Impact of Machine Breakdowns on Productivity

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ABSTRACT

This paper reports the machine breakdowns and their impact on the total productivity for the FMCGs (Fast Moving Consumer Goods) industry because higher productivity rate is important factor on which the customer services largely depend in this competitive business world. This paper also suggests that the machine breakdowns and other related problems within the plant are due to improper care, keeping the plant operative for twenty four hours a day, seven days a week without any break and lack of management's concentration towards these issues. These break-downs results in untimely closure of the plant and very poor production performance is achieved in the plant that affects the service level at great level. Realising the importance of maintenance in improving productivity and service, an attempt has been made in this paper to study the scope of maintenance with the help of a case study.

Key Words: **Breakdowns, Fast Moving Consumer Goods, Maintenance, Capacity Planning.**

1. INTRODUCTION

Equipment of whatever type, no matter complex or simple, however cheap or expensive, is liable to break-down. Thus in manufacture, supply, transport and service not only procedures exist for equipment maintenance but also the possibility of breakdowns and disruption of operation must be considered during capacity planning and activity scheduling [1]. The purpose of maintenance is to attempt to maximise the performance of equipment by ensuring that such equipment performs regularly and efficiently, by attempting to prevent break-downs or failures and by minimising the losses resulting from break-downs or failures. In fact, it is the objective of the maintenance function to maintain or increase the reliability of the operating system as a whole [2-6].

Organisational systems used in the production of goods are subject to deterioration with usage and date. Systems deterioration results in increased breakdowns leading to higher production costs and lower production quantity. A scheduled/timely care programme can reduce costly breakdowns. Tasks such as replacing filters, lubricating and adjusting settings are such examples [7].

Preventive maintenance attempts to anticipate future problems, and to reduce/remove the impact of such problems. It is a maintenance activity that aims at retaining a part of a technical system in the operable state as compared with corrective maintenance, which aims at restoring a part of the system to operable state [8].

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In general, maintenance may be considered to be of three categories. One is failure maintenance, where the maintenance is undertaken only after the equipment has failed. The second is preventive maintenance that is undertaken while the equipment is still in operating condition, so as to prevent or reduce the probability of a failure. The third is predictive maintenance that is undertaken at known or un-known intervals while the equipment is still in use.

As production systems move towards advanced and hence more expensive technologies, proper maintenance planning becomes more important. Direct maintenance costs are increasing because of high costs of components and technical support that are needed for the advanced technologies. In addition, downtime due to system breakdown also has become expensive. Hence, a sound maintenance planning becomes imperative in a modern production system [9].

Maintenance literature is rich with studies concerning the development and implementation of mathematical models for maintenance planning in deteriorating systems. Surveys conducted by authors [10-12], and an in-depth mathematical analysis by [13] comprehensively document the various approaches to modelling maintenance. Many researchers have developed models to address systems that operate continuously, as well as system that operates intermittently. The latter case assumes the system to age or deteriorate only during the operating periods [14]. Most of the maintenance activities in this situation could be performed during non-operational times.

A number of research reports available in the literature deal with the maintenance from a narrow perspective of improving the reliability of the facilities. However, only few articles treat maintenance as a strategy to improve productivity. Also, there is a lack of research based on the case studies to demonstrate the claim of maintenance as a strategy.

2. A FRAMEWORK FOR MAINTENANCE

Let us assume that a maintenance schedule has been developed for all the machines. The planners develop maintenance schedules on an annual basis in conjunction with aggregate production plans, and specify the actual schedule for performing various maintenance tasks on each machine during specific time periods of the year. However, there are some factors, which severely limit the effectiveness of the schedule. First, due to dynamic nature of the production environment, machine usage and breakdowns during the year, priorities of different maintenance tasks may change. Second, the availability of maintenance work force in terms of the skill-type and man-hours may change during the year due to un-scheduled leaves, hires, layoffs, and cross training. This may force the administration to defer the maintenance schedule for other periods. Fig. 1 summarises and links the maintenance with some of these factors, which, if, taken into account can contribute significantly towards production improvement.

