

THE DEVELOPMENT OF A MAINTENANCE PHILOSOPHY

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Competitiveness in the world market is crucial for a business enterprise. This includes maintenance where there is substantial scope for improvement. Many solutions are offered to the maintenance organisation within a company, and these contain ideas that might be conflicting. A unique maintenance philosophy forms the framework for each company within which the company can develop specific maintenance policies for the technical systems. It must address the maintenance system and its interactions with the rest of the company and the environment. Factors that must be addressed are identified as part of a conceptual model. Through using this conceptual model, a company can direct the development of a unique and "comfortable" maintenance philosophy.

Introduction

World Class Manufacturing is currently an important driver in many companies. This means that all functions in the company, including maintenance, should be "world class". Maintenance is often just seen as an area where costs could be reduced. However, there is substantial scope for improvement in many aspects of maintenance. To improve performance, maintenance must be addressed in its totality, throughout the company. The maintenance practice itself is also changing with the availability of technology and is rapidly moving away from the stated, or assumed, maintenance philosophy.

To "improve" the existing maintenance philosophy, new philosophies are typically bought "off the shelf" from consultant groups. These philosophies are then implemented directly in the company. Unfortunately, it often makes no difference in practice, as the philosophy is not suitable for conditions in the company and is then not accepted and successfully implemented on floor level. Alternatively, maintenance practices are changed without any thought given to the change on philosophical level. The implications of these changes are not considered.

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Many solutions are offered to the maintenance organisation in a company, and these contain ideas that are often conflicting. One of the main reasons for this is the lack of standard terminology that would have made it easier to compare options. The different guiding concepts, such as maintenance philosophies, maintenance policies and maintenance approaches must be defined.

In this paper the different guiding concepts for maintenance are defined. A model is presented to describe a maintenance philosophy, and to show what factors, internal and external to an organisation, should be considered during the development of a maintenance philosophy for a company.

Hierarchical nature of maintenance guiding concepts

The definitions of the different terms used for concepts in maintenance are not clear and are often interchanged. It is therefore necessary to define exactly what the meaning of each term is and how they fit together hierarchically. Figure 1 contains a hierarchical representation of the interaction between the different terms. This figure is not meant to contain exhaustive lists of all possible examples, but just to serve as explanation of their hierarchical nature.

At the lowest level of the hierarchy, are the maintenance technologies. These are combined and found within tasks done within maintenance. The relationship is not one to one, but certain tasks may require more than one technology. In a similar manner the maintenance processes (or maintenance types) are combinations of the maintenance tasks. The combination of maintenance processes used is termed the maintenance approach (or concept).

A maintenance philosophy is the highest level of guiding principle for maintenance and includes aspects of other policies within the specific organisation.

Terminology used

According to the Oxford Dictionary,¹ philosophy is *the study of the general principles of some particular branch of knowledge*. Other sources link a maintenance philosophy with the concept of a framework. The purpose of

a maintenance philosophy of a company can therefore be defined as: *to form the framework of principles from which the maintenance policies for each technical system can be deduced*. It will also help to direct the development of a maintenance strategy from the business strategy of the company.

When Reliability Centered Maintenance (RCM), Total Productive Maintenance (TPM), Business Centered Maintenance (BCM) or another recognised and documented philosophy is used exclusively and in full, by a company, it is referred to as a philosophy. However when only certain components are used, it can be regarded as an approach or a concept. In some cases only certain systems are sourced from TPM, RCM, or other approaches.

A *maintenance philosophy* comprises:

1. Elements from various policies in the organisation, and
2. The maintenance approach

Characteristics of a successful maintenance philosophy are that it is:

- comfortable,
- compatible with the culture of the company, and
- results in improved performance of the company as a whole.

A *maintenance approach* is system specific and is formed by a specific combination of different maintenance systems. The models for modern maintenance management show that certain maintenance processes or types of maintenance should all be present in a modern maintenance approach. The specific combination will vary from one application to another. It is also important to note that the specific approach utilised will be dependent on the criticality of the equipment and the possible production scheduling problems and economic consequences that can result if the equipment fails. Most of the "maintenance philosophies" used by maintenance managers in industry are actually maintenance approaches formed by an integrated combination of the maintenance types or processes that are appropriate for that specific technical system.

When a maintenance philosophy for a company is not clearly formulated, these approaches are often directly translated into maintenance policies to guide the maintenance practices on the plant. Because all the influences on maintenance have not been considered in these approaches, the resultant practices might not be directed at the strategic objectives of the system or the company. A maintenance approach consists of a combination of maintenance types or maintenance processes.

A *maintenance process* functions within a maintenance approach to ensure that a certain type of maintenance is done. Among the processes found are:

- planned maintenance,
- corrective / breakdown maintenance,
- time-based maintenance, and
- condition-based maintenance.

