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Enterprise Resource Planning System Implementation in Preventive Maintenance: Case Study in AB Furniture Company

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Abstract

Many manufacturing plants still use corrective policies in their plant maintenance practice. Often it is too late for the managers to react upon their plants performance reports such as losses due to plant unavailability, performance inefficiency and dropping rate of quality. Neglect of the preventive maintenance planning is a great disadvantage in any manufacturing system. If such a system is ever going to reach perfect one-at-a-time manufacturing, there is no time for failed or wasted parts or standstill. Therefore, the availability of real time data of plant equipment and process history to enhance the discovery of opportunities for manufacturing optimization is imperative. This paper describes the Enterprise Resource Planning (ERP) system concept in the Preventive Maintenance (PM) practice, and in other part presents the case of AB Furniture where ineffective maintenance practices are being carried in one of the components of Manufacturing and Planning Control. The AB company objective is to maximize all possible values in their products. Therefore, the company must compete on the basis of Cost Leadership thereby focusing on elimination of waste, economies of scale, cost reduction and more returns from an initial invested asset in their mainstay of their operations. However, their maintenance operations, such as ineffective spare parts management and ineffective maintenance work orders, contradict their capabilities to compete on the basis of Cost Leadership thus pose a strategic threat. Consequently, to counter this threat, this paper recommends adoption of maintenance practices purported by their pre-installed ERP system and the adoption of PM philosophy supported by that system. Using ERP system to measure maintenance practices performance indicator coupled with Maintenance Work Order Analysis, AB Company will be in better position to identify on how to optimize their maintenance activities in the future.

Keywords*: Plant Availability, Preventive Maintenance, Enterprise Resource Planning system.*

1. Introduction

Just In Time (JIT) is a modern logistic strategy implemented to improve the manufacturing plan and control (MPC) of a company by minimizing waste in manufacturing and pursuing zero inventories, zero transactions and zero disturbances (Vollman et.al, 2004). The JIT process is driven by a series of signals, or Kanban, which tell production processes to make the next part. These Kanban signals are usually simple visual notifications, such as the presence or absence of a part on a shelf (Schonberger, 1986; Vollman et.al, 2004). When implemented correctly, JIT could lead to dramatic improvements in a manufacturing organization's return on investment, quality, and efficiency. While JIT, along with Total Quality Management (TQM), have been recognized as significant factors to manufacturing performance, the management shall not forget the role of plant maintenance in supporting both initiatives to improve plant performance (Schonberger, 1986; Vollman, et.al, 2004). A manufacturer's competitiveness and profitability depends directly on the availability and

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reliability of mechanical plant and equipment. Plant availability and reliability are outcomes of the maintenance process (Sherwin, 1995; McKone et. al, 1998; Moubray, 2005).

A comprehensive Preventive Maintenance (PM) plan for the facilities is required to achieve the above objective. Vollman et. al (2004) points out that" two critical aspects of JIT are Total Preventive Maintenance or Total Productive Maintenance and *Poka Yoke*". PM is a critical adjunct to lean production because several reasons. Firstly, PM can minimize the unscheduled breakdowns of all electrical and mechanical equipment in the plant and ensure that repaired equipment will be in satisfactory condition (Tseng, 1995; Sherwin, 1995, McKone et. al, 1998; Moubray, 2005). If machine uptime is not predictable and if process capability is not sustained, production floor cannot produce at the maximum capacity to fulfill the velocity of sales demand.

Secondly, once PM is aligned to production, normal mechanical failure modes which can degrade the products quality can be avoided. If the problem is detected early, major repairs can be prevented, in most instances. Products will flow with zero defects requires high levels of process capability that, in conjunction with error proofing, allow the manufacturer to reduce or eliminate inspection (Sherwin and Jonsson, 1995; Sharp et.al, 1997). This premise suitably complies with the JIT strategy which requires 100% quality to assure the latest possible time in order fulfillment (Vollman, et.al, 2004).