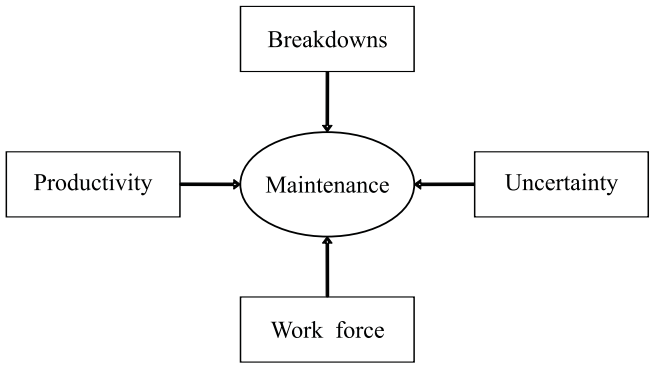

FIG. 1. MAINTENANCE FRAMEWORK FOR PRODUCTIVITY IMPROVEMENT

3. BACKGROUND OF THE COMPANY

Cussons (UK) Limited is a medium-sized manufacturing company producing household cleansing products and toiletries, a company probably best known for Imperial Leather Soap, with an annual turnover of around £90m. At Cussons, it was recognised that despite adequate production capacity the Nottingham based SM (Soap Making) plant failed to meet customer's demand, so a review of the SM process at Nottingham was instigated in order to find out where the problems were.

4. HISTORY OF MACHINE BREAKDOWNS/ SHUTDOWNS

Given the importance to maintenance in any plant and the concerns voiced about the maintenance department in the SM plant, the logical step was to focus attention on the maintenance department in this paper. Discussions took place with maintenance staff both in the soap manufacturing process and soap finishing room the managers' log books were also studied.

It became apparent that there is no maintenance policy. In fact, the company's maintenance policy amounts to little more than a 'run to breakdown' policy. This has evolved because of the high demand on the soap manufacturing plant.

The maintenance department had a maintenance scheduling programme, but again because of the need for the machines to be in constant use, particularly the drier; the scheduling was put aside or deferred to a later date, in effect a 'never-never' situation.

Previously, servicing and maintenance had been carried out during holiday periods, however, at some point; a management decision was taken to stop this procedure on the grounds that it was not cost-effective.

Inspection of the log books revealed that the soap finishing room log books contained records of maintenance, training etc., for each of the ten production lines. However, going through the manager log books for the soap-making plant, it became apparent that this was not the case with these records and there were apparently no records for individual plant. So to build up an accurate picture of shutdowns within the soap-making plant, shift managers' log books were studied in detail, shift by shift, for the period of six months from January 2005-June 2005. All the shutdowns in that period were noted and are reported in the Figs. 2-4. All shut-downs noted during this period are on hourly and weekly basis. On the basis of these break-downs, the shutdowns occurred that affected the productivity rates to certain level and Cussons was unable to meet the agreed orders. Because Cussons was committed to provide good service

