



# METHODOLOGY AND THEORY

## A framework for strategic planning in maintenance

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### Abstract

**Purpose** – The purpose of this study is to introduce a framework for developing a maintenance strategic plan that links the maintenance function with the corporate strategy and integrates it with other functional areas. Within the proposed framework, a systematic process for maintenance strategic planning is described and key success factors that need special attention are identified.

**Design/methodology/approach** – An analytical methodology is adopted to develop a systematic approach for implementing the framework

**Findings** – The study finds that the involvement of major stakeholders as well as top management commitment is essential for the successful development of a maintenance strategic plan. The process of development of the strategic plan in maintenance differs from other areas because of its intangible benefits to the organization and special type of stakeholders. More emphasis should be put into handling senior management and other partners within the organization.

**Practical implications** – Senior maintenance managers and strategy developers may benefit from this study in developing their own plans. The process of developing the plan is well explained in a systematic manner that will drive the developers throughout the whole process.

**Originality/value** – The literature of strategic management and strategic issues in maintenance is summarized to set the foundation for the framework and to enrich the process of strategic planning with alternative strategies for different issues that will help in selecting the most appropriate strategy. The value of the paper is in its framework that puts elements of strategic planning together in an integrated framework.

**Keywords** Maintenance, Strategic Planning, Organizations, Corporate strategy

**Paper type** Research paper

### Introduction

Strategic planning is increasingly being adopted by many organizations around the globe to help in facing challenges in highly competitive and rapidly changing business environment. However, these corporate strategies need to be accompanied by strategies for key supporting functions. Companies in the manufacturing and construction business are heavily dependent on their machinery and equipment in securing a competitive advantage. Maintenance, in its wide sense, is the function that is mostly concerned with that aspect of the business. Therefore, it is essential to have a long-term plan for maintenance that takes into consideration the vision, mission and objectives of the organization and the anticipated changes in technology.

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Maintenance in its narrow meaning includes all activities related to maintaining a certain level of availability and reliability of the system and its components and its ability to perform to a standard level of quality. It includes activities related to maintaining spare part inventory, human resources and risk management. In a broader sense, maintenance includes all decisions at all levels of the organization related to acquiring and maintaining a high level of availability, reliability and value of its assets. Maintenance is becoming a critical functional area in most types of organizations and systems including construction, manufacturing, transportation, etc. It is becoming a major function that effects and is affected by many other functional areas such as production, quality, inventory, marketing and human resources. It is also getting to be considered as an essential part of the business supply chain at a global level. This increasing role of maintenance is reflected in its high cost, which is estimated to be around 30 per cent of the total running cost of modern manufacturing and construction businesses. As such, planning for maintenance is becoming an essential part of planning for the whole organization.

Planning is done at two different decision levels: strategic or tactical. Decisions at the strategic level are concerned with issues related to the existence of the business as a corporate whereas tactical decisions affect the way business is conducted at a certain stage of its growth. Strategic planning sets the long-term vision of the organization and draws the strategic path for achieving that intended vision. Long term and short term planning at the tactical level is concerned with selecting ways within a preset strategy for achieving long, medium and short term goals and targets. Strategic planning is by definition a vision based long term plan that can be done at the functional, business or corporate level. In general, regardless of the type and purpose of planning, strategic planning includes the determination of actions or tasks as well as resources needed for their implementation.

Corporate business planning, long or short term, strategic or tactical should take maintenance into consideration for all types of decisions that involve future major investments. A decision on acquiring a new facility, for example, might turn into a complete disaster for the whole business for its low maintainability. Capacity planning of the plant should consider its maintainability and the capacity of maintaining it.

Traditionally, maintenance is not viewed as a strategic unit in the organization and hence maintenance planning was, at most, done at the midterm range. However, the strategic dimension of the maintenance function has lately drawn the attention of the researchers and practitioners with the increase in the competition at a global level and with the increase of the maintenance cost relative to other costs in the organization. Equipment availability, especially in certain business sectors like energy generation and oil exploration and other mega projects, is becoming a major concern for its high cost of acquisition. Emerging operational strategies such as lean manufacturing are shifting the emphasis from volume production to quick response, defect prevention and waste elimination. These changes in operational strategies require changes in maintenance strategies related to equipment and facility selection and in optimizing the maintenance activities with respect to the new operations objectives. Rapid technological changes in non-destructive testing, vibration measurement and other emerging technologies have generated an alternative strategy of condition-based maintenance. However, these new technologies introduced new challenges that maintenance systems have to face including the development of new capabilities and

management practices to utilize these technologies. In the long run plans have to be developed at a strategic level for keeping up with emerging technologies. See Murthy *et al.* (2002). Environment and safety are becoming global concerns accompanied by laws and regulations that have great impact on maintenance activities across major industries such as oil, gas, chemical, petrochemical, mining and transportation.

