical, administrative, and managerial actions carried out during the life of an object. Effective maintenance requires proper data management—collecting, analysing and using models for

decision making. Traditionally, maintenance was done in-house by the owner of the object and also dealt with the data management issues. Over the last few decades, there has been an increasing trend in the outsourcing of maintenance where some or all the maintenance is carried out by an external service agent under a maintenance service contract (MSC). This raises several challenging issues for both parties—the owner of object and the service agent (provider of the maintenance service). Data is needed for many different purposes in outsourcing of maintenance, e.g. contract formulation, monitoring of the quality of maintenance provided by the service agent, improvements to maintenance, etc. Our focus in this paper is on data management in maintenance outsourcing.

The outline of paper is as follows. We start with a brief discussion of outsourcing and the issues involved in Section 2. Outsourcing involves two (or more) parties—the owner of the object (and customer for the maintenance service) and the service agent. Section 3 deals with decision problems from the perspectives of the customer and the provider. Section 4 deals with the role and use of data and data management. Section 5 looks at data management in the context of maintenance outsourcing and discusses the several issues involved. Sections 6–8 deal with a real case study where the object under consideration is a hydraulic pump whose maintenance is outsourced. Section 6 gives the description of the case study, Section 7 deals with data collection and Section 8 looks at the data analysis and modelling to gain new

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insights and how it can be used to improve the maintenance process. Section 9 deals with the improvement process in data management. We conclude with some comments in Section 10.

2. Outsourcing

2.1. Basic concept

The conceptual basis for outsourcing [3] is as follows:

1. Domestic (in-house) resources should be used mainly for the core competencies of the company.
2. All other (support) activities that are not considered strategic necessities and/or whenever the company does not possess the adequate competences and skills should be outsourced (provided there is an external agent who can carry out these activities in a more efficient manner).

There are a number of reasons that drive businesses to outsource. The list of reasons include

- Lower overhead costs through smaller workforce.
- Uneconomical to have in-house experts.
- Improve processes by benefitting from external input.
- Improve focus on core activities.
- Reduce risk by transferring some of the risks to the external agent.

There are several issues that need to be addressed before deciding on outsourcing and include the following:

- Is there a well-defined set of achievable business objectives?
- Does outsourcing make sense?
- Is the organisation ready?
- What are the outsourcing alternatives?
- What activities should be outsourced?
- How should the best external agents be selected?
- What are the negotiating tactics for contract formation?
- How to decide on the fee?¹
- How to decide on incentives and/or penalties in the contract?
- What systems are needed for effective monitoring?
- What are the potential risks?

There is a vast literature on outsourcing. Clemons and Hitts [4] introduced a framework for assessing the balance between outsourcing and in-house, and to determine which activities to outsource and which to retain internally.

2.2. Maintenance outsourcing

Most businesses tend not to view maintenance as a core activity and have moved towards outsourcing it. For these businesses, it is no longer economical to carry out the maintenance in house. There are a variety of reasons for this including the need for a specialist work force and diagnostic tools that often require constant upgrading. In these situations, it is more economical to outsource the maintenance (in part or total) to an external agent through a maintenance service contract.

Maintenance of an object involves carrying out three sequentially linked activities indicated below.²

1. Work planning (D-1): what elements (components) need to be maintained?
2. Work scheduling (D-2): when the maintenance should be carried out?
3. Work execution (D-3): how the maintenance should be carried out?

There are three different scenarios (S-1, S-2 and S-3) depending on which of the three the maintenance activities are outsourced and they are shown below

Scenarios	Decisions	
	Customer	Service agent
S-1	D-1,D-2	D-3
S-2	D-1	D-2,D-3
S-3	–	D-1,D-2,D-3

In scenario S-1, the service agent is only providing the resources (workforce and material, i.e. D-3) to execute the work and the customer makes decisions about what and when the maintenance should be carried out (i.e. D-1 and D-2). This corresponds to the minimalist approach to outsourcing. In scenario S-2, the service agent decides on how (workforce and material) and when (i.e. D-2 and D-3) and what is to be done is decided by the customer (i.e. D-1). Finally, in scenario S-3 the service agent makes all three decisions (i.e. D-1, D-2 and D-3).

2.3. Parties involved

The two main parties are—the customer (owner of the object and recipient of the maintenance service) and provider (service agent providing the maintenance service). For complex plants and infrastructures there can be many other parties. Fig. 1 indicates the different parties involved in the context of the privatisation of the rail infrastructure in the UK and many of them are important in the context of track maintenance outsourcing.

Each party has a different goals or objectives. The decisions of a party affect the outcomes for all the other parties. As such a game theoretic approach is most appropriate one for all the parties in making their decisions. We will confine our discussion to the simplest case involving only two parties—(i) owner of the object (customer for the maintenance service) and (ii) service agent (provider of maintenance service) and the maintenance service contract (MSC) specifies the maintenance actions to be carried out by the service agent.³ The contracts between the different parties determine the interactions between them.

2.4. Maintenance service contract

A MSC is a legal document that is binding on both parties and it needs to deal with technical, economic and legal issues.

Classification of contracts

1. *Standard contracts*: mainly in the form of extended warranties for consumer products and service contracts for commercial and industrial products (e.g., lifts in buildings). The terms of the

(footnote continued)

improvement, maintenance preparation, maintenance execution, and maintenance assessment.

³ We use customer and owner [provider and service agent] interchangeably throughout the paper.

¹ The fee can take many forms—based on the transaction, labour hour, cost per unit, cost per project, annual cost, cost by service levels, etc.

² According to IEC 60300-3-14 [7] the generic maintenance process includes: maintenance management, maintenance support planning, maintenance

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