Lastly, PM will ensure the manufacturer's Safety, Health and Environmental (SHE) compliance imperatives. An effective program shall include provisions for the systematic identification, evaluation, and prevention or control of manufacturing facilities hazards. If not, hazards or potential hazards will be missed and the chance of workplace accident such as, injury or illness will significantly increase which in the end will disrupt the worker productivity (Manuele, 2003). Therefore, PM initiative should be closely linked to give positive impacts to JIT and TQM implementation. These strategies should not be implemented in isolation as they are closely related and in combination can help foster better manufacturing performance (Schonberger, 1986; Vollman, et.al, 2004).

2. Implementation Background

2.1 Organization Profile

The AB Furniture company (AB) is furniture manufacturing located in Pasuruan, Indonesia. Its primary vision is simple; to maximize, all possible values in their products by seeking out market opportunities and secure an adequate supply line that delivers products to these markets efficiently and effectively.

2.2 The AB Strategic Profile

Seeking out these new market opportunities, AB cannot just compete on the basis of price. Instead, it must compete on the basis of Cost Leadership. Consequently, if the price commanded by AB is too high, consumer can easily substitute AB products with of its competitors. Conversely, if the price commanded is too low, AB risk sparking a price war. Faced with this price pressure, AB cannot compete on the basis of price.

The only alternative available for AB is to compete on the basis of Cost Leadership. Cost Leadership, defined by Porter (1980), as a strategy designed to achieve profitability with tight control of the organization cost and overhead structure. Organizations adopting this strategy, must actively strive to achieve the following objectives (Porter, 1980), including, elimination of waste, reduction of costs, acquiring more benefits from an invested asset and economies of scale. Consequently, for AB to remain strategic AB supply chain must strive to achieve these objectives also; thus give raise to AB the capability it needs to compete on the basis of Cost Leadership.

2.3 Problems found in AB Maintenance Operation

Unfortunately, the AB supply chain is further from these objectives. Problems were found in the Maintenance Operation in AB. In charged with function of maintaining the reliability of AB supply chain, this component of AB is wasteful and ineffectual stemming from ad-hoc and precarious work practices adopted by this Maintenance Operations. Consequently, this culprit continually drives up cost, further grinding down the strategic edge AB needed to compete on the basis of Cost Leadership. Critical elements of Maintenance Operations are as follow:

a) Ineffective spare parts management practices results in spending more time locating and waiting for the parts than actual carrying out of repair. Consequently, these times are unproductive and therefore does not generate of any value; thereby in essence a form of waste.
b) Ineffective spare parts management practices further leads to ineffectual parts replenishment. Purchasing Department is forced to dispatch "urgent orders" to hide Maintenance Operations failure to locate critical parts for maintenance. This "urgent orders" attracts a higher charges; thus driving the cost of maintenance upwards.
c) From above point, dispatching "urgent orders" means orders are likely to be small and from many different vendors. Thereby, Maintenance Ops fails to exploit cost saving opportunities, such as of Bulk Discount, negotiated by AB from its Maintenance Partners, thus driving cost upward unnecessarily.
d) Moreover, ineffective maintenance work orders results in lack of understanding the overall maintaining tasks of AB supply chain. In return, it affects the overall reliability of AB supply chain. Poor reliability means higher the frequency of downtime, thereby driving cost up further as opportunity cost are lost due to unrecoverable production capacity while looses the chance to generate revenue streams from that capacity.
e) To recuperate this lost, AB incur premium cost, in a form of an Overtime, to recover the lost of production capacity from downtime.
f) Ineffective maintenance work orders practices results in lack of understanding the exact parts specification for maintenance. Consequently, Purchasing Department are at a lost of purchasing the right parts for the right maintenances. Unable to secure the right parts for maintenance, any maintenance activity are ineffectual.
g) Ineffective maintenance work orders practices also results in lack of understanding the maintenance histories of maintained equipment. AB run a possible risk that the current maintenance will nullifies the previous maintenance activities.

