MAiNTENANCE
The University of Manchester

Proceedings of 1st International Conference on Maintenance Engineering, IncoME-I 2016
The University of Manchester, UK

Paper No ME2016_1105

Identifying Organisational Requirements for the Implementation of an Advanced Maintenance Strategy in Small to Medium Enterprises (SME)

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Abstract In many organisations the production equipment represents the majority of invested capital, and deterioration of these facilities and equipment increases production costs, reduces product quality and has a significant impact on energy consumption. Over recent years the importance of maintenance, and therefore maintenance management within manufacturing organisations has grown. The maintenance function has become an increasingly important and complex, activity – particularly as automation increases. The opportunity exists for many organisations to benefit substantially through improvements to their competitiveness and profitability by adopting a new approach to maintenance management. Several tools and technologies including Condition Based Maintenance, Reliability Centred Maintenance and more recently E-Maintenance have developed under the heading of Advanced Maintenance Strategies. However, the adoption of advanced maintenance strategies and their potential benefits are usually demonstrated in large organisations. Unfortunately, the majority of organisations, classified as Small and Medium Sized Enterprises (SMEs), are constrained by the lack of knowledge and understanding on the requirements which need to be in place before adopting an advanced maintenance strategy. This paper will present the findings from an extensive literature review and an ex-amination of multiple case studies. The results show that there is a set of key requirements which strongly influence the implementation of an Advanced Maintenance Strategy (AMS) within SMEs.

Key Words: advanced maintenance, Condition-based Maintenance (CBM), Small, Medium Enterprises

1.0 Introduction

Small and Medium Enterprises (SMEs) are the new engines that are driving the economies of the world, more specifically those of the developing nations. They contribute in providing job opportunities, act as supplier of goods and services to large organizations. SMEs act as specialist suppliers of components, parts, and sub-assemblies to larger companies because the items can be produced at a cheaper price than the large companies could achieve in-house. Therefore, a lack of product quality supplied by the SMEs could adversely affect the competitive ability of the larger organizations [33]. SMEs around the world face the challenges of having a flat organisational structure that is riddled with limited resources. They often lack the financial muscle to have in-house experts or even to hold on to the knowledge that they gain. Majority of SMEs rely on outdated technology, labour intensive and traditional management practices, thereby leading to inefficiency, lack of information and inadequate in-house expertise [13]. Smaller firms seldom have strategic planning horizons and generally end up resorting to fire-fighting rather than long term responses. Managers of SMEs have poor skills in reflecting upon their companies strategically [34]. Cooke [8] brings out the lack of strategic planning in four British firms. The SMEs must identify and explore core competencies that must be added. Otherwise the current competencies can become obsolete and begin to function as core rigidities [33]. Major constraints of SMEs in meeting the challenges of competitiveness are summarized in Singh et al. [33] as follows.

- Inadequate technologies as well as other resources [10, 13].
- Excessive cost of product development projects [6].
- Lack of effective selling techniques and market research [13].
- Unable to meet the demand for multiple technological competencies [26-27].
- Lack of funds for implementing expensive software such as ERP system [38].

Many of the SMEs are fighting with each other for a larger market share. Only companies that produce products of high quality at reasonable cost will be able to achieve sustained growth and survival in this competitive environment [18]. Smaller firms have to continuously upgrade themselves to stay in competition. If a competitor's technology is accepted as the industry standard, it can threaten the existence of the firm [27]. In order to stay relevant in today's cut-throat global marketplace, the SMEs have to look beyond the conventional up-gradation of machinery, production processes, supply chains and marketing strategies. Smarter firms have understood that the God is in the detail. With all the firms going for conventional upgrades, the firms which have started improving associated processes like maintenance have emerged as winners. In fact, the costs associated with maintenance labour and materials are likely to go even higher in the future

with the addition of factory automation through the development of new technologies [11].

In order to sustain manufacturing productivity and customer satisfaction at the highest possible level, maintenance strategies used by the firms have been widely used to decrease the downtime, the needless repair work and increase both quality and productivity [11]. The quality and maintenance functions are vital factors for achieving sustainability in an organization [19]. SMEs have been compelled to increase reliability of machines to improve their performance standards in many dimensions such as quality of product, cost, and productivity, product introduction time, delivering time and performing smooth operations by adopting a favourable maintenance system due to high global competition [18]. The increasing sensibility for safety, the high quality requirements, the sustainability needs and the goods preservation are becoming, critical considerations for companies' competitiveness [2].