These changes in the business environment developed the realization that maintenance must not be viewed only in the narrow operational context dealing with equipment failure and their consequences. Rather it must be viewed in the long-term strategic planning context that integrates technical and commercial issues as well as changes in the sociopolitical and environmental trends. Maintenance must be viewed strategically from the overall business prospective and has to be handled in a multidisciplinary approach. See Murthy *et al.* (2002).

The purpose of this paper is to introduce a framework for maintenance strategic planning that takes into consideration the view of maintenance in relation to other parts of the organization at different levels. It links strategic issues in maintenance to global organizational issues, philosophies and directions. Thus the framework introduced here is a conceptual model of maintenance in relation to the organization that guides the process of developing a maintenance strategic plan. The process incorporates that link into the plan in a way that can be used by practitioners in the field of maintenance.

Issues related to strategic management and strategic decisions are well studied in the literature, however, these need to be put in perspective through a framework that links these elements together with higher-level strategic issues and plans. The proposed framework gives the understanding of the nature of maintenance and its role in relation to other functional areas in the organization. This understanding guides in developing comprehensive maintenance plans that have a higher chance of success.

In the next chapter, the literature is reviewed for strategic issues and decisions related to maintenance. Chapter 3 introduces the proposed framework followed by a detailed description of the planning process. The most important factors for successful maintenance strategic planning is discussed in chapter 4 of the paper followed by summary and conclusions in the last chapter.

### **Strategic issues in the literature**

The literature of strategic management had, to a certain extent, attracted the attention of researchers in the area of maintenance expressed in articles studying the role of maintenance in the whole organization. Visser (1998) introduced a system view of the maintenance put in perspective with respect to the enterprise as shown in Figure 1. In this view, maintenance is put at the heart of the enterprise and hence it should have its own strategic plan that aligns its objectives and goals with the objective and goals of the whole organizations. Strategies for maintenance operations should be carefully selected among alternatives to achieve these objectives.

Murthy *et al.* (2002) view the maintenance system by the equipment state, the operating load, maintenance actions (strategies) and business objectives. The state of the equipment is affected by the operating load as well as the maintenance actions. The operating load is dependent on the production plans and decisions, which are in turn effected by commercial needs and market consideration. Therefore, maintenance

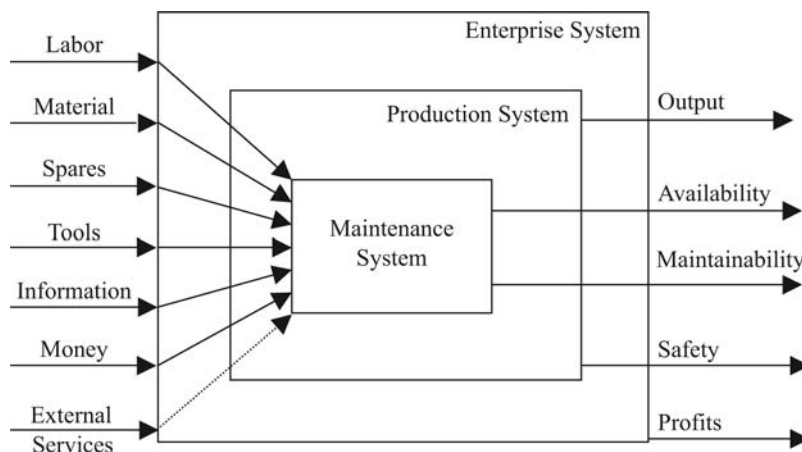


Figure 1. Input output model of the enterprise

planning has to take into consideration the production planning, maintenance decisions, equipment inherited reliability and market and commercial requirements.