Such are the critical elements that drives the overall cost structure upwards. Faced with these spiraling costs AB will inevitably force to raise higher price for its products to recover costs. Higher prices however drives away customer thus losing the revenues stream it need for profitability. On the other hand, should AB absorb these costs; it loses its profitability again and moreover decreases its values.

3. Result and Solution

3.1. Information System Solution

Hence, to counter this immense threat, this report formulates a solution; one that leverages the world best practices of SAP PM (Plant Maintenance) module to transform AB ad-hoc and precarious practices of maintenance into a world class that is leaner, less wasteful, and more importantly exploit cost saving opportunities available from AB Business Partners. In doing so, it enhances AB capability to compete on the basis of Cost Leadership thus making an already invested SAP R/3 investment a truly a strategic one. Additionally more benefits from an already invested SAP R/3 system

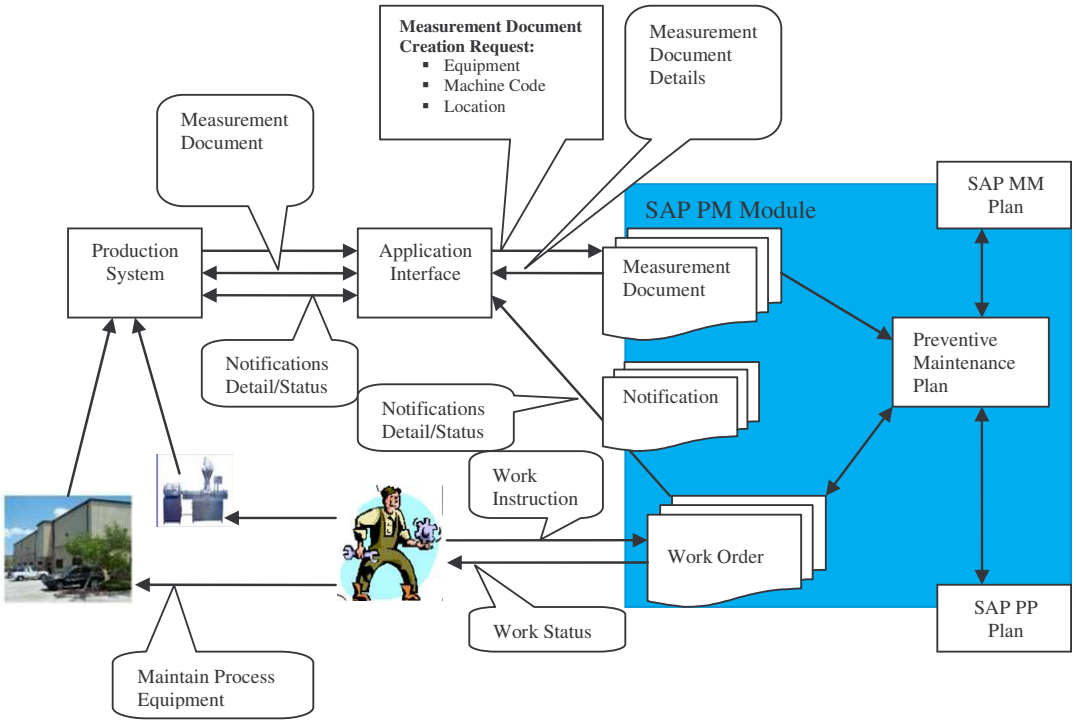

Figure 1. SAP Preventive Maintenance Module Integration

The figure above shows how SAP PM (Plant Maintenance) module tracks maintenance history and schedules maintenance activities. PM supports measurement points and counters for each piece of equipment that will be maintained based on actual data from the plant. That equipment is also monitored in Production System to calculate the runtime (measurement counter) or determine alarm conditions (measurement point) that should be sent to R/3 via Application Interface. The system will detect if an alarm condition (e.g., high temperature) has occurred and passes the signal to SAP PM. This creates a measurement document and an optional maintenance notification. The measurement document and the notification number are returned to System interface and sent to SAP Production Plan and Material Management module for analysis with production and procurement data.

