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What Management Philosophy Does It Take to Improve Employee Quality of Work Life and Performance

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Abstract: This study empirically examines the joint effects of technical and social lean work practices on employee performance (EP) and employee quality of work life (QWL) by surveying front line supervisors in 200 manufacturing firms throughout the United States. The model was analyzed using structural equation modeling and the findings suggest that implementing lean technical practices without implementing social practices such as employee involvement and empowerment has only a limited effect on EP. However, large performance gains are obtained when technical and social practices are implemented together (simultaneously). This research also provides support to practitioner arguments that middle managers are essential to successfully implement lean systems and that lean systems cannot thrive without changes in the supporting management systems.

Key words: lean management; quality of work life; employee performance; middle management support
JEL codes: M11

1. Introduction

Lean operations and the Toyota Production System (TPS) practices have been studied extensively in the last 30 years. There have been multiple explanations of these practices (Ohno, 1988; Holweg, 2007; Monden, 1993; Shah & Ward, 2004, 2007) and some researchers have suggested work design rules that create these lean practices (Spear & Bowen, 1999; Staats et al., 2011). Spear and Bowen (1999) and Staats et al. (2011) argued that the lean practices in use at their focal companies were the result of the consistent application of work design rules. However, the relationship of the various practices to each other are not fully understood. This may be because these practices have emerged from multiple paths instead of being created from clearly documented, rational decisions (Fujimoto, 1999).

Many lean implementations have been successful (Shah & Ward, 2003), but others have failed (e.g., Herron, 2008; Herron & Braiden, 2007). Prior studies investigating the reasons for these different outcomes have considered top management commitment and support (Sakakibara et al., 1997), but have not considered the role of middle management. While middle management's role has received limited investigation, many firms implementing lean have focused on developing their middle managers' abilities to support top management initiatives. For example, when Toyota opened its first U.S. factory, a major concern "was to develop the

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capabilities and attitudes of the leaders for self-management of their groups" (Fujimoto, 1999, p. 253). Prior research has demonstrated that human resource practices affect firms' competitive position (Jayaram et al., 1999), but it did not specifically examine middle management's involvement.

A recent meta-analysis of 25 survey studies of JIT manufacturing (Mackelprang & Nair, 2010) showed that researchers have examined only a limited number of lean practices, most of which were technical practices. For example, only 2 of the 25 studies in the meta-analysis examined the level of authority given to employees. This meta-analysis did suggest that the performance of some lean work practices is moderated by un-identified variables (Mackelprang & Nair, 2010). Some research also notes that lean practices are not universally applicable and/or that in some companies they are only partially adopted (Cooney, 2002). Herron's (2008) study conclusively found that implementing lean technical practices alone does not ensure lean operations.

This paper investigates three research questions. First, whether there are unidentified moderators whose identification can help explain the various outcomes of lean implementations. Second, whether lean technical practices improve employee productivity (Bonavia & Martin, 2006; Shah & Ward, 2007), but also increase worker stress (Bruno & Jordan, 2002; Dankbaar, 1997), which then reduces the employee's quality of work life (Parker, 2003). Third, how middle managers affect both the implementation of lean work practices proposed by Shah and Ward (2003).

To investigate these questions, this paper proposes a model for lean implementation based on the conceptualization of lean as a socio-technical system (Shah & Ward, 2003, 2007). The basic premise of socio-technical system (STS) research is that all production systems have both a social component and a technical component, and both must be implemented synchronously for success. However, STS researchers have not proposed a formal theory, but only suggested system design principles (Cherns, 1976, 1987). This paper uses those premises to develop a formal empirical model that incorporates both social and lean technical practices to investigate how they affect both EP and employee QWL. This allows an investigation of whether there is synergy between the technical and social practices. In particular it also allows investigation of whether increased use of social practices such as employee involvement and empowerment will significantly improve both employee QWL (Hyer et al., 1999; Trist & Bamforth, 1951) and EP.

The next section provides a theoretical justification for the relationships examined in the proposed model. This is followed by an explanation of the methodology used, the analysis of the data and a discussion of the findings.

2. Theoretical Development

Upon review of the lean and STS literature, we used a technique previously used by Liu et al. (2006) to develop a linkage between organizational work practices, the lean principles and the principles of STS (see appendix A).

As discussed earlier, middle management support for both social and technical practices is important. This is supported by the STS principle of "compatibility" (Cherns, 1976, 1987) and the lean principle of "production decisions based on meeting customer expectations" (Dennis, 2007). Compatibility means that the process of designing the systems design and production needs should match the organization's long term goals and objectives. Translating top management's goals into daily work practices that will achieve those goals is critical to the success or failure of any systems design and implementation and is an essential task of the middle manager (Hyer et al.,

1999). It is the middle managers' activities that guide employees on implementing top management directives (Balogun, 2003; King et al., 2001; Mintzberg et al., 2003), which then achieves compatibility between the system's design and its goals and helps facilitate meeting customer expectations (Ramus & Steger, 2000). By making production decisions that are focused on meeting customer expectations, the middle manager creates compatibility between the social and technical systems. Therefore, middle management support (MMS) is defined as the "set of managerial practices that facilitate in the implementation of top management directives by providing resources and interpreting the top management directives to employees to accomplish their task(s)".

