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A Pilot Study for Total Production Management in Printing Industry

KEYWORDS: Total Productive Maintenance (TPM), Total Quality Management (TQM), Printing performance and System Dynamics

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ABSTRACT *Globally, even in printing industry, customer is demanding for high and consistent quality at low cost and fast delivery. Sustaining a printer's technical and operational systems require a verification program to be developed and followed so that performance excellence (good manufacturing performance) is maintained. In this research, considering a theoretical framework of social-Technical system, a conceptual model for Total Production Management will be built, in which TotalProductive Maintenance (TPM) is pooled with Total Quality Management (TQM) and System Dynamics (SD) for attaining a "Total productive environment", which we are coining as "Total Production Management". This is premeditatedto convey,together production and maintenance functions composed by a blend of good working practices, team-working and continuous improvement, and thus achieve the objective of good manufacturing performance. In the Pilot study, convergent and discriminant validity test of the variables was performed using Smart PLS software.*

1. INTRODUCTION

Quality printing with maintaining accurate dot percentage and color value is still considered as a major challenge for many leading printers mainly because of the problems like: scheduling, dynamic printing environment, poor maintenance and operations of machine and reliable raw materials. According to Kutucuoglu et al.,(2001) printing equipment can be considered as a keyprovider towards the performance and profitability of printing business

1.1 Challenges of Maintenance Function

In present global manufacturing scenario, manufacturing practices are playing the important role in optimizing the organization's core competency (Riss et al., 1997). It is possible to reduce the maintenance cost by at least one-third, and also simultaneously progress the throughput, if maintenance management is given priority (Al-Hassan et al., 2000). An efficient maintenance system should contribute to about 20-40 percent of value addition to products and services moving over the plant (Hora, 1987: Eti et al., 2006). The maintenance management system followed in printing industry must result in achieving required performance (Ahmed et al., 2005; Kumar et al., 2004).

1.2 Need of Total Production Management in Printing Industry

The important goal of any printing press is to have an optimized system, through the effort of minimized input and efficient manpower. The second goal is to reduce and control the variation in the process. According to Schipper (2001), both the above goals can be met through TPM. The concept of TPM appeals for the knowledge and teamwork of operators, equipment vendors, engineering, and support personnel to augment machine production, thuscausingelimination of breakdowns, reduction of unprepared and planned downtime, better utilization, higher output, healthier product quality and entire participation of all Total productive maintenance employees in pursuing the key feature of economic efficiency (Ahuja and Khamba, 2008).

2. LITERATURE REVIEW

In reply to the maintenance and support problems met in manufacturing surroundings, the Japanese establishedthe concept of total productive maintenance (TPM), initially in Japan, in the year 1971, by involving employees from every level. TPM helps in developing a synergistic relationship in the organization, mainly between production and maintenance. The attainment of TPM depends on the combined effort of production and maintenance activities (Chan et al., 2005; Dwyer, 1999; Dossenbach, 2006).

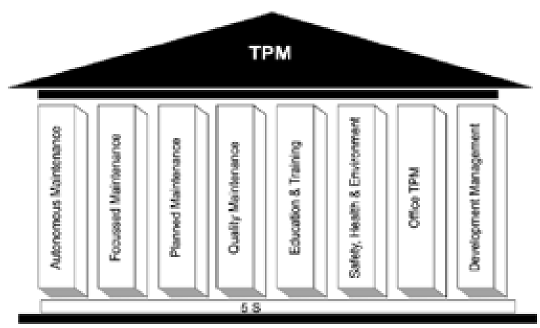

Figure 1: Eight pillars of TPM (Source: Ahuja &Khamba, 2008)

According to Voss (2005), TPM is the core of "operations management" and tremendously influential technique, whichearns immediate consideration by organizations globally. TPM aids to maintain the existing plant and equipment at its top productive level through the collaboration of all functional areas of an organization (Besterfield et al., 1999).The practices of TPM are known as the pillars of TPM, on which the complete structure of TPM is built, as shown in Figure 1. (Sangemeshwran and Jagannathan, 2002).