The information collected in the substation operator's weekly inspection is a critical component of the maintenance decision-making process. Abnormal values or conditions found during the weekly inspection are used to create a maintenance notification in SAP for follow up via a corrective maintenance work order. This enables a company to move from calendar based or emergence maintenance program (such as maintain every 4 years or when the machine breaks) to an operations based maintenance trigger. Moreover, having recognized the immense cost associated with supply chain downtime, this report explains not only to plan and manage maintenance activities in a case of a breakdown but also seek to maintain the overall reliability of the AB supply chain. This marks a shift in maintenance philosophy in AB, from one of corrective maintenance to one of preventative maintenance.

The capabilities to plan and to manage maintenance activities are crucial to improve the control and the timing of maintenance work order in AB. As well, it is crucial to improve the management of spare parts in AB.

3.2. Practice requirement in Inventory & Spare Parts Management

To seek this proficiency, AB must acquire the following capabilities in SAP MM (Material Management) and PM Module, inclusive of:

- Maintenance BOM (Bill of Material) Creation Capabilities
  Identifies the exact spare parts that make up equipment in supply Chain, This permits AB to use and source parts correctly for maintenance thus making repair effective.
- Spares Parts Tracking and Control Capabilities
  Permits AB to locate spare parts quickly and reviews the availability of spare parts upfront before issuing any maintenance work, thereby better coordinate maintenance work depends on availability of spare parts.
- MRP Ordering of Spare Parts Capabilities
  Permits AB not only to position itself to exploit cost saving opportunities offered by AB Business Partners, but also position itself to issue accurate maintenance work order, taking account of the delivery schedule provided by the vendors.

3.3. Practice Requirement in Maintenance Management

Proficiency to plan and schedule maintenance work order is also essential for planning and managing maintenance activities. Therefore, to seek this proficiency, AB must acquire the following capabilities in SAP PM Module, inclusive of:

- Maintenance Work Orders Capabilities
  AB can track, plan and schedule and issue maintenance request in a manner that its takes into consideration on availability of spare parts and availability of the production capacity of AB supply chain.
- Downtime Planning Capabilities
  Permits AB to manage the total shut down of supply chain for maintenance activities while taking into account the seasonal variation and ever-changing style of furniture products.
- Work Order Completion Analysis Capabilities
  Analysis of previous maintenance works permits AB to identify, evaluate and disseminate improved maintenance procedures to all maintenance personnel.

3.4. Practice Requirement in Reliability Monitoring

Proficiency to monitor the reliability of the supply chain is absolutely critical for preventive maintenance capabilities. It eliminates unproductive time of waiting for the supply chain to be operational while under maintenance. As such, AB must seek the following capabilities in PM Module to uphold this preventative maintenance proficiency, inclusive of:

- Preventative Maintenance Capabilities
  Permits AB to plan and assign maintenance tasks regularly and over longer time horizon to prevent equipment failure to transpire in the first place thus increase uptime while avoiding downtime.
- Early Warning Alert Capabilities
  Permits AB to be alerted of imminent failure of the equipment, so that maintenance work can be carried out immediately in AB supply chain thus increases uptime while avoiding downtime.
- Maintenance Measurement Key Performance Indicator Capabilities
  Key Performance Indicator (KPI) such as Standard Mean Time to Repair (MTTR) and Mean Time between Failure (MTBF) permits AB to evaluate the performance of the Maintenance Ops so that AB do not consistently procure inferior equipment at a premium price while keeping its Maintenance Operations comparable to the industry.