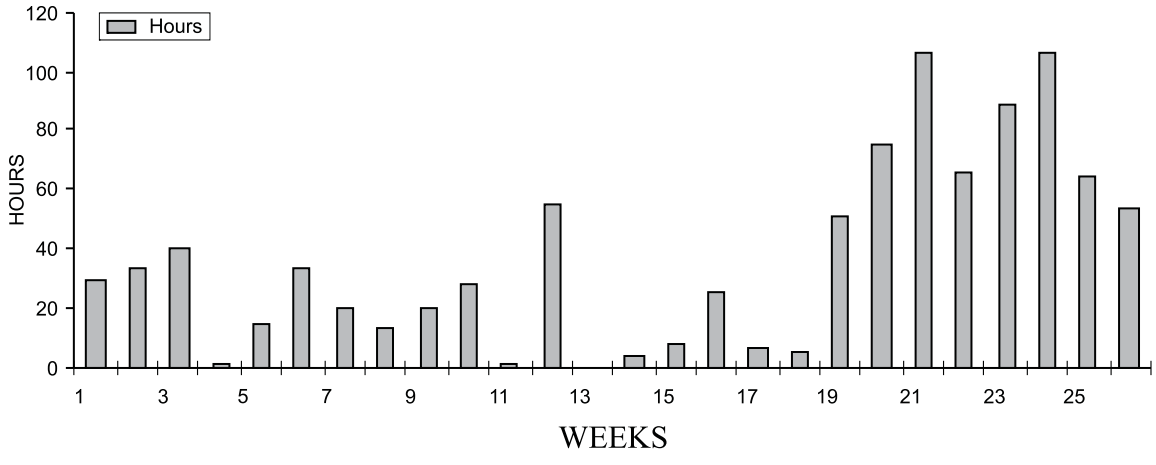

FIG. 2. WEEKLY SHUTDOWN OF LAVAL PROCESS IN HOURS

to their customers so the plant was running without any break and frequent break-downs occurred.

These frequent breakdowns/shutdowns greatly effect the production performance resulting in lost production. This weekly-lost production is reported in Fig. 5. This production performance reflects that the Cussons is loosing at least 25-30% of the overall production only because of these break-downs and this is very big amount in this competitive world. As Cussons is competing with well brand names namely Lever Brothers, Johnson and Johnson, Colgate Palmolive etc. So Cussons cannot afford to loose such valuable production.

5. COMPARISON BETWEEN ACTUAL AND POTENTIAL SOAP PRODUCTION

Fig. 6 shows the actual soap production against potential soap production on the weekly basis for the 26 weeks. The achieved soap production is around 64% of the potential soap production and reveals 36% shortfall. There may be other reasons for this shortfall in production but discussion with various company managers and personnel's revealed and there was general consensus of opinion that due to heavy demand, the plant is running continuously 24 hours a day, seven days a week. In this situation, plant lacks proper maintenance which results in frequent breakage and shutdowns.