Few papers have been published recently that discuss issues related to strategic maintenance planning. Tsang (2002) identified four strategic dimensions of maintenance. The first dimension is the service delivery strategy. Outsourcing versus in-house maintenance are two possible alternatives for maintenance delivery strategies. Many petrochemical processing plants outsource all their equipment and facility maintenance. Others outsource particular specialized or risky aspects of maintenance. The potential benefits of outsourcing maintenance activities include less hassle, reduced total system costs, better and faster work done, exposure to outside specialists, greater flexibility to adopt new technologies and more focus on strategic asset management issues (Watson, 1998; Campbell, 1995).

Tsang (2002) has an excellent analysis of the two options in terms of things that should not be outsourced. An activity that is considered to be the organization's core competency should not be outsourced. An activity may be considered as a core competency if it has a high impact on what customers perceive as the most important service attribute or the activity that requires highly specialized knowledge and skills. The costs involved in the internal service include personnel development and infrastructure investment and managing overhead. The costs involved in the outsourcing include the costs of searching, contracting, controlling and monitoring.

Murthy *et al.* (2002) explored the outsourcing issue and discussed the long-term costs and risks of different alternatives. Some general guidelines are laid out in relation to this issue including that maintenance management and planning should not be outsourced. The maintenance implementation, however, may be outsourced based on cost and risk consideration. Risks are very much linked to the service supply market. Having a single dominating supplier in the market makes the user company hostage to that supplier services. On the other hand if the suppliers are weak, they might not be able to supply quality and reliable service as much as the internal service can do. Furthermore, the service should not be outsourced if the company does not have the capability to assess or monitor the provided service and when it lacks the expertise in negotiating sound contracts.

Contractual relationship with the service provider is an important aspect of outsourcing. Martin (1997) studies different aspects of contracts. Contracts have to be carefully written to avoid long-term escalation in its costs and risks. The benefits of outsourcing are seldom realized because of contracts that are task oriented rather than performance focused and the relationship between the service provider and the user is adversarial rather than partnering. In the absence of long term partnership between maintenance service supplier and the user, the supplier will be hesitant to invest in staff development, equipment and new technologies. The relationship between the supplier, and the user, is determined by the type of contract.

While outsourcing has great potential for significant benefits, it also includes some potential risks such as loss of critical skills, loss of cross-functional communications and loss of control over a supplier. To reduce the risks, the contract and the contracting process should be dealt with in delicate manner. Specialists in the maintenance technical requirements and specialists in technology and business needs as well as specialists in contract management should be involved in the process. The contract itself should have a conflict resolution and problem solution mechanism for uncertainties and inevitable changes in the requirements and technology changes. Other measures for reducing risks include splitting maintenance requirements in to more than one supplier.

The second dimension of strategic maintenance management identified by Tsang (2002) is the organization and work structure. Traditionally, the organization structure is hierarchical and highly functionalized within which maintenance is organized into highly specialized trades. This organization has led to many problems in terms of efficiency and effectiveness. New process oriented organization structures are emerging for more effective and efficient management of business units. Within these structures, maintenance is viewed as part of a group owning the process. Different work structures may be considered for different types of maintenance work. Choices between plant flexible and plant specialized tradesman, centralized versus dispersed workshops, trade specialized versus multi-skilled trade-force has to be made.

The third dimension of strategic maintenance management is the maintenance methodology. There are four basic approaches to maintenance: run to failure, preventive maintenance, condition-based maintenance, and design improvement. Methodologies for selecting the most suited approach such as reliability-centered maintenance and total productive maintenance are developed and adopted globally by many companies. The choice between these methodologies is a strategic decision that has to be made based on the organization's global objectives.