3.5. Implementation Requirements

To seek these capabilities AB must seek to counter this strategic threat posed by Maintenance Operations. Below are the implementation requirements.

a. Data Requirements

The following data objects are needed to support the capabilities outlined in this report, including:

- BOM and Spare Parts Data
  AB must gather data on the spare parts and its associated quantities that make up equipment in the supply chain. This exact specification in a form of model numbers and code are thus entered into SAP much similar to entering Material Master Data in SAP MM Module. It is anticipated that vendor supply these data to AB.
- Maintenance Vendor Data
  AB must gather Vendor specific data such as Dunning, Discount, Delivery schedule and Vendor Contact Details from Vendor replenishing these spare parts thus entered it into Vendor Master Data.
- Maintenance Work Order Data
  AB maintenance personnel must update maintenance work order data in any regards to the nature of the maintenance work, the equipment in maintenance, the spare parts used, the labor cost incurred and finally the status of maintenance. Moreover, maintenance manager must update this maintenance order with a scheduled and assigns it to the appropriate maintenance personnel in AB.
- Performance and Time Based Wear and Tears Data
  With aim of supporting Reliability Monitoring, AB must gather data on the wear and tears of the equipments in the supply chain. Several methods were available; but by far the easiest is time based wear and tears data. Set by manufacturer specification, AB will create preventative maintenance plan in PM module to alert maintenance personnel to replace certain parts in the supply chain at a specified time frame. Performance based wear and tears data can be collected by the task of requiring maintenance personnel to take measurement on a equipment on a regular basis to gauge possible wear and tears.
- Maintenance Criticality Data
  AB must map the criticality element of each of the equipment in the supply chain, so that maintenance strategy can be prioritized in response to these criticality data.

b. Business Process Requirements

The following business processes transformations are needed to support the capabilities outlined in this report, including:

- Integrated maintenance horizon
  AB must taken into consideration criticality of the equipments in the supply chain, the production capacity of supply chain, availability of spare parts and the production planning before issuing maintenance work order.
- Expansion of maintenance scheduling horizon
  Such initiative from corrective to preventative maintenance demands Maintenance Ops to consider a longer time horizon for maintenance planning. Maintenance Ops must plan a scheduled downtime for all the preventative replacement of spare parts that outlived their effective life; this also includes planning for right personnel to perform these replacements task while planning to have enough spare parts for the completion of this personnel to take measurement.

- Centralized Maintenance Practices
  All acquisition and dispensing of spare parts; scheduling of maintenance works and Reliability Monitoring must be performed in a centralized fashion so there is one central Preventative Plan that dictates all the maintenance activities in AB.

c. People and Training Requirements

The following people based transformations are needed to support the capabilities outlined in this report, including:

- Culture of measurement
  Maintenance Personnel maintenance personnel must adopt a culture of measurement; recording every activity associated with maintaining an equipment in the supply chain. Therefore, personnel must be train on how to enter maintenance data accurately while dispensing do and forget culture which does not generate maintenance history.
- Culture of improvement
  SAP PM demands more commitment from the maintenance personnel to analyze and evaluate their performance of their repairs; so any maintenance improvement can be identified to drive further the maintenance cost downwards.
- Culture of Preventative Measure
  Furthermore, Preventative Maintenance demands maintenance personnel to adopt a philosophy of stopping a break down from happening in the first place.
- Formalized roles and responsibilities
  Preventative Maintenance demands internal roles must be created and formalized with the responsibility of taking reading of the wear and tears data and the responsibility of replacing spare parts once these parts lived out it effective life.
- Training and Change Management
  In order to move from current manual based maintenance practices into computer based maintenance practices, such as of SAP PM module, AB must train maintenance personnel not only on how to use SAP system but also trains these personnel on how to use the computer itself.

d. Financial Requirements

The following costs must be incurred to support the capabilities outlined in this report, including:

- Project Implementation Cost
  AB must incur the cost of hiring a project team both internally and externally to implement the above mentioned capabilities suggested by this proposal. These includes external personnel labor costs that are measurable; generally includes the cost of hiring personnel to configure the PM module, hiring personnel to manage the entire change process, hiring personnel to test and document these new maintenance practices as well as hiring personnel for consulting work. As well, it includes internal labor costs that are tacit and sometime hidden; but generally includes labor cost of those personnel who will be diverted to this project rather than performing their normal duties.
- Training and change management cost
  This includes cost of hiring trainer as well as the cost of providing training to maintenance personnel with the SAP PM.
- Maintenance Cost
  Predictability this includes the cost of purchasing license, hardware and maintaining the integrity of SAP PM Module.