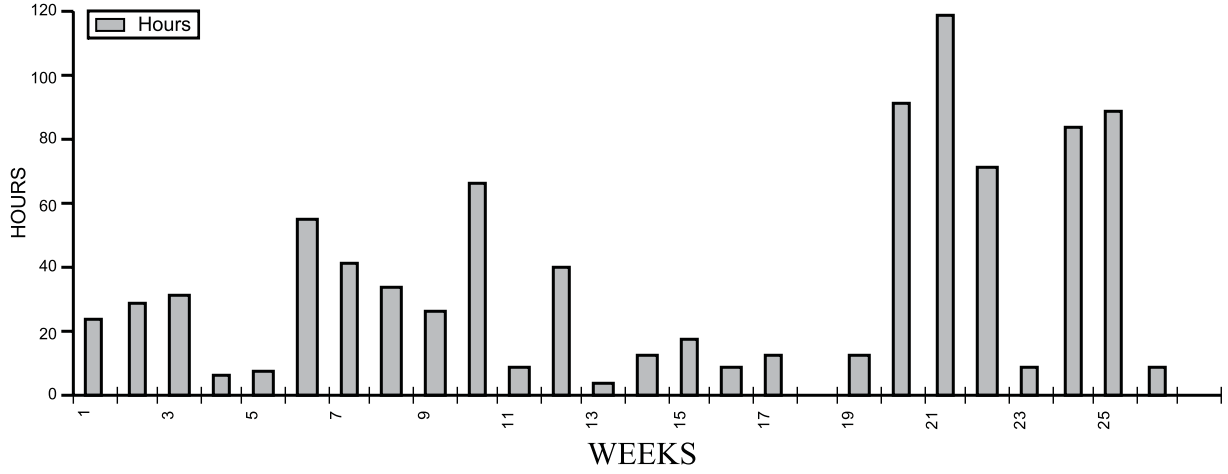

FIG. 3. WEEKLY SHUTDOWN OF DRYING PROCESS IN HOURS

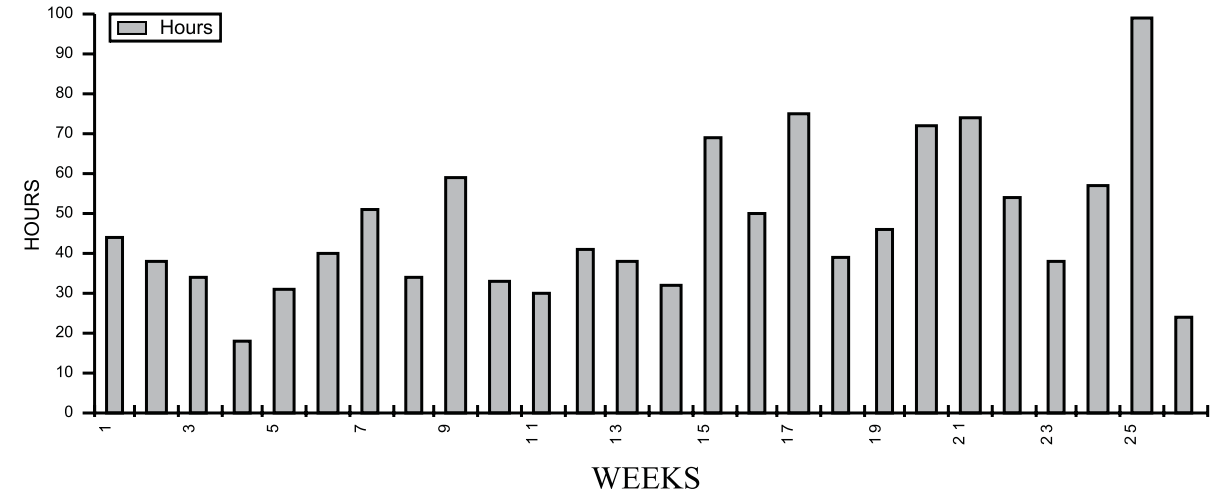

FIG. 4. WEEKLY SHUTDOWN OF MAZZONI EVAPORATOR IN HOURS

Keeping in view the performance of the plant, Cusson's management adjusted the potential production target levels for every week by reducing the production shutdown and breakdown periods in a hope to achieve that production level to meet customer's demand. Unlikely Cusson's soap plant failed to achieve the adjusted level as well; the same is reported in Fig. 7.

The comparison of potential and adjusted production reveals that by adjusting the production the shortfall level did not change too much. Because the adjusted production, which is approximately 93% of the potential production with a difference of 7%, interestingly the shortfall difference is 10%, which reveals even more decrease in production and makes too much difference between the adjusted and potential production.

This overall situation is the result of improper maintenance, which can be improved significantly by introducing the preventive maintenance schedule for each machine rather than to wait for its failure.

6. FRAMEWORK FOR THE DEVELOPMENT OF MAINTENANCE SYSTEM

It is evident from the company's performance that Cussons' is loosing too much production due to lack of proper implementation of maintenance policy resulting in frequent