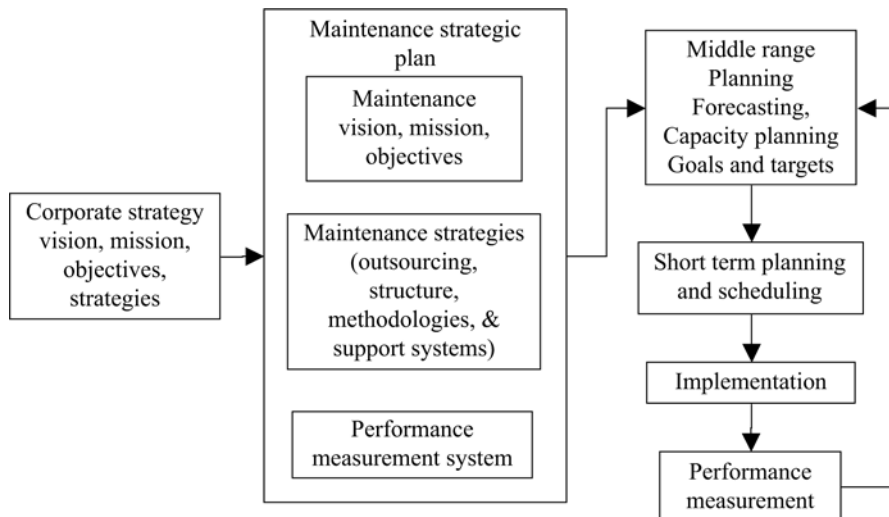
The fourth dimension of strategic maintenance management is the selection of the support system that includes information system, training, and performance management and reward system. Each element has to be carefully selected to support the overall objective of the organization. Enterprise Resources Planning, ERP, systems are gaining ground in large organizations and to a certain extent in medium size organizations. The power of ERP lies in its ability to integrate different functional areas within the organization which is an essential requirement for maintenance planning and scheduling. Successful implementation of the system requires careful system selection and implementation strategy that is human focused. For details about integrating maintenance strategies in ERP see Nikolopoulos *et al.* (2003).

Managing maintenance performance has many strategic aspects that are discussed in the literature. Tsang (1998) was one of the first authors linking maintenance performance to corporate strategy. He suggests a framework that uses the Balanced Scorecard approach for measuring performance at strategic, tactical and operational levels through the four perspectives; financial, customer, internal processes and learning and growth. He briefly discusses the process of developing a strategic plan within the context of maintenance performance management. Kutucuoglu *et al.* (2001) introduce a more comprehensive framework for managing maintenance performance. They identified the main features of quality performance measurement system that includes vertical and cross functional integration at all levels, strategic, tactical and operational. They suggest Quality Function Deployment (QFD) methodology for building an integrated performance measurement system.

Parida and Kumar (2006) discuss the maintenance performance measurement system as the backbone for maintenance strategic management. They introduce the concept of total maintenance effectiveness that includes internal and external effectiveness, rather than overall equipment effectiveness. Internal effectiveness includes productivity, cost, skills and competencies, and reliability and efficiency of resource utilization. External effectiveness includes customer satisfaction and growth of market share. They also make it clear that the MPM system should be based on a clear maintenance strategy that in turn should be derived from and linked to the corporate strategy. The top objectives should be cascaded into team and individual goals. They suggest a hierarchical system in which the top level addresses the corporate or strategic issues and the middle level addresses tactical issues and the lowest level addresses the operational level.

### Strategic planning in maintenance

Maintenance planning that is composed of strategic, medium and short term is described in Figure 2. Starting from the corporate strategic plan, the maintenance



**Figure 2.** The maintenance planning as part of the corporate planning system

strategic plan is developed from which medium and short-term plans are extracted. The focus of this paper is on the development of the strategic part.

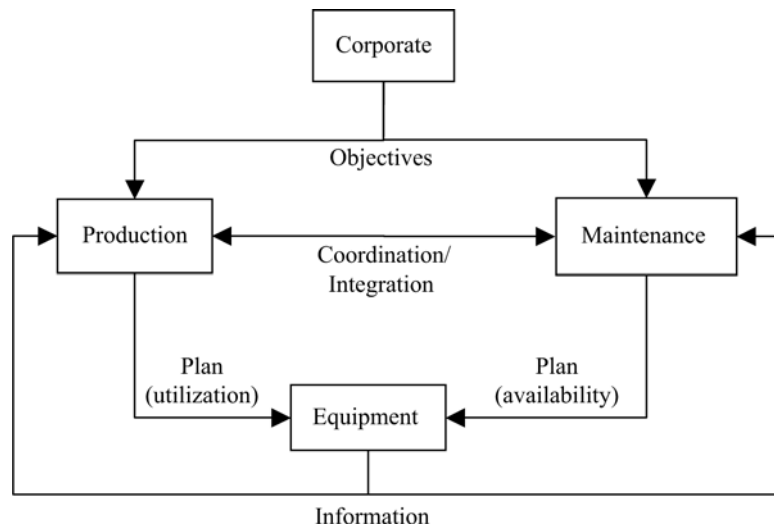
A strategic plan for maintenance, like any other functional plan, has to be consistent with the vision and objectives of the corporate. However, strategic planning in maintenance differs from other functional areas as follows:

- the traditional view of maintenance as a cost center rather than a profit center;
- the strong interconnection between maintenance and major asset management;
- the high influence of maintenance on corporate objectives through asset acquisition and its management;
- the nature of being highly technical and labor intensive; and
- the nature of key stakeholders (mostly internal).