In the end, what makes this paper recommend is that Plant Maintenance use in this fashion is a truly strategic. This is because AB when implemented Plant Maintenance in this manner is in far better command of its own destiny during price wars. As the price drops in price wars, AB able to withstand the loss of revenue because AB has already drop cost beforehand; thus maintaining its profitability; thereby making AB to survive and to compete in the marketplace strategically secured.

4. Conclusion

Idea of a continuous improvement in this paper is highlighted. Measuring maintenance practices Key Performance Indicator (KPI) coupled with Maintenance Work Order Analysis, Maintenance Operations are in better position to identify on how to improve maintenance activities in the future. With improvement, comes the ability to do more and more with less effort. And this sparks more improvement in future. Such is the cycle of continuous improvement and such are the benefits of continuous improvement. Therefore, with this consideration in mind, this paper sees this as an excellent tool to sustain AB Cost Leadership Strategy in a longer time frame; thereby guaranteeing its support.

Nonetheless, what makes this recommendation tips over its balance to the extreme in support of this proposal is the preventative maintenance philosophy. Preventative Maintenance prevents downtime. Less downtime means more production capacity with less capital investment to build more plant. Less capital investment means less debt incurred. Less debt incurred means less risk. This also means less interest loan repayment too, thereby saving cost furthest. Less risk means investment invested by the co-operative members to form this co-operative is financially secured. It also means AB is less vulnerable to economic downturn, i.e. reduction of demand during economic recession; as fewer funds are needed to service the debt; thereby guaranteeing AB survivability.

However, this recommendation cannot ignore the significant of “People Issue” outlined in the cost benefit analysis. This is because this proposal seeks huge shift in culture, one that support measurement, continuous improvement, and preventative maintenance practices. These huge shifts are therefore disruptive henceforth resistance to the change is likely high. Therefore, this risk must be mitigated.

Reference List

Bascur, O.A and Kennedy, J.P. (2003), Reducing Maintenance Costs Using Process and Equipment Event Management, http://www.contac.cl/descargas/productos/SMEPlantOper5412.pdf, viewed 12 May 2008.

Manuele, F.A. (2003), Superior Safety Performance: A Reflection of an Organization's Culture, *On the Practice of Safety* 3rd Edition, Pages 9-35. http://www3.interscience.wiley.com.ezproxy.lib.unimelb.edu.au/cgi-bin/booktext/109856081/BOOKPDFSTART, viewed 12 May 2008.

McKone, K. E., Schroeder, R.G., and Cua, K.O. (1998), The Impact of Total Productive Maintenance on Manufacturing Performances, http://www.sbaer.uca.edu/research/dsi/1998/Pdffiles/Papers/1430.pdf, viewed 12 May 2008.

Moubray, J. (2005), *RCM II. Reliability-Centered Maintenance*. 2nd ed Oxford: Butterworth Heinemann.

Schonberger, R.J. (1986), *World Class Manufacturing: The Lessons of Simplicity Applied*, The Free Press, New York, NY.

Sharp, J.M., Irani, Z., Wyant, T., and Firth, N. (1997), TQM in maintenance to improve manufacturing performance, *Proceedings of PICMET Conference*, Portland, OH, http://ieeexplore.ieee.org.ezproxy.lib.unimelb.edu.au/iel4/4876/13450/00620779.pdf?isnumber=&arnumber=620779, viewed 12 May 2008.

Sherwin, D.J. and Jonsson, P. (1995), TQM, Maintenance and Plant Availability, *Journal of Quality in Maintenance Engineering*, Vol. 1 No. 1, 1995, pp. 15-19. viewed 12 May 2008

Sheng-Tsaing, Tseng (1996), Optimal Preventive Maintenance Policy for Deteriorating Production System, *IIE transaction*, vol.28, pp. 687-694, Institute of Industrial Engineers.

Vollman, T.E, Berry, W.L., and Whybark, D.C. (2004), *Manufacturing Planning and Control System for Supply Chain Management*, 5th edition, Irwin McGraw-Hill.