In each documented maintenance philosophy, there is a specific breakdown of how these maintenance processes can be combined. The breakdowns differ, according to the definition associated with each maintenance process. In a model describing modern maintenance management, nearly all approaches or concepts of maintenance, several of these maintenance processes will function together. Development of a new field of maintenance theory will often result in a new maintenance system being developed. A maintenance type or process consists of several maintenance tasks. The tasks are not exclusive to any one process, but several processes can have a specific task as an element.

Maintenance tasks are the tasks that are done in any of the maintenance processes. Some of these tasks will be found in nearly all the maintenance processes discussed previously. In order to show this, a grid can be drawn between maintenance processes and maintenance tasks in Figure 1. The tasks utilised in each of the maintenance systems can then be indicated on the grid, as necessary. A maintenance task needs maintenance technologies. Any one technology is required in more than one, and sometimes in many, maintenance tasks.

Maintenance technologies refer to the skills, knowledge and tools utilised in maintenance. Some of these technologies are:

- condition monitoring,
- repair technologies,
- safety technologies, and
- quality assurance.

The full list would be long, as new developments are constantly being made. The availability of new technologies is often the drive behind re-evaluating the maintenance philosophy. They are often directly incorporated into maintenance practices and then leads to the formulation of an emerging maintenance philosophy. Maintenance technologies are the lowest level in the hierarchy.

Maintenance as a system

The purpose of developing a maintenance philosophy for a company is to assist that company in improving its total performance. A model describing a maintenance philosophy must therefore provide a framework for a dynamic system and should take into account all relevant factors in the system, its interactions and its environment.

A conceptual model for a maintenance philosophy

The conceptual model will direct the development of a unique and "comfortable" maintenance philosophy for a company. The sources to be used in defining a maintenance philosophy are important, as they too will have an effect on the final acceptance of the philosophy. Sources used in the development of a maintenance philosophy include:

- maintenance approaches in use within the company (this might not be specified, but could exist in the minds of maintenance practitioners)
- documented maintenance philosophies (such as RCM, RCMII and TPM)

A conceptual model for a maintenance philosophy is illustrated in Figure 2 and the factors to consider in the development of a maintenance philosophy are discussed in the following paragraphs.

How does maintenance fit into the strategic approach?

As maintenance often requires a large proportion of the company's resources, and can affect the long-term profitability of the operating equipment, it should be considered at the company strategic level.² The alignment with the goals of the rest of the company should be addressed in this process. If the process is successful it should result in strategies for handling finances, human resources and other important aspects.

The business strategy of a company should indicate the plans that the company has for achieving its mission. In most instances this would include changes and adaptations to the capacities of companies. This would have a direct influence on the strategies of maintenance, especially if capital extensions are required. These are all considerations that must be kept in mind when formulating a maintenance philosophy.

Unfortunately, maintenance is not always included as an important consideration when company strategies are

formulated. Even production strategies could be formulated without consideration of the impact on maintenance. In this case, any person wishing to formulate a maintenance philosophy for the company should take cognisance of what the company strategy is, and what the impact of it will be on the maintenance function.

The maintenance environment

The success of maintenance is dependent on its interaction with different people and groups of people.³ Each of these has its own objectives, needs and expectations that differ from each other, and also, possibly, from that of the maintenance organisation.

The environment is shown, in the model given in Figure 2, as consisting of three levels. The first level is the internal environment of the maintenance organisation itself. The next level is that of the rest of the specific company in which the maintenance organisation functions, and the third level of the environment is the external environment, with all its associated variables and complexities.

The maintenance approach

The maintenance approach was defined earlier as the combination of maintenance processes or types of maintenance that will be practised within the company. The maintenance practices, structure of maintenance, and the support systems required (among others) will be directly determined from the maintenance approach required.

The maintenance approach is one that is comfortable for maintenance practitioners, and in many situations this alone is seen as the maintenance philosophy.

Structure

The place of maintenance in the decision making network determines the overall place of maintenance in the organisational structure. The size of the organisation will also influence the nature of the interchanges in the decision-making centres. The position of maintenance can ensure better co-operation with other functions, more technical assistance and create more interest on the part of top management in the maintenance function.

The internal structure of a maintenance organisation is dependent on the task assigned to maintenance in that specific organisation. There are three basic structures for a separate maintenance organisation:

- central maintenance,
- area maintenance, and
- unit / departmental maintenance.

Nearly all the structures found in the industry are based on these three or combinations thereof. The integration of maintenance and production, or operational functions is often seen in modern organisations, and can lead to improved communication and co-operation. However, this integration requires an increased span of control and wider knowledge base for a person managing both production and maintenance functions. Long term maintenance considerations may be neglected if proper care is not taken to avoid the negative consequences of integration of functions.