Modern maintenance practices including TPM, CBM, and RCM, provide that edge to the SMEs. Large investments in maintenance operations or functions can improve the performance of a manufacturing system and enhance the competitive market position of the organization [7]. Sharma et al. [32] highlighted that in order to get more competitive, the firms should adopt effective and efficient maintenance strategies such as condition-based maintenance (CBM), reliability-centered maintenance (RCM) and TPM rather than being reactive. TPM implementation in any organization enhances the overall equipment effectiveness (OEE) by increasing equipment availability, decreasing rework, rejections and also enhancing the overall productivity of an industry [36]. Jain et al. [18] concluded that this is true not only for large industries but also for small-scale industries. Deshmukh and Chavan [9] have also researched and reached similar conclusions. Jain et al. [16] highlight that TPM is implemented mostly in large-scale industries either Indian or non-Indian, but in SMEs, use of TPM is limited. This study also conclude that Indian SMEs are in the need of TPM implementation to enhance availability, performance, quality rate, OEE, productivity, quality of product and to reduce maintenance cost, breakdown, losses etc. In fact, SMEs have been laggards when it comes to implementation of Modern Maintenance Practices (MMP). Among others, major challenge for SMEs is the up gradation of technology [20], which is often a must have to implement MMPs. Han and Yang [11] has listed certain key areas that require development in order to implement e-maintenance system. The list includes the problems of high sensor costs and lack of standardization among others. Liebler [23] has described CBM as "the most misused and misunderstood of all the industrial plant improvement programs". Walker [37] points out that many implementation efforts fail and that condition monitoring tools all too often end up in maintenance workshops cupboards, hardly ever used.

2.0 Key Enablers for Successful Implementation of AMS in SMEs

The enablers for implementation of any change are similar for both large firms and SMEs. However the literature is limited that deals with implementation process in SMEs. In the current research, an extensive literature review was carried out to highlight implementation enablers specifically in case of SMEs.

2.1 Organizational Enablers

These are the factors that are present in the organization (Characteristics of the organization, Human Resources, etc.) and can help in implementation of a change in the firm. It encompasses the leadership, the workforce and the general culture in the firm.

2.1.1 Top Management Commitment

This is considered as the most important factor in implementing any change in any organization. It is necessary that the top management is committed to the aim of implementing MMP into the firm. Kotter [21] states that successful implementation of change in organizations has to be driven by a strong leadership. Schroder and Sohal [31] have found that the drive to invest in new improvement programs is influenced mainly by senior management, regardless of firm size. Higgs et al. [16] has highlighted top management support as one of the key factors for smoother introduction of CBM. Hansson et al. [12] have furthered this deduction to be applicable to TQM, TPM and RCM. Lazim et al. [22] have defined that the top management commitment and support is one of the key success factors for managing change. It is important that management gives support for an implementation and communicates this support [3]. In SMEs, major problem is that owner of the company usually does not delegate adequate power and responsibility to top managers of the company [33].

2.1.2 Organizational Culture

Culture and cultural fit are more important in SMEs than other organizations because an SME is likely to be entirely enveloped in a culture, rather than large organizations, where several cultures may be present. This makes it easier to attain cultural change in SMEs than in larger organizations [33]. A favourable organization culture will bring in improvement and innovation in SMEs. A far lesser number of verticals in the hierarchy with lesser number of departments make SMEs much more flexible to adapt to the changes that the top management is committed to bring.

2.1.3 Human Resource Management

Higgs et al., [16] deduce that among other factors, the level of employee expertise and training of employees to appreciate the idea of condition based maintenance is a fundamental requirement to implement CBM in firms. Jain et al. [17] rate the participation of all the employees to improve or enhance equipment effectiveness, availability, performance, quality rate, OEE, reliability and safety as the most important requirement of TPM. Lazim et al. [22] lay emphasis on the factors like morale and motivation of the staff. Training and education can also help to upgrade the skills and technical capabilities of the production and maintenance staff.

2.2 Strategic Enablers

These enablers deal with the long term strategic planning of the firms. Organizations that have a long term perspective tend to implement institutional changes more effectively than those which are fire-fighting on a daily basis.

2.2.1 Collaboration

Collaboration with bigger and better firms has a positive impact on the functioning of SMEs. Chen and Huang [5] have highlighted the potential of vulnerable new SMEs to collaborate with international companies. Such collaborations and alliances help SMEs to learn from the best in the business. Best maintenance practices and implementation techniques from the bigger collaborators can be absorbed by the SMEs to attain better practices. These alliances improve overall performance and effectiveness [30].