Productive Maintenance is anpioneeringtactic to plant maintenance that is paired to Total Quality Management (TQM), Just-in-Time (JIT), Continuous Performance Improvement (CPI)and other topnotch manufacturing strate-

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gies (Maggard et al., 1989; Schonberger, 1996: Ollila and Malmipuro, 1999; Cua et al., 2001). Figure 2 shows the relationship of TPM and other manufacturing strategies.

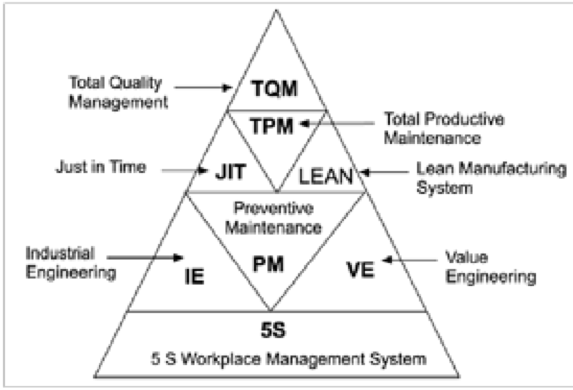

Figure 2: Relationship of TPM with other practices (Source: Ahuja and Khamba, 2008)

According to McKone et al., (1999), for achieving successful TPM, information system (with feedback) is an important consideration. System Dynamics (SD) is a technique with a feedback loop, which can focus relations among a group of variables and simulate results for a given period (Forrester, 1968). Today system dynamics is applied to a variety of systems that are dynamic in nature, and by which it will be possible to recognize the systems performance and its effect on different variables (Morecroft, 2007; Sterman, 2000; Lane, 2007).

3. METHODOLOGY

Following steps are involved in this research of developing the conceptual model for Total Production Management.

3.1 Theoretical framework

According to the socio-technical system theory of Cua et al., (2000), the combined optimization of practices that are socially and technically oriented should lead to good performance. Hence in this research work we are combining TQM, TPM, Human factors, Contextual factors and a feedback loop of System Dynamics, to achieve the desired printing performance and thus contribute to a total productive environment known as "Total Production Management in Printing Industry, as shown in figure 3.

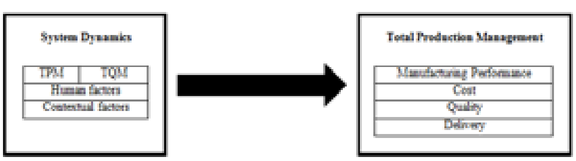

Figure 3: Theoretical frame work for Total Production Management

3.2 Conceptual Model

According to our conceptual model, by have good Overall Equipment Effectiveness, by following autonomous maintenance and 5s, good planning of maintenance and removing the bottleneck, and with effective training and motivation of work force, it is possible to influence the print operation, which can result in obtaining good printing performance.

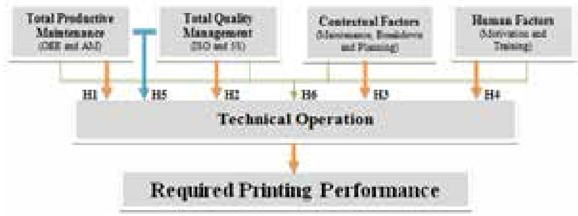

Figure4:Conceptual model for Total Production Management

3.2.1 Contributions of TPM in achieving manufacturing performance: From earlier literature it is found that, autonomous maintenance, equipment technology importance, dedicated leadership, tactical planning, cross-functional training and employee involvement are the utmost practices of TPM, contributing to Total Productive Environment (Nakajima, 1988; Tsuchiya, 1992; Steinbacher and Steinbacher, 1993).

3.2.2 Contribution of TQM in achieving manufacturing performance improvements: Total Quality Management (TQM), is directed at incessantlyrefining and supporting quality products and methods by working towards the involvement of management, manpower, supplier and customer, inorder to meet or exceed customer expectations (Dean and Bowen, 1994; Hackman and Wageman, 1995; Powell, 1995).

