

Outsourcing Maintenance of Power Generating Equipment in Malaysian Palm Oil Mills

Nazim Baluch¹, Che Sobry Abdullah², and Shahimi Mohtar³

¹(School of Technology Management & Logistics (COB), Universiti Utara Malaysia, Malaysia)

²(School of Technology Management & Logistics (COB), Universiti Utara Malaysia, Malaysia)

³(School of Technology Management & Logistics (COB), Universiti Utara Malaysia, Malaysia)

Abstract: *Government of Malaysia has acknowledged that its sources of fossil fuel are depleting and stresses the need to seek other forms of energy sources as critical and of strategic importance for its long-term energy security. The government continues to undertake efforts to manage both non-renewable and renewable energy resources to meet the energy demands of Malaysia's rapidly growing economy; in particular, Malaysian government's renewable energy efforts promote the biomass power generation and co-generation in the palm oil mills. However, Power producers must also consider the nature of power generation, i.e. uninterrupted electric service and environmental impact, which requires high reliability, stability and safety. Industrial organisations are constantly in search of new solutions and strategies to develop and increase their competitive advantage. This paper discusses the pros and cons of one such solution, outsourcing maintenance in power generating plants in palm oil mills and outlines, maintenance outsourcing process, and selection criteria of Maintenance Service Provider.*

Key Words: *Power Generation, Outsourcing Maintenance, Service Provider, Life Cycle Costing, Palm Oil Mills*

I. Background

Malaysia is blessed with an abundant supply of fossil fuel which has provided the country with a largely resilient economy through its energy autonomy, since independence five decades ago. However, the Government of Malaysia has acknowledged that its sources of fossil fuel are depleting and stresses the need to seek other forms of energy sources as critical and of strategic importance for its long-term energy security. The Government's commitment to the promotion and development of renewable energy were incorporated in development planning documents such as the Third Outline Perspective Plan (OPP3 2001-2010) [1] and the 9th Malaysia Plan (2006-2010). The government continues to undertake efforts to manage both non-renewable and renewable energy resources to meet the energy demands of Malaysia's rapidly growing economy.

In recent years, stakeholders and governments are moving towards an electricity market that is deregulated, open, competitive, and pool market which requires dramatic cost reductions in providing and generating electricity. Power producers must also consider the nature of power generation, i.e. uninterrupted electric service and environmental impact, which requires high reliability, stability and safety. Industrial organisations are constantly in search of new solutions and strategies to develop and increase their competitive advantage. Outsourcing is one of these strategies that can lead to greater competitiveness (Embleton & Wright, 1998) [2].

II. Maintenance Outsourcing - Process and Selection of Maintenance Service Provider

Briefly, maintenance outsourcing can be defined as a "managed process of transferring activities to be performed by others" and its main advantage is conceptually based on two strategic pillars: The use of domestic resources mainly for the core competencies of the company; and The outsourcing of all other (support) activities that are not considered strategic necessities and/or whenever the company does not possess the adequate competencies and skills (Campbell, 1995) [3]. Unfortunately, single cost-based decision processes remain the most used approaches by maintenance managers for making outsourcing decisions (Lyly-Yrjänäinen *et al.*, 2004) [4]. The cost dimension may be sufficient if maintenance is strictly considered a support functional cost center; however, following the new maintenance strategies such as TPM, and if maintenance is considered a stand-alone business unit, different approaches are necessary. Organisations need to realise, there is no single position regarding maintenance outsourcing that is correct for all. Nevertheless, there is enormous value in retaining core maintenance competencies in capital intensive industries by developing in house maintenance expertise on equipment that is vital to their manufacturing process. To successfully support physical assets, a high level of knowledge and skill needs to be present, along a strong sense of ownership for the performance of the assets. To have an environment that enunciates positive thinking and induces continuous improvement process into the way things are done, it is imperative to look at the pros and cons of maintenance outsourcing

before making a decision. Many companies believe that the value of outsourcing prevails in bringing process, technology, and practices to their plant. In reality, most outsourcing organisations do not have a true understanding of the concepts of proactive, predictive, and condition based maintenance.

Successful companies that invest in sustainable growth appreciate the strategic impact maintenance can have on their business and are prepared to invest in their own people; not incite encumbrance to a third party. While, in some situations, a business case may exist to outsource; a few examples might include: lack of sufficient in-house skilled trades; nature of the equipment is highly specialized, such as turbines, where an external organisation has the expertise and it is not cost effective to build it internally; nature of the equipment that requires maintenance is highly cyclical with extended periods of low maintenance demand; or the size of the facility is too small to justify the investment.