2.2.2 Clarity of AMS implementation Objectives

As the management decision is made to implement the programme, objectives need to be set in clear terms. There is a necessity to communicate these goals to everyone in the organization. Non-clarity of the organisation objectives and organisational policy towards the TPM programmes results in the failure of TPM implementation [1]. It is essential to let the organization, at least the maintenance department, be involved in the goal setting, as they are supposed to fulfil the goals at a later stage [3].

2.3 Technical Enablers

2.3.1 ICT

Information and communication technologies are indispensable to the operation of the core routines of organizations [15]. Larger organizations have a much formal and planned implementation process of IT management. Sadowski et al. [29] noted that SMEs generally have an ad hoc approach to IT management. Due to this,

SMEs seldom have a defined IT budget or an explicit IT plan or strategy. Investments in technology are often driven by the owner, rather than by any formal cost-benefit or strategic analysis [33]. There is a need to seek advice of experts in the field before implementing any ICT project in the SMEs. It should not be based on the "ideas" of the owner alone. Morgan et al. [24] bring out the importance of accredited experts in smooth implementation of projects. SMEs can get competitive advantage by having integrated information systems [4].

2.4 Operational Enablers

2.4.1 Stepwise Implementation

The implementation process of AMS must be done in phases with the terminal objectives of each phase laid out at the outset. This creates power and motivation to overwhelm the reactionaries [21]. The goals should be set in a phased approach with several short-term and a few long-term goals [3].

2.4.2 Timely Implementation

One major reason for failure of big change in an organisation is the prolonged implementation period. Vrakking [35] states that the success of the implementation of an innovation relates to the time elapsed between the generation of the innovation and its implementation. This time is to be kept to a minimum while ensuring that the basic tenets of the implementation process are followed. Vrakking [35] argues that such implementation is only successful in companies that follow a very strict implementation strategy.

2.4.3 Careful Selection of Assets and Monitoring Techniques

Economic viability of the project of implementing AMS will always be the prime consideration for a SME. This is due to the fact that there will always be a constraint of the total budget. The business case for implementing such a strategy is equally important to the technical possibility of implementing [14]. Moubray [25] point out that it is important that such programmes are implemented where it is appropriate, not as an overall policy. This is because many techniques are expensive, and it would not be cost effective. Parida [28] states that there is a tendency that industrial companies measure what is easy to measure, not what is required. This implies that a rigorous decision-making process is necessary in order to not suffer the effects of a trial and error or ad-hoc approach.

3.0 Conclusion

This paper has examined a range of key requirements to support the implementation of an advanced maintenance strategy within SMEs. The requirements have been proposed from an extensive literature review and data collected from a range

of experts and practitioners. The list, although not exhaustive, clearly identifies the core elements required including, organizational, strategic, technical and operational. The aim of the paper is to provide a possible framework which SMEs could consider, either all or part of, when deciding upon a new approach to maintenance strategy development. Here the main driver has been to take into account the resources the typical SMEs have i.e. due to the daily challenges the human resources are limited and similarly the financial resources are limited thus requiring that the payback time has to be short and that the benefits have to be clearly measurable.

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Authors' Biography

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David Baglee gained his PhD from the University of Sunderland in 2005. He is a Senior Lecturer at the University of Sunderland UK, a Visiting Professor of Operations and Maintenance at the University of Lulea Sweden and a Visiting Associate Research Professor at the University of Maryland USA. David has published extensively in international journals and presented at a large number of international conferences. David is currently supervising 6 PhD students in a range of engineering topics

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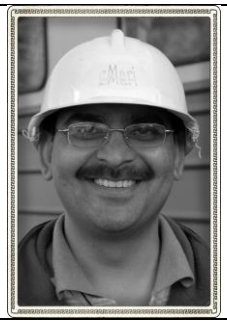
Dr Erkki Jantunen is principal scientist at VTT Technical Research Centre of Finland. Between 1978 and 1990 he worked in the shipbuilding industry in structural, vibration and hydrodynamic fields. Since 1990 he has been employed by VTT having various project responsibilities related to maintenance, condition monitoring and diagnosis of rotating machinery. He has been a member of the editorial board and acted as a reviewer of a number of scientific journals. He has been project manager of many research projects. He is the author and co-author of several books and more than 100 research papers in the field of condition monitoring, diagnosis and prognosis and e-maintenance. He has a position as a visiting professor at the University of Sunderland.



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