As such, strategic planning in maintenance is special in nature and has to be handled in a slightly different manner than other functional areas.

The maintenance strategy is developed based on the corporate objectives and is based on a clear understanding of the role maintenance plays in the corporate strategy and on clear objectives that are in line with the corporate objectives. Strategic choices have to be made in relation to organization structure, maintenance methodologies, supporting systems and outsourcing related decisions. Once selections are made, middle range plans have to be made regarding capacity and workforce planning. Weekly and daily plans are then made and activities are scheduled for implementation followed by measuring performance for continuous feedback for improvement. This paper focuses on the strategic planning portion of maintenance planning.

The global view of the enterprise in relation to production and maintenance introduced by Visser (1998) can be modified to reflect the partnership between the two functions in utilizing and maintaining the equipment as shown in Figure 3. This view forms the base for more liberal strategic planning from the maintenance point of view



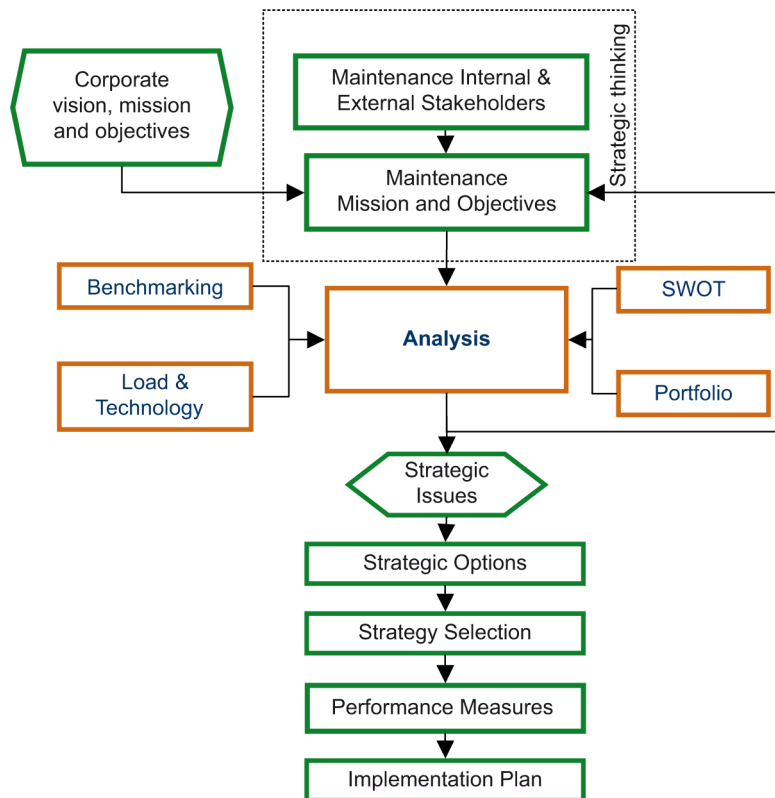
**Figure 3.**  
Interrelation between  
production and  
maintenance

that is consistent with the model introduced by Murthy *et al.* (2002). Both functions, production and maintenance, have to take cooperate objectives into account in their planning as well as each other's perspectives and views regarding their own plans. While the main focus of planning is to satisfy demand by utilizing resources to the maximum, maintenance focuses on maximizing asset value and its availability. Information flowing back from operations to production and maintenance regarding equipment condition is essential in adjusting plans and also revising decisions.

There are different alternative methodologies for the strategic planning process. All of them stress the involvement of all stakeholders in the process using different tools such as brain storming sessions and focused group meetings. This section proposes a framework for developing a maintenance strategic plan that is based on the global view of maintenance presented in Figure 3.

The development process is presented in the chart in Figure 4. The process comprises the following steps:

- (1) *Identify major internal and external stakeholders.* Internal stakeholders include top management of the organization, other functional areas like production and inventory, other supporting functions such as IT and finance functions. Top management and production management are extremely essential in formulating the mission and objectives. The role of the labor as major



**Figure 4.**  
A framework for  
maintenance strategic  
planning



stakeholders is essential in assessing the current situation and choosing strategies for different maintenance issues.