2.1 Outsourcing: There are two key strategic issues that determine the option between outsourced and internally provided services. The first factor is the potential for achieving a sustainable competitive edge by performing the work internally. If management perceives that excellence in performing certain maintenance services – done cheaper, better or in a timelier manner – will enhance the company’s competitiveness, such services should be carried out internally. The second factor is the degree of strategic vulnerability if the work is outsourced. If there is insufficient depth in the market, an overly powerful supplier can hold the company hostage. On the other hand, if the individual suppliers are too weak, they may not be able to supply quality and innovative services as good as the buyer could by performing the work internally (Quinn & Hilmer, 1994) [5]. Knowledge is another important dimension that affects vulnerability. It is extremely risky to outsource work when the company does not have the competence either to assess or monitor suppliers, or when it lacks the expertise to negotiate a sound contract. The caveat that companies should not outsource those activities that are crucial elements of their core competencies is often not heeded when outsourcing decisions are driven by cost-cutting and headcount-reduction criteria. As a result, control of activities critical to establishing the company’s competitive advantage can be inadvertently ceded to suppliers. Another common misconception in making outsourcing decisions is to regard “core competencies” as “things that we do best”. This equivocation is damaging as it encourages management to outsource activities with which it is having problems. If the company has difficulty in managing an internal supplier, it probably cannot communicate its requirements adequately to the external supplier. Thus, internal problems are traded with more sticky problems of dealing with external suppliers. It will be even more devastating if the problematic activity over which the company relinquishes control is a critical link in its current or future value-creation process. When an external supplier offers a significant cost-saving deal on the company’s core activities, management should refrain from outsourcing them. Instead, the internal service provider should be challenged to improve its cost-effectiveness, using the supplier’s offer as a benchmark of performance. Furthermore, one should not rule out the possibility that the supplier may be using a “loss-leader” tactic in making the favourable offer to the client – the price differential could well be the supplier’s investment in controlling and developing such strategic capabilities (Lonsdale & Cox, 1998) [6].

In terms of maintenance outsourcing, however, a set of additional potential and attractive benefits can be achieved such as to: increase labour productivity; reduce maintenance costs; focus of in-house personnel on “core” activities; improve environmental performance; obtain specialist skills not available in house; and improve work quality. Nonetheless, outsourcing also involves a set of drawbacks that must be taken into account by the customer that include: loss of control and loss of a learning source, because an internal activity is externalised; loss of knowledge of the plant; possible dependencies on the supplier; variations in the quality of the product given to the customer; and problems among personnel, since they lose their functions. Magnitude of these benefits and risks, however, depends on the qualifications of the supplier and on the type of outsourcing contract negotiated. The idea of outsourcing is to achieve the optimal performance within a company and a supply chain. Outsourcing decisions, therefore, require life cycle analysis of anticipated changes concerning all relevant costs, including indirect ones, to avoid undesired surprises.

2.2 Life Cycle Costing (LCC): is an approach which aims at producing comprehensive cost information for decision makers by estimating the costs incurring in the future and by monitoring the costs during the life cycle. Despite the fact that at least one of the main objectives of outsourcing is to reach cost reductions – also in a longer term, the systematic utilization of cost management in outsourcing is quite rare. As a result, companies do not generally know the full financial effects of outsourcing. This, however, becomes increasingly important as the outsourcing trend continues. Life cycle costing is a tool that can be used when the outsourcing decision is being made. LCC is well aligned with outsourcing objectives of long term cost reductions; LCC seeks to identify long term costs. LCC communicates the costs as time-dependent variables; outsourcing of an activity may be cost effective at one point of the life cycle but ineffective at another point. These kinds of assessments are not possible without cost information on a life cycle basis. The management of fragmenting value chains

requires relevant and comprehensive cost information that often extends the boundaries of a single firm. If companies fail to sufficiently track their own cost, which is often the case, they will face serious problems in evaluating the economical effects of outsourcing and new value chain designs (Sievänen *et al.*, 2001) [7]. There has also been an interest towards outsourcing of the ownership of individual assets or the whole process (Markeset & Kumar 2004) [8]. Suppliers of machines and equipment nowadays provide different services to their customers in addition to pure products during a product's whole life cycle, which generates a need to examine the cost effects of the changes in business from the supplier's point of view (Laine *et al.*, 2004) [9]. The range of these strategic alliances and the type of contracts negotiated can vary from simple parts availability programs or 'Operating Plant Service Agreements (OPSA)' to 'Long Term Programs (LTP)' with risks sharing elements and the value based payment methods.

It must be stated that the outsourcing of certain functions or services should not be considered as the equivalent of granted success. Strategic factors that can ensure a higher possibility of success in the process of moving from a centralised maintenance management to the outsourcing of certain services can be identified in the: strategic analysis evaluating feasibility of the entire project on the basis of the existing corporate constraints; assessment of those activities that should be managed in outsourcing and the selection of the service providers for their realisation; and acquiring managerial capabilities for monitoring and evaluating service provider and customer relationship (Embleton & Wright, 1998) [10].