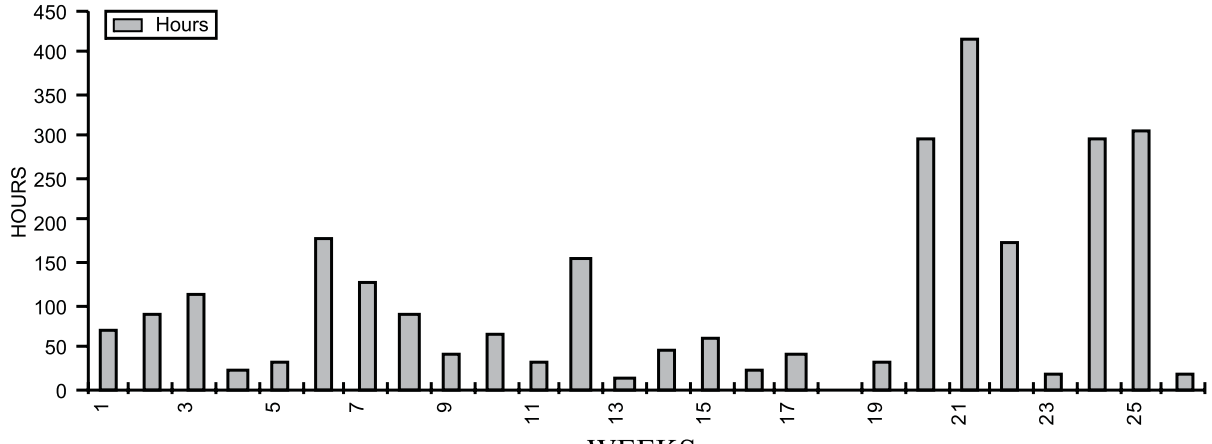

FIG. 5. WEEKLY DRIER'S LOST PRODUCTION IN TONNES

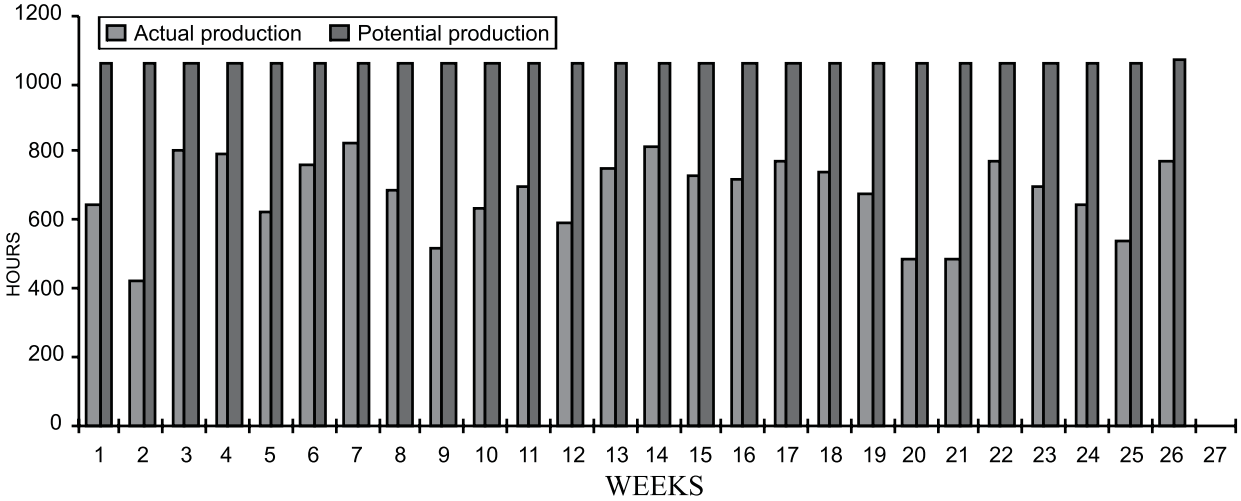

FIG. 6. ACTUAL PRODUCTION AS COMPARED TO POTENTIAL PRODUCTION IN TONNES ON WEEKLY BASIS

breakdowns. Cussons' has a maintenance policy but it is not properly implemented merely because it is not cost-effective. Looking to all the aspects of the company it is suggested that Cussons should formulate a comprehensive maintenance schedule. Though in Cussons' opinion it is not cost-effective but the breakdowns are even more costly which directly affect the production performance.

Key to any manufacturing operation is the 'care and feeding' of its production equipment. In theory, an effective preventive maintenance program will preclude any major problems with the equipment and will allow producers to maximise output, minimise cost, and assure on-going quality of the parts being produced. Table 1 presents such an illustrative scenario for improving the efficiency of the plant.