3.2.3 Contribution of Socially-oriented practices in achieving manufacturing performance: According to Moore (1997), TPM implementation proceduredelivers organizations with aescort to basicallyconvert their shop floor by incorporating culture, process and technology. Ahuja and Khamba (2008), concludes that TPM implementation will help to foster motivation in the workforce.

3.2.4 Contribution of contextual practices in achieving manufacturing performance improvement: The context of manufacturing plant may affect its performance. According to Cua et al., (2001), number of employees, capacity, procedure and the machines type could be some of the contextual variables for consideration, for efficient production.

3.2.5 Contribution of both TPM and TQM in achieving manufacturing performance improvements: Through past empirical literature review, it has been found that, the implementation of TQM and TPM are to be interrelated and by which the manpower can be empowered by learning and get involved in the operation of efficient system (Flynn et al., 1995; McKone et al., 1999, 2001)

3.2.6 Contribution of basic techniques, contextual factors and common practices in achieving manufacturing performance improvements: Even in printing industry, equipment is considered as an indispensable function and if TPM can be pooled with EOM and 5S, it will be possible to obtain a "Total productive environment", (Ahmed et al., 2005).

3.3 Questioner design and Pilot Study

Developing the instrument: The part A questions are formalized and concealed. Part B questions, formalized and un-concealed and Pact C questions are non-formalized and un-concealed.

Pilot study:Pilot study was administered personally as well as through electronic media and the collected data was processed using Smart PLS, which could assess the quality of the data and analyze the proposed research model.

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4. PLS ANALYSIS AND RESULTS

This analysis is particularly suitable for small sample size (Hair et al., 2012). Two exogenous (Technical (TI) and Performance (PI)) and three endogenous variables (Human issues (HI), Contextual issues (CI) and Common practice issues (CPI)) were employed in this model. Minimum of two indicators are needed to measure a construct (Kline et al., 1998). In this research the indicator ranged from three to eight as shown in figure 5.

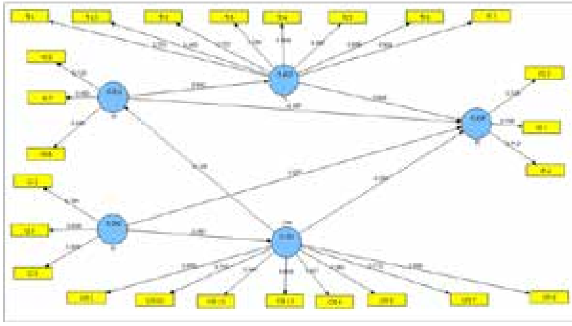

Figure 5: Smart PLS analysis

4.2 Convergent Validity

The first stage assessed the model's convergent validity by two measures: individual item reliability and internal consistency (Santosa et al., 2005). All indicator loading used in this research were above the minimum requirement (0.4) suggested by Igbaria et al., (1997) and Hair et al., 2006).

The second convergent validity measure considers the internal consistency of construct, composite reliability, which should be greater than 0.5. Fornell and Larcker (1981) also suggests that convergent validity can be determined by average variance extracted (AVE) and should equal or exceed 0.5, all construct used in this research meet this requirement, as shown in Table1.

Table 1: Quality Criteria

	AVE	Composite Reliability	R Square	Cronbachs Alpha
CI	0.645	0.845	0.156	0.727
HI	0.523	0.763	0.407	0.546
PI	0.518	0.763	0.418	0.538
QI	0.644	0.934	0.307	0.919
TI	0.514	0.891		0.859

4.3 Discriminant Validity

In the correlation matrix of the construct, the square root of AVE is greater than the off-diagonal values in their corresponding rows and column, hence there is no issues of discriminant validity of the construct, as shown in Table 2 (Barclay et al., 1995: Gefen et al., 2000).