2.3 Maintenance outsourcing process primarily entails the following aspects

- I. Evaluate if the company is ready to outsource:** Prior to starting the outsourcing program the company should objectively evaluate its actual situation with respect to some critical issues. Maintenance staff should adequately review internal structure, processes and management procedures, personnel capabilities and their responsiveness to changes and innovations. A definite picture of the overall ability to manage the outsourcing program could be drawn and company's readiness to outsource maintenance activities could be somehow quantified.
- II. Define what activities to outsource:** The choice of the activities to be externalised represents another important decision to be faced at the very early stages of the outsourcing program. Generally, "non-core" competencies are all good candidates for outsourcing, being standard, well defined and repetitive activities (such as, repair of generic and common equipments, electrical and electronic parts and plant overhauls). Besides, many of them are adequately performed by a growing number of specialized suppliers available in the marketplace, with interesting costs and quality rates. In this case, the risk of losing expertise and know-how is minimal while, on the other hand, in-house maintenance personnel can concentrate on critical and valuable technical topics (Dunn, 2009) [11].
- III. Selection of Maintenance Service Provider:** To maximise the potential advantages and to minimise the risks deriving from the adoption of outsourcing policies, an extremely important role is covered by the selection of the right supplier. It is, therefore, necessary to develop the selection criteria and the benchmarking activities to evaluate and analyse their capabilities including:
 - geographical position (i.e. local presence)
 - i.** the perceived quality of goods and services
 - ii.** contractor flexibility
 - iii.** technical excellence
 - iv.** plant-specific know-how and experience, and
 - v.** Competitive low price

These are some good examples of performance factors that may be used to this end (Choi & Hartley, 1996) [12]. It is crucial to obtain a sustained spirit of co-operation and mutual understanding that benefits both parties; the most successful outsourcing arrangements are those in which the supplier brings a "partnership philosophy" to the alliance (Judenberg, 1994) [13]. Of particular importance will be the explicit consideration of risk at various key points in the contracting process, and the identification of appropriate strategies for managing those risks. The specification of requirement during the tendering process will need to be carefully considered. In particular, for those contracts involving large-scale outsourcing of most maintenance functions, there will be a requirement to ensure that the requirements specification is outcome-based, rather than input-based. In other words, the specification will need to detail what is to be achieved from the contract, not how it is to be achieved, or what inputs will be required for its achievement.

- IV. Payment structure:** may include; Fixed or Firm price, Variable Price, Price ceiling incentive, Cost plus incentive fee, Cost plus award fee, Cost plus fixed fee, Cost plus Margin. Each of these price structures represents a different level of risk sharing between the contractor and the outsourcing organisation, and a number of considerations will need to be made in determining the most appropriate payment structure including: The extent to which objective assessment of contract performance is possible; The ease with

which realistic targets can be set for contractor performance; The administrative effort involved with each payment option; and The degree of certainty with which the desired contract outcomes can be specified. Before the contract is conceded, the client will need to have decided on the appropriate contract administration process, and the roles and responsibilities of its own staff in managing the contract. It is appropriate to combine special conditions of contract with the standard conditions to develop a new contract structure that suits the particular contract being negotiated. Service providers usually supply the basic terms of contract that are open to modifications as per client's specific needs. Contract termination arrangements need to be addressed before the contract is approved; In particular, agreement needs to be reached regarding the duties and obligations of the outgoing contractor in handing over to the incoming contractor (or the client organisation, should they decide to bring maintenance back in-house).

- V. Monitor the contractor's performance:** The outsourcing contractor assumes greater responsibility for successful performance of the function being outsourced; sharing not only rewards but risks as well (Judenberg, 1994) [14]. A fundamental aspect for the adoption of outsourcing policies is strictly joined to a clear and distinct definition of responsibilities, so that it can be possible to establish a link between the performances of an item with the maintenance activities effectiveness, both when the control activities are performed by the customer or by the provider. By this point of view it becomes extremely important to define a system of performance indicators, usually linked with quality, quantity and costs (Leverly, 1998) [15]. Quality measures are usually linked to the time necessary to restore the equipment. Quantity refers to the commitment of the maintenance provider to assure the required services. Finally, costs should be used to evaluate how much the investments for adjusting and enhancing the maintenance service reflect into a measurable reduction of all those costs that can be related to the disservice following a failure. The most commonly used measures of contractor's performance are: price/cost; equipment availability (e.g., MTBF); safety and environmental performances (e.g., average number of incidents); on-time performance (e.g., MTTR); work quality/rework; and amount of work.