Maintenance, like any other operations management entity, requires its decisions to be made in a multi-criteria environment. It needs co-ordination between various functional groups like production and maintenance. It is a support function of production activity. In this paper, which follows a case study at a FMCGs industry, such an illustrative scenario is presented. This shows the need for cooperation between production and maintenance.

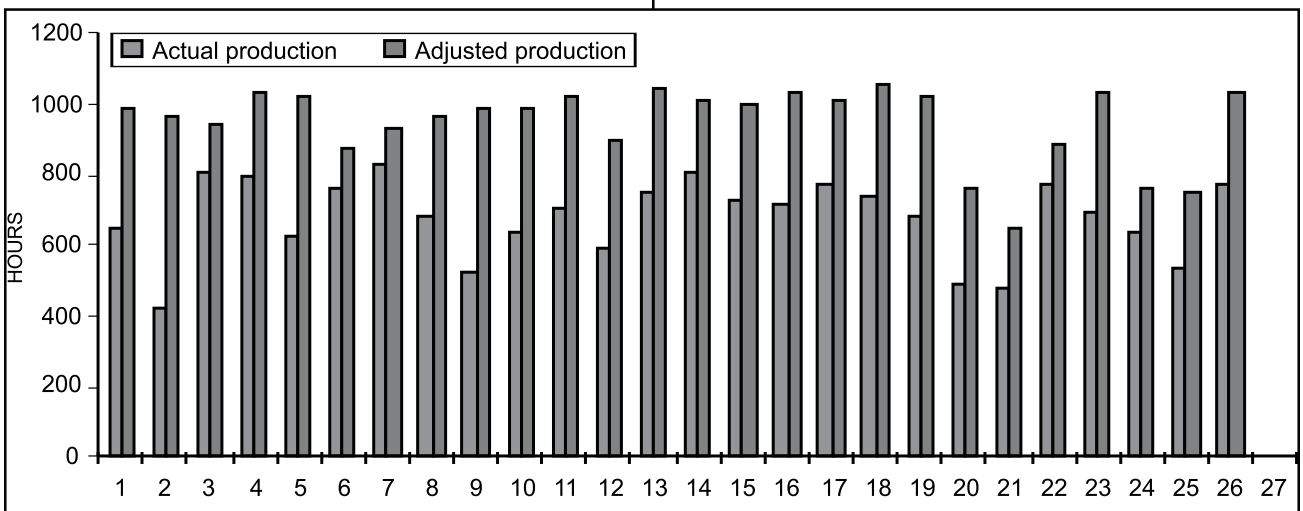

FIG. 7. ACTUAL PRODUCTION COMPARED TO ADJUSTED PRODUCTION IN TONNES ON WEEKLY BASIS

TABLE 1. STRATEGIC SCENARIO OF CUSSON'S MAINTENANCE PROCESS FOR PRODUCTION IMPROVEMENT

Problem Areas Identified	Strategies/Methods of Maintenance
Machine breakdowns	Special care and regular monitoring of the plant is essential to reduce the costly breakdowns. In this way, maintenance tasks such as timely oil or lubrication should be provided to all the machines to run satisfactorily.
Work force	Special work force should be prepared within the company to look after the machines during working hours and should be allowed to take maintenance tasks on their own to remove the minor defects in the machines, if needed.
Uncertainty	It is necessary to create the healthy environment within the plant. At the moment, the plant is only running at 50-60% of the capacity. The plant efficiency can be improved and uncertainty can be reduced by taking such maintenance measures.
Productivity improvement	To improve the productivity is the foremost task for every company. This task can be achieved through the efficiency of the plant. To keep the plant running is only way to improve the productivity. This can be achieved through the maintenance strategies reported earlier in this table.

7. CONCLUSIONS

Keeping in view, all aspects of company's performance with particular reference to machines breakdowns and shutdowns, it is in Cusson's interest to formulate the comprehensive maintenance policy to reduce costly break-downs, avoid shutdowns and increase the productivity. This policy will lead management to an excellent measure of production improvement. In this competitive era, no company in the world affords to sustain the behaviour of the manufacturing plant, which results in heavy production loss. It requires a long term commitment; continuous monitoring of maintenance technology; a constant assessment of the financial and organisational trade-offs in contracting out versus in-house maintenance. Elements such as employee moral, efficiency, effectiveness and costs all have to be considered.