Table 2: Correlation matrix of construct and square root of AVE

	CI	CPI	HI	PI	TI
CI	0.804				
CPI	-0.556	0.801			
HI	0.383	-0.105	0.721		
PI	0.394	-0.295	0.358	0.719	
TI	0.434	-0.092	0.641	0.598	0.716

5. Conclusion

Considering the value of AVE, Cross loading value of variables, Correlation matrix and square root of AVE, we have proved that the variables included in the conceptual model are valid and hence with this combination of socio-technical practices, we can build the required synergy in the printing operation and result in a total productive environment known as "Total Production Management".

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REFERENCE 1. Kutucuoglu K Y., Hamali, J., Irani Z and Sharp JM (2001), "A framework for managing maintenance using performance measurement systems", Int. journal of Operation & Production Management, Vol. 21 No 1-2, pp 173-94 | 2. Schonberger, L. (1996), "World Class Manufacturing: The Next Decade: Building Power, Strength and Value",The Free Press, New York, NY. | 3. Nakajima, S. (1988),"TPM: Introduction to total productive maintenance",Cambridge: Productivity Press Inc, UK. | 4. Powell, T.C., (1995),"Total quality management as competitiveadvantage: A review and empirical study",Strategic ManagementJournal 16, 15–37. | 5. Kristy O. Cua, Kathleen E. McKone, and Roger G. Schroeder (2001),"Relationships between implementation of TQM, JIT, and TPM and manufacturing performance", Journal of Operations Management,19 675–694. | 6. ShamsuddinAhmed, MasjukiHj. Hassan and ZahariTaha (2005), "TPM can go beyond Maintenance: excerpt from a case implementation", Journal of Quality in Maintenance Engineering, Emerald Group Publishing Limited. | 7. Al-Hassan, K Chan, J F L and Metcalfe, A V (2000), "The role of Total Productive Maintenance in Business Excellence", Total Quality Management and Business Excellence. | 8. Hora M (1987), "The unglamorous game of managing maintenance", Business Horizons. | 9. Eti M C, Ogaji S O T and Probert S D (2006), "Reducing the cost of preventive maintenance through adopting a proactive reliability-focused culture", Applied Energy, Vol. 83. | 10. Riis J, Luxhoj and Thorsteinsson U (1997), " A situational maintenance model", International Journal of Quality and Reliability Management, Vol. 14 No. 4, pp. 349-66. | 11. Schippers, W.A.J., (2001),"An integrated approach to process control",International Journal of Production Economics 69 (1), 93–105 | 12. Ahuja, I.P.S., Khamba, J.S. and Choudhary, R. (2006), "Improved organizational behavior through strategic total productive maintenance implementation", Paper No. IMECE2006-15783,ASME International Mechanical Engineering Congress and Exposition (IMECE), Chicago, IL, November 5-10, pp. 1-8 | 13. Flynn, B.B., Sakakibara, S., Schroeder, R.G., (1995),"Relationship between JIT and TQM: practices and performance",Academy of Management Journal 38 (5), 1325–1360 | 14. McKone, K.E., Roger, G.S. and Cua, K.O. (1999), "Total productive maintenance: a contextualview", Journal of Operations Management, Vol. 17, pp. 123-44 | 15. F.T.S. Chan, H.C.W. Lau, R.W.L. IP, H.K. Chan, and S. Kong (2005) Implementation of total productive maintenance: A case study. Int. J. Production Economics 95 71–94 | 16. Maggard, B.N., Bailey, C.L. and Moss, D. (1989), "Total productive maintenance: TPM thatworks", Electronic Manufacturing Technology Symposium, Proceedings of the 7th IEEE/CHMT International, 25-27 September, pp. 13-17. | 17. Ollila, A. and Malmipuro, M. (1999), "Maintenance has a role in quality", The TQM Magazine, Vol. 11 No. 1, pp. 17-21 | 18. Ireland F and Dale B G (2001), "A study of total productive maintenance implementation", Journal of Quality in Maintenance Engineering, Vol. 7 No. 3, pp. 183-91 | 19. Dwyer, J. (1999), "More