- (2) *Formulate the mission statement.* The mission statement explains the purpose of existence of maintenance in the organization and its role in achieving the vision and mission of the organization. The mission statement should clearly define the scope of work including asset identification and equipment selection, acquisition, and management. Hence, it should be embraced and approved by top management and communicated to other parts of the organization. Mission statements reflect the focus and philosophy of the organization. The traditional focus is on quick response to breakdown, reduced down time or controlled cost. Lately, safety and environment are increasing becoming a major concern of maintenance. An example of a mission statement is "To deliver cost effective equipment availability and reliability". This statement gives a clear idea about the objective to be developed in the next step. Another example is "To provide excellent support for customers by reducing and eventually eliminating the need for maintenance services" (Joel Levitt, 1998). This statement is clearly linked to a vision of the future of maintenance within the organization and it also reflects a new philosophy of being lean organization.
- (3) *Set the strategic objectives of maintenance.* The objective(s) to be formed here is the highest level measure of mission achievement that is directly linked to the overall corporate objective. Strategic objectives should be set based on the following principles:
- to meet the major needs of the stakeholders based on their aspirations;
  - to improve on existing strength;
  - to overcome a major weakness or challenge; and
  - to mitigate a major threat.

Stakeholders should be heavily involved in identifying the objective(s) with the corporate objective as a reference. The objective(s) should be stated in qualitative and quantitative forms. A traditional objective is to increase overall equipment reliability and/or availability that are currently viewed as challenges or threats to the overall performance of the organization in terms of its productivity and value of assets. Certain measures are adopted for each objective and targets are set based on a benchmark.

- (4) *Analyze the current situation.* The current situation means all maintenance related internal and external matters. Internal matters include strengths and weaknesses in terms of performance and its trends, current practices, available technologies, relation with other functions, and strategies and maintenance policies and practices. Duffuaa *et al.* (1999) have developed a checklist that can help in assessing the current maintenance practices. External matters include opportunities and threats. It includes competitor's performance and practices, emerging technologies and anticipated and current government rules and regulations, emerging maintenance strategies and approaches. Several tools can be used for the analysis including:
- SWOT (strengths, weaknesses, opportunities and threats) analysis is used to identify internal and external factors affecting the maintenance function. It

identifies internal strengths and weaknesses and external opportunities and threats. This is usually done through a series of sessions with major internal and external stakeholders. SWOT also helps in identifying major issues that need immediate attention as well as strategic issues that need to be addressed in the long run. It also helps in seeking the desires of different stakeholders in terms of the role of maintenance and required performance. This might require a revision of the mission and objective that was set in the previous steps. This revision should be done before proceeding further in the strategic planning process. SWOT helps in understanding the key challenges facing maintenance operations. Primary and secondary data may be collected and analyzed to confirm the results of the SWOT.

- Portfolio analysis. This method is used to study trends in performance in terms of the identified objectives and existing measures of performance.
  - Benchmarking is the study of the best practices in the area of maintenance in similar organizations. The focus is on performance and best practices. It is a process of identifying the best practices in the business that can be adopted for self-improvement in quality and performance. This step will help in setting targets and selecting strategies at later stages of the process. The benchmarking process for maintenance quality of performance, and maintenance audit is proposed by Raouf (2009).
  - Load and technology analysis. This step is basically a forecasting exercise for both production load and future technologies in maintenance, production and information. This step is essential for the maintenance function since it is highly labor intensive and technology driven more than any other function in the organization. This must be conducted in partnership with the production function with the involvement of finance and human resources. In the context of strategic planning it is used for identifying strategies and initiatives that have proven success for possible adaptation. Feeding the results of the analysis back into the mission and objectives that was previously set gives an opportunity for revisions and adjustments if necessary. So if it was too ambitious with respect to the analysis it may be brought closer to reality and vice versa.
- (5) *Identify the strategic issues.* The analysis conducted in the previous step has pointed out some issues that have a long-term strategic impact. These strategic issues should be put in perspective and agreed on with clear statements. The most common strategic issues in maintenance are identified by Murthy and by Tsang and summarized in the literature review.
- (6) *Strategic options.* A strategic option is an action, or a set of actions, that help to achieve a strategic objective. At this step, we analyze the strategic issues identified in the previous step and explore all possible strategies for each. The benchmarking that was conducted in the analysis is very influential in exploring alternative options in addition to the literature cited earlier. Brainstorming sessions are also useful when conducted with experts in the area. For each objective, strategic options will be developed to close the gap between the current state and the ambitions. The strategic options will be developed based on best practices in leading organizations.