Employee involvement is a work practice that requires information sharing, training, and rewarding employees for involvement (Lawler et al., 1995). This corresponds to the four STS principles — information flow, support congruence, multi-functionality, and transitional organizations (Cherns, 1976, 1987) — and two lean principles — participatory management and labor utilization (Dennis, 2007). The information sharing practices facilitate the exchange of accurate, relevant, and timely information about organization functions and allow employees at all levels to participate in some functions traditionally performed by managers (Cua et al., 2001). Employee training supports both lean principles of participatory management and labor utilization. Employee training helps employees conform to specifications and provides them with multiple functional work related skill-sets that support their involvement in improvement activities and increases their labor utilization as they can perform more tasks (Cua et al., 2001; Dennis, 2007). Reward practices that incentivize individual performance and employee participation can increase employee involvement in improvement activities (Sumukadas, 2005, Schonberger, 2007) when the rewards are highly valued and visibly connected to performance (Vandenberg et al., 1999). These employee involvement activities shift responsibility for some tasks from managers to employees which create participatory management (Schonberger, 2007). Therefore, employee involvement is defined as "as an approach that emphasizes participatory organizational and management systems that involve employees in planning, problem solving, and decision making activities aimed at the success of an organization".

Empowerment is critical to lean operations and it changes a firm's work practices. To empower employees, a firm must provide them with the ability to control (or influence) decisions in their work area, and allow them to exercise authority and initiate work behaviors to meet their responsibilities. This means that employees must have the ability to address both routine and non-routine demands, in their work situations (Menon, 2001; Seibert et al., 2004). As an example, employees at lower levels in the organization are given the control of and access to resources to carry out their job responsibilities. More specifically, they are given the authority to stop a production line when a defective part is produced and not allow it to be moved to the subsequent process until the root cause of the defect is corrected. For employees to do this, they need all the information that is essential and critical to the successful completion of the task(s). The practice of employee empowerment is supported by two STS principles — minimal critical specification and power and authority (Cherns, 1976, 1987) and also by the lean principle of stop production (Dennis, 2007). Therefore, empowerment is defined as an "individual's cognitive state of mind which is characterized by a sense of perceived control, perceived competence, and goal internalization" (Menon, 2001). Perceived control is described as the individual's perception of autonomy in the scheduling of work, performance of work, utilization of resources, and decision making. Perceived competence is described as an individual's self-efficacy and confidence with regards to role demands. Goal internalization is described as an individual's belief in the goals of the organization and his/her readiness to act on its behalf.

Shah and Ward (2003) categorized lean practices into three bundles — just-in-time (JIT), total preventative maintenance (TPM), and total quality management (TQM). The JIT bundle includes the pull production,

continuous flow, production leveling, and setup time reduction practices (Hopp & Spearman, 2004; McLachlin, 1997; Shingo, 1983). The TPM bundle includes the total productive maintenance practices (Cua et al., 2001). TQM bundle includes the standardized work practices, kaizen, zero defects, 5-S and visual control practices (Dennis, 2007; Spear & Bowen, 1999). In this paper, these three lean practice bundles are referred to as technical practices, and are defined as "a set of practices that aim to continuously eliminate all kinds of 'waste' by minimizing internal variability and providing stability and standardization during production" (Hopp & Spearman, 2004). Technical practices correspond to two STS principles — variance control and incompletion (Cherns 1976, 1987) — and two lean principles — process stability and standardization, and just-in-time production (Dennis, 2007) — all of which emphasize creating stable processes and reducing (or eliminating) variability to improve tasks/activities (Mackelprang & Nair, 2011, Mann, 2005; Stewart & Grout, 2001).

The STS principle of boundary location emphasizes those organizational boundaries which should be determined based on a logical process criterion and not how it was managed in the past (Cleggs, 2000; Huber & Brown, 1991). This is a structural issue and will not be discussed in this paper.