than a maintenance technique", Works Management, Vol. 52 No. 9, pp. 15-16. | 20. Dossenbach, T. (2006), "Implementing total productive maintenance", Wood and Wood Products, Vol. 111 No. 2, pp. 29-32. | 21. Voss C A (2005), "Paradigms of manufacturing strategy re-visited", International Journal of Operation and Production Management, Vol. 25 No. 12, pp. 1223-7.. | 22. Besterfield D H, Besterfield-Michna C, Besterfield G H and Besterfield-Sacre M (1999), "Total Quality Management", 2nd ed., Prentice-Hall International, Englewood Cliffs, NJ. | 23. McKone, K.E., Roger, G.S. and Cua, K.O. (1999), "Total productive maintenance: a contextualview", Journal of Operations Management, Vol. 17, pp. 123-44. | 24. Forrester J W (1968), "Principles of Systems", MIT Press, Cambridge, MA | 25. Morecroft J D W (2007), "Strategic Modelling and Business Dynamics", Wiley ,Chichester. | 26. Sterman J D (2000), "Business Dynamics- System Thinking and Modeling for a Complex World", McGraw-Hill, Boston,MA. | 27. Lane D C (2007), "The power of the bond between cause and effect: Jay W Forrester and the field of System Dynamics", System Dynamics Review, Vol. 23, Nos 2/3, pp. 95-118. | 28. Tsuchiya, S., (1992),"Quality Maintenance: Zero Defects Through Equipment Management",Productivity Press, Cambridge, MA | 29. Dean Jr. J W, Bowen D E (1994), "Management Theory and total quality improving research and practice through theory development", Academy of Management Review 19(3), 392-418. | 30. Hackman J R and Wageman R (1995) "Total Quality Management: empirical, conceptual and practical issues", Administrative Science Quarterly, 40 (2), 309-342 | 31. Moore, R. (1997), "Combining TPM and reliability-focused maintenance", Plant Engineering, Vol. 51 No. 6, pp. 88 90. | 32. Hair, J.F., Sarstedt, M., Ringle, C. and Mena, J. (2012), "An assessment of the use of partial leastsquares structural equation modeling in marketing research", Journal of the Academy of Marketing Science, Vol. 40, pp. 414-33 | 33. Barclay, D., Higgins, C. and Thompson, R. (1995), "The partial least squares (PLS), approach to causal modelling: personal computer adoption and use as an illustration", Technology Studies (Special Issue on Researh Methodology), Vol. 2 No. 2, pp. 285-309 | 34. Kline, J.P., Schwartz, G.E., Allen, J.J.B. and Dikman, Z.V. (1998), "Perceptual and electroencephalographic registration of masked emotional words in defensiveness: an exploratory study", Personality and Individual Differences, Vol. 24 No. 4, pp. 499-512 | 35. Santosa, P.I., Wei, K.-K. and Chan, C.C. (2005), "User involvement and user satisfaction withinformation-seeking activity", European Journal of Information Systems, Vol. 14 No. 4, pp. 361-70 | 36. Igbaria, M., Zinatelly, N., Cragg, P. and Cavaye, A.L.M. (1997), "Personal computing acceptance factors in small firms: a structural equation model", MIS Quarterly, September, pp. 279-305. | 37. Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. and Tatham, R.L. (2006), "Multivariate Data Analysis", 6th ed., Prentice-Hall, Englewood Cliffs, NJ | 38. Fornell, C. and Larcker, D.F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", Journal of Marketing Research, Vol. 18, pp. 39-50 | 39. Gefen, D., Straub, D.W. and Boudreau, M.C. (2000), "Structural equation modeling and regression: guidelines for research practice", Communications of the Association for Information Systems, Vol. 4 No. 7, pp. 2-76 | 40. Kumar P, Wadood A, Ahuja I P S, Singh T P and Sushil M (2004), "Total productive maintenance implementation in Indian manufacturing industry for sustained competitiveness", 34th Int. Conference on Computers and Industrial Engineering, San Francisco. | 41. Sangameshwran P and Jagannathan R (2002),"HLL's manufacturing renaissance", Indian Management. |