By implementing maintenance schedule and making full use of employees in this production improvement process, Cussons can improve their manufacturing processes, reduce costly machine break-downs and significant improvement in productivity. On the basis of that Cussons can improve the customer service at significant level and a general improvement in its competitive position against competitors is to be achieved.

8. RECOMMENDATIONS

(i) Cussons should focus on the machines where the frequent break-downs occur.

(ii) Cussons should formulate comprehensive maintenance policy to avoid these costly break-downs.

(iii) Preventive schedule should be implemented in true spirits to avoid further productivity loss.

(iv) Employees valuable suggestions should be incorporated and also involved in decision making process.

(v) The difference between actual production and potential production can be reduced by implementing preventive maintenance schedule.

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REFERENCES

[1] Wild, R., “Production and Operations Management", 5th Edition, Cassell Educational Limited, New York, 1987.

[2] Tanwari, A.D., Abbasi, A.A., and Rashdi, R.S., "Preventive Maintenance as a Productivity Improvement Strategy", Journal of Engineering and Applied Sciences, University of Engineering & Technology, Volume 19, No. 2, pp. 36-42, Peshawar, Pakistan, 2000.

[3] Liu, Y., Huang, H.Z., and Kuang, Y., "An Optimal Sequential Preventive Maintenance Policy Under Stochastic Maintenance Quality", Structural and Infrastructure Engineering, Volume 57, No. 1, August, 2009.

[4] Lanza, G., Niggeschmidt, S., and Werner, P., "CIRP Annals", Manufacturing Technology, Volume 58, No. 1, pp. 429-432, 2009.

[5] Sun, Y., Ma, L., and Mathew, J., "Failure Analysis of Engineering Systems with Preventive Maintenance and Failure Interactions", Computer and Industrial Engineering, Volume 57, No. 2, September, 2009.

[6] Radhoni, R.M, and Chelbi, N., "Integrated Model of Preventive Maintenance, Quality Control and Buffer Sizing for Un-Reliable and Imperfect Production Systems", International Journal of Production Research, Volume 47, No. 2, January, 2009.

[7] Barlow, R., and Hunter, L.C., "Optimum Preventive Maintenance Policies", Operations Research, Volume 8, pp. 90-100, 1960.

[8] Berg, M., "A Preventive Replacement Policy for Units Subject to Intermittent Demand", Operations Research, Volume 32, pp. 584-595, 1984.

[9] Chareonsuk, C., Nagarur, N., and Tabucanon, M.T., "A Multicriteria Approach to the Selection of Preventive Maintenance Intervals", International Journal of Production Economics, No. 49, pp. 55-64, 1997.

[10] Gits, C.W., "On the Maintenance Concept for a Technical System: A Framework for Design", Ph.D. Thesis, Eindhoven University of Technology, 1984.

[11] Krishnan, G., Ahire, S.L., and Miller, D.M., "Maximising the Effectiveness of a Preventive Maintenance System: An Adaptive Modelling Approach", Management Science, Volume 43, No. 6, pp. 827-840, June, 1997.

[12] McCall, J.J., "Maintenance Policies for Stochastically Failing Equipment: A Survey", Management Science, Volume 11, No. 5, pp. 493-524, 1965.

[13] Sherif, Y.S., and Smith, M.L., "Optimal Maintenance Models for Systems Subject to Failure: A Review", Naval Research Logistics Quarterly, Volume 28, pp. 47-74, 1981.

[14] Flores, V., and Feldman, R.M., "A Survey of Preventive Maintenance Models for Stochastically Deteriorating Single-Unit Systems", Naval Research Logistics Quarterly, Volume 36, No. 4, pp. 419-446, 1989.