The maintenance structure is an area that receives the first attention whenever "something is done about maintenance". If the structure is not considered as only one factor in a number of interrelated factors that should be considered as part of a maintenance philosophy, any benefits derived from a restructuring may only be valid for a short term. An ill-considered change might also result in the opposite of what was intended of being achieved.

Cost effectiveness

The attitude of maintenance towards cost effectiveness will be a direct result of the business strategy of the company. However, even within a company, differences will be found from one system to another. If a system,

(for example a production plant, a specific group of vehicles in a fleet, or even a building) is due to be closed down, life cycle costing (LCC) or long term financial evaluations will not be done. The system will simply be run into the ground with the minimum expenditure on maintenance. The criticality of a system breakdown will also influence the attitude towards cost management.

In bureaucratic cultures, staying within budget will be seen as the ultimate cost effectiveness and in more dynamic cultures all decisions will be evaluated according to financial viability. The dependability, availability, system performance, and other factors define system effectiveness. The system effectiveness required by the business strategy will dictate the final cost effectiveness of maintenance.

Human resources

Who should be doing the maintenance is an important consideration in the development of a maintenance philosophy. Trained production personnel can do certain traditional maintenance tasks. Furthermore, in a situation where certain maintenance tasks are centralised and others decentralised, this question must also be addressed. As a further alternative it must also be determined if some tasks cannot safely be outsourced.

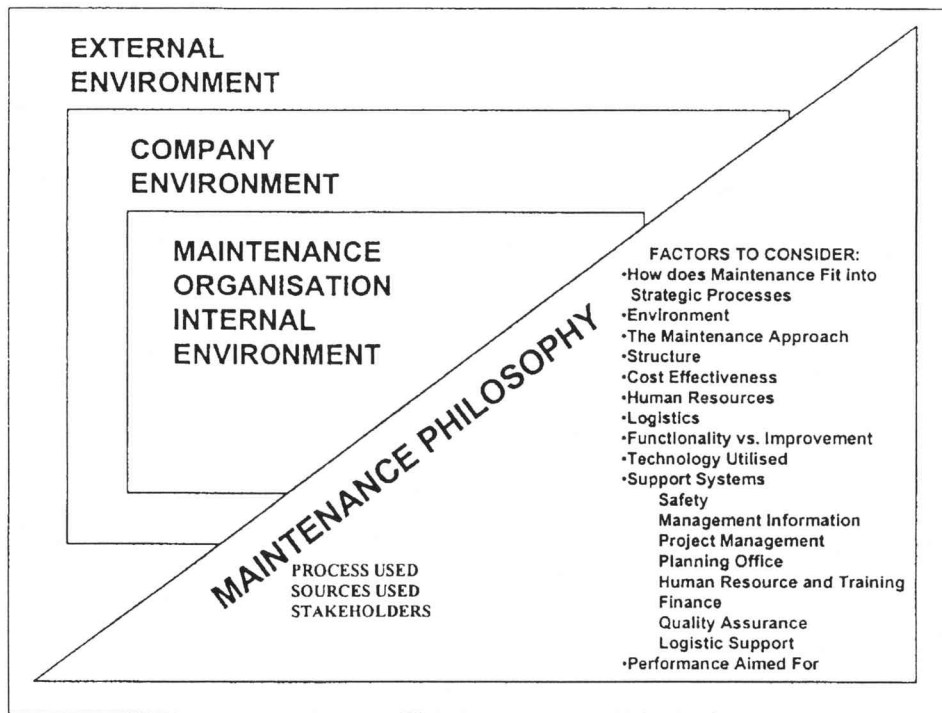


Figure 2 Conceptual model for a maintenance philosophy

The Human resource policy is important in a maintenance philosophy, as it will indicate the attitude towards labour relations, unions, affirmative action, remuneration, and others. The guidelines set by the parent company / holding company would have a strong influence.

Logistics

Clearly logistics is an intimate part of maintenance, and should be considered with great care. It can not be seen as just a supplies management or transport function, as it is much more than that.

Many tasks traditionally seen as those of both maintenance and stores (and other support functions) fall within the scope of logistic support. In other words, it is a composite of all considerations necessary to ensure the effective and economic support throughout its programmed life cycle.⁴

These elements do not all have to be performed within the maintenance organisation, but must be present in a logistic support system:⁴

- maintenance planning,
- test and support equipment,
- personnel and training,
- technical data,
- facilities,
- transportation and storage,
- supply of spare parts, and
- reconditioning of spare parts.

Functionality versus improvement

It should be determined if a company desires its equipment to be kept at designed capacity and specification, or if a culture of continuous improvement is desired. This improvement does not have to be only on the technical level, but can also be in terms of cost.

When companies match their system's capability and capacity with that required by the marketing plan, the system will not continually be forced to react to changes in production requirements. In addition it would promote change instead of resisting it.⁵

If continuous improvement is desired, the rate at which improvement is desired and the maximum level must be stated. Quantum leaps in improvement will need direct intervention, and this should also be considered in the maintenance philosophy.