III. Power Generation in Malaysian Palm Oil Mills

There are 434 palm oil mills operating in Malaysia; with 18 million tons of crude palm oil production capacity per year, the oil palm mills, at five times the rate of CPO production, generate 90 million tons of biomass available for power generation (MPOC, 2010) [16]. The primary objective of every palm oil mill that owns a power plant is to install and to operate their plant in a most cost-effective way in order to maximize their profits while ensuring a reliable power supply for their operations. Besides the investment costs for construction - the life cycle costs need to minimize; one of the major such cost involves operation and maintenance cost that cumulates in course of operation period of the power plant. Cost reduction by outsourcing of Operation and Maintenance (O&M) activities is one opportunity to meet such requirements.

Power generation equipment in Malaysian palm oil mills makes a good business case for outsourcing its maintenance. Factors that contribute to this decision are:

1. Remoteness of mills – most of the mills are deep in land and operate away from the national grid
2. Lack of in-house skilled workforce - power generating equipment is complex and highly specialized and qualified technicians are needed for the job to guarantee reliable and effective power generating equipment maintenance
3. Abundant free boiler fuel – 90 million tons of biomass is available to be used as fertilizer or boiler fuel, making steam production process economical
4. Worldwide rising cost of the energy production demands that mills do not load the national grid; in certain cases surplus power could be sold back to national grid
5. Most palm oil mills having over capacity or standby, redundant, power generating equipment – boilers and turbines
6. Aging power generating equipment needs to be replaced with new more efficient ones
7. Malaysian government is offering various incentives to facilitate the change

Older power generating units are no longer considered effective for reliable and efficient power supply (Wan *et al.*, 2010) [17]. When considering replacement of old power generating equipment, palm oil mills should consider the High-Pressure Boilers with Backpressure Turbine for Cost-Effective Power Generation, recommended by the US department of energy – Country Malaysia (USDOE/GO-102006-2267, 2006) [18].

Packaged or “off-the-shelf” backpressure turbo-generators are now available in ratings as low as 50 kW. Backpressure turbo-generators should be considered when a boiler has steam flows of at least 3,000 pounds per hour (lb/hr), and when the steam pressure drop between the boiler and the distribution network is at least 100 pounds per square inch gauge (psig). The backpressure turbine is generally installed in parallel with a pressure relief valve (PRV), to ensure that periodic turbine-generator maintenance does not interfere with plant thermal deliveries. The capital cost of a back-pressure turbo-generator complete with electrical switchgear varies from about \$900 per kilowatt (kW) for a small system (150 kW) to less than \$200/kW for a larger system (>2,000 kW). Installation costs vary, depending upon piping and wiring runs, but they typically average 75% of equipment costs.

A wide range of service products from the simple supply of spares to integrated asset management is offered. Due to the recent market developments, the focus is now, more and more on Long Term Service products. The scope of such Long Term service products can vary according to customer demands. To optimize customer's benefit and to minimize customer's risk in the project several service products are being offered by the Original Equipment Manufacturers (OEM). A service package of O&M products can be customized as to meet customer's specific needs: comprehensive maintenance programs for Steam Turbine, Power Train or for the whole Plant can be provided. Regarding power generation, a preferred approach is to outsource all of the steps; giving controls over the development of equipment maintenance strategies to the contractor. In this instance, the contract must be structured around the achievement of desired outcomes in terms of equipment performance, with the contractor being given latitude to achieve this to the best of his ability. It is of great importance to a power plant owner to be informed about the concept of how the fleet experience of an OEM/O&M contractor is introduced and available to his power plant.

IV. Conclusion

Power generation markets deregulation prompted by rapid depletion of fossil fuel reserves as well as climate change, and the push towards renewable energy sources, in particular biomass fuels, is impelling changes in the behaviour of power producers. Increasing competition has caused power plants to switch from traditional time-based maintenance strategies to those based on a plant's operating condition. As competitive power production becomes standard operation procedure, the quality of power a company produces becomes the measure of its success. To achieve these demands cost reduction and technical innovation programs are implemented in power generation process. Furthermore according to the actual market conditions a higher flexibility in operating and maintaining the plants is necessary. The decision concerning the maintenance outsourcing was traditionally executed using cost-based decision models. However, the dramatic change in the way maintenance function is viewed has challenged the validity of this approach. Outsourcing of maintenance of power generating equipment in palm oil mills offers a viable solution, as today, maintenance outsourcing decision is analysed in a different way, taking into account complex and extended sets of (tangible and/or intangible) strategic factors. Palm oil mill managers need to be persuaded to bring in the outsourcing of palm oil mill power generating equipment into 21st century through the use of e-maintenance and IT based hardware & software tools available, using the Knowledge and experience of the OEM&OM service providers. This, besides helping the Malaysian government to achieve their Millennium Development Goals (MDG), will ensure a reliable, flexible, and cost effective power supply to the palm oil milling sector for years to come.

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