- (7) *Strategy selection.* For each strategy for each issue the pros and cons should be studied in order to make the selection that would achieve the objectives in the most efficient and effective manner. As there are several alternative, yet feasible, ways an objective can be achieved, it is prudent to consider the option that is most attractive, effective and viable. The strategic options are evaluated against the metrics of impact, cost and resource requirement, and ease of implementation.
- (8) *Develop performance measures.* For each objective identified, develop a set of quantitative measures. There are few quantitative measures that are used in assessing the performance of the maintenance and its degree of achieving the objectives. After developing the strategic objectives the following steps will be performed:
- Operationalize every objective through specific measurable performance indicators. Parida and Kumar (2009) suggest a set of performance indicators that can be helpful in this regard.
  - Assess the current status of the objectives.
  - Agree on the future ambition or level for the same objectives based on the performance of the leading centers in date or palm research.
  - Map the gaps between the current state and the future desired ambition. Defining the performance gap contributes to an understanding of where the current system is performing in relation to the strategic objective.
- (9) *Implementation planning.* The implementation-planning step creates a framework to execute the selected strategy via a series of programs and specific recommendations. The programs will be first prioritized according to their impact and feasibility of implementation. The most important and feasible programs are further short-listed by urgency (short-term vs long-term) and resource requirement. It is necessary to focus on a limited number of programs to ensure successful implementation. A comprehensive roadmap for implementation will be constructed. Each of the selected programs has to be defined in terms of timelines, milestones, roles and responsibilities. Organizational mechanisms to continuously monitor the entire project plan should be established. Part of the implementation plan is to develop a system for continuous assessment and strategic adjustment. The model for continuous improvement and maintenance audit introduced by Raouf (2009) can be adopted for this purpose.

#### *Key success factors*

The history of strategic planning cites less success than failure in implementing strategic plans due to several reasons that are mostly referring back to the development stage. However, there are a few issues that need to be taken into consideration at the development stage for higher chances of success.

- *The support of top management.* This support is not guaranteed for the maintenance as it is seldom considered as a strategic function. Therefore, unusual effort is needed for gaining their support. Awareness sessions about the role of maintenance in the core business of the organization supported by figures

and analysis for key people in management helps in gaining understanding and hence the support of top management. This issue should not be taken lightly and could consume considerable time and effort. Without full and genuine support of top management results, most of the time, end in failure either in the planning process or at the implementation stage.

- *The involvement of major stakeholders is another key success factor.* The absence of key stakeholders in the development process leaves some gaps in either the analysis or in evaluating strategic options. Special attention should be given to top management, production management, and operations. The alignment between maintenance with corporate strategy as well as production can be achieved by the close involvement of management at that level.
- *Ownership.* The implementation plan should have an owner that controls and monitors the progress of the implementation and assess goals and target through a well developed systematic procedure. A balanced scorecard is usually used for that purpose.
- *Strategic planning culture.* Strategic planning is a culture as much as it is a process. Spreading the culture throughout the organization and maintenance management in particular is a major success factor of strategic planning. In a culture of strategic consciousness, people tend to behave and make decisions based on strategic impacts and global objectives rather than on local and short-term benefits. This culture can be achieved by awareness sessions and training workshops at all levels of the organization. The strategic plan, after its development, has to be well communicated to all concerned people within the maintenance function and all stakeholders in general.

### Conclusion

Maintenance planning and scheduling must serve the global objectives in the enterprise, hence it must be based on clear vision of its role in its success. Maintenance strategic planning is the process that assures matching between the maintenance objectives and objectives of the whole enterprise as well the as objectives of other functional areas. It selects the appropriate strategies regarding service delivery mode and type of contracts for outsourcing if needed as well as the organization and work structure and maintenance management methodology. Therefore, the process of strategic planning should be done in a way that assures the alignment between various parts of the organization as well as the success of its implementation.

In this paper a framework for strategic planning in maintenance is proposed for structured development of the plan. It links between the mission and objectives to selected strategies. Some points need special attention because of the nature of the maintenance function in its view at higher level of management as well as its nature of high technology and labor intensive. The proposed framework will guide practitioners and planners in maintenance in various types of organizations in developing their strategic plans.

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