Technology utilised

The level of technology that can be maintained in a com-

pany is dependent on the industry sector in which the company operates. It is also a direct result of the culture predominant in the company. The size of the company and its ability to keep specialists as well as other resources will influence the decision to go into higher technology. Support systems available to the company are further deciding factors.

The high technology option is not necessarily the best decision, either financially or technologically. An option that is comfortable within the company and can be maintained should be selected.

Support Systems

The support systems available to maintenance can enable it to reach its objectives. Inadequate or unfriendly support systems, on the other hand, can prevent maintenance from reaching its objectives, even if it has the best people, equipment, and intentions. The support systems that can easily be identified in a maintenance environment are:²

- safety,
- management information system,
- project management,
- planning office systems,
- human resource and training,
- finances,
- quality assurance, and
- logistic support

A support system should function as a source of expertise or information – not a hindrance. The automation of maintenance systems is not necessarily the best way of improving support systems. A computerised maintenance system cannot function effectively if major and intermediate failures persist.⁶ A failure data management system might be more effective in such a situation. Several factors, including the maturity of the specific organisation should be considered when a maintenance management system is developed.⁷

Although maintenance management information systems (MMIS) and maintenance planning systems are often computerised, this does not necessarily mean that these information systems are better.

A further aspect that can be identified as a system is performance measurement. This will play a significant part in directing the efforts of people in the maintenance organisation to achieve the desired, and rewarded, performance.

Conclusion

Performance aimed for

There are two aspects that should be considered when looking at the performance aimed for by a maintenance organisation. These are:

- in which areas should performance measures be set, and
- what should the values aimed for in these performance measures be?

The aim of performance measurement is to direct the efforts of an organisation to those areas that need to be at a high level to ensure world class performance of the total company.

In practice, however, measurements tend to be done in areas where it was easy to measure and also areas with a low impact on profit. Examples of this are:

- labour
- materials / spares
- outside services
- maintenance overhead

Other areas that are more difficult to measure but have a potentially higher impact on profit are seldom measured in practise. These areas often influence the capacity of the plant and result in a loss of potential revenue for the company. Examples of this are:

- changeovers (set-ups and adjustments),
- breakdowns,
- idling and minor stoppages,
- running at reduced speed,
- scrap, yields and rework,
- start-up losses,
- low flexibility,
- poor image,
- ineffective use of skills, and
- late delivery

The performance to be aimed for can be determined from history, but it would be of more benefit to determine these levels through a benchmarking exercise. The aimed for levels should be challenging, but reachable to serve best as incentives.

In conclusion, it is emphasised that a maintenance philosophy can only be regarded as successful if it has been implemented fully in the business enterprise.

A change in the maintenance philosophy affects the working life of people and as such can create significant resistance to change at all levels of the organisation. Resistance to change should be expected and translated to positive feedback that can direct the development of the optimal maintenance philosophy for a specific organisation.

The maintenance philosophy must function within the reality of the company, including the organisational culture and the resources available to that company. The development of a maintenance philosophy is therefore not a "clean sheet exercise". The constraints of the environment should be taken into account.

All possible sources for development of a maintenance philosophy must be used, including the ideas of people in the organisation. Ownership of the new philosophy is of crucial importance for a successful implementation. A philosophy that works in practice and leads to improved performance is of more importance than a perfect theoretical exercise.

During the development of a maintenance philosophy there are two relevant decisions:

1. To develop a maintenance philosophy, and
2. To accept it.

The management of change is therefore crucial and can never be underestimated. One recommendation to increase the likelihood of acceptance, and successful implementation is to allow individual units to develop further. This can be done within the framework provided by the developed maintenance philosophy.

Developing a unique and "comfortable" maintenance philosophy can help to improve the total performance of the maintenance organisation, and improved performance of the maintenance organisation will enable the company to increase its competitiveness in the world arena.

References

1. *Oxford Dictionary*. Oxford University Press, Oxford, 1973.
2. Vosloo R. *Maintenance Management – The Strategic Approach*. MEng (Eng. Management) dissertation, University of Pretoria, 1992.
3. Blaas A. Communication in the Modern Maintenance Environment. *Proceedings of the Annual*

- Maintenance Management Convention*. The SA Institute of Mechanical Engineers, 1984.
4. Blanchard BS. *Logistic Engineering and Management*. Prentice-Hall, New Jersey, 1986.
 5. Petersen GT. Capacitance — Redefining Maintenance. *Chemical Engineering*, 1994, p.76–82.
 6. Suzuki T. *TPM in Process Industries*. Productivity Press, Portland, 1994.
 7. Langan G. Maintenance Automation: out of the Broom Closet and into the Boardroom, *IEE Solutions*. 1995, p.14–17.