3. Research Model

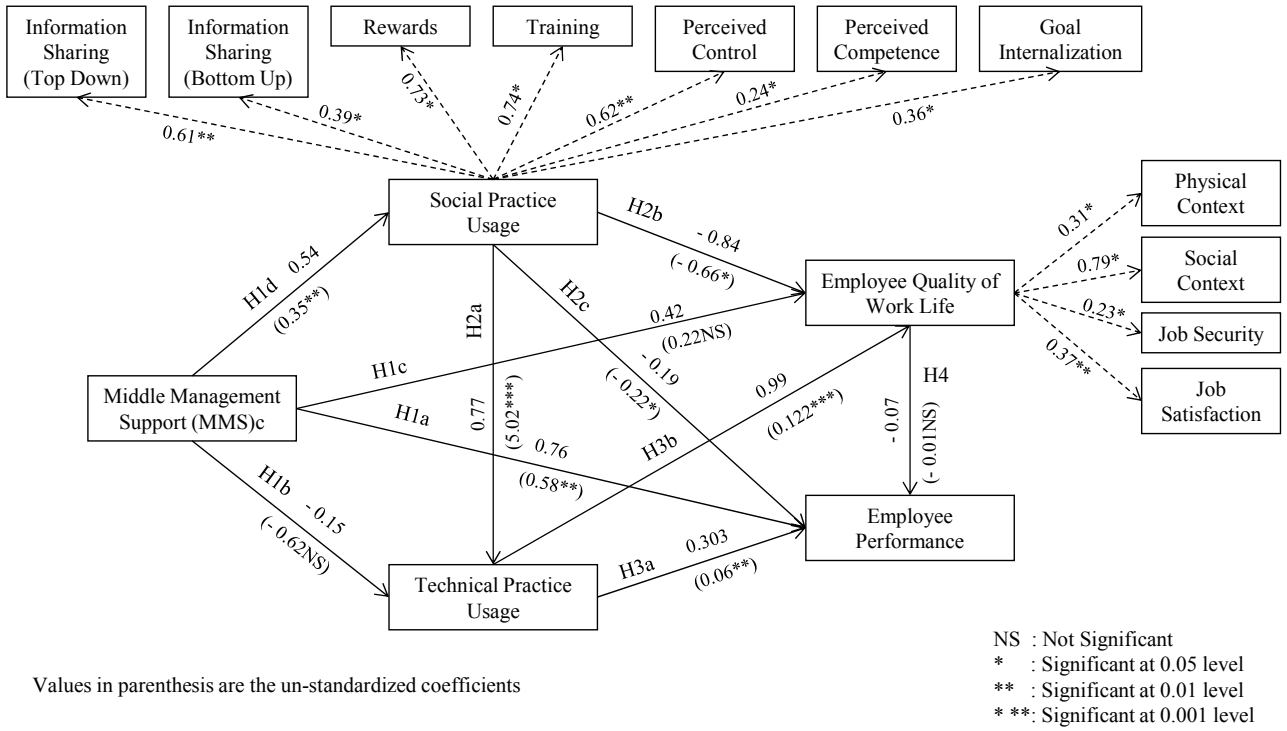

Figure 1 Hypothesized Model with Standardized Path Loadings

Figure 1 is a structural model that considers lean as a socio-technical system, a system that recognizes the inter-relationship between specific work practices and how they affect system performance. Middle management support (MMS) is a variable needed to implement both the social and technical practices of lean. The system's performance is evaluated by measuring QWL and EP. EP has been studied using a wide variety of measures (Globerson & Riggs, 1989; Motowidlo et al., 1997). For the purpose of this study, EP is defined as, "an appraisal process in which the management evaluates employees on how well they do their jobs compared with a set of

standards determined by the organization." QWL is a multi-dimensional construct evaluating the working conditions experienced by individuals (Martel & Dupius, 2006; Rethinam & Ismail, 2008; Sirgy, 2001). For the purpose of this study, QWL is defined as "the condition experienced by individuals that result from the effectiveness of their work environment". This study focuses on four dimensions — physical context, social context, job security, and job satisfaction. Physical context is described as the organization's physical environment that is likely to influence workers' safety and health. Social context is described as the quality of social interaction with other employees in the organization. Job satisfaction is defined as the appraisal and feeling one has towards their job. Job security is defined as the ability of the organization to provide stable full-time employment regardless of changes in the environment.

4. Hypothesis Development

The successful implementation of top management directives depends on how middle managers manage daily operational activities, interpret system changes required to achieve top management's vision for themselves and effectively communicate management directives to their teams (Balogun & Johnson, 2004; O'Toole, 1995). Middle managers are closer to frontline employees than senior managers, and are positioned to provide their employees with the necessary oversight, guidance, and resources to complete tasks effectively and efficiently (Kuo-Wei, 2005; Rue & Byars, 2003). Middle managers can also resolve internal conflicts, ensure that standards are met, alleviate problems, and motivate employees to perform to the best of their ability (Kraut et al., 1989). Since these middle managers allow employees to effectively perform their jobs, it is hypothesized:

H1a: Middle management support is positively related to employee performance.

Middle managers not only provide oversight of technical practices, but they promote their usage by coaching and facilitating training opportunities for their employees (Spear & Bowen, 1999). In large organizations, it is only the middle managers who can encourage the use of technical practices, since line workers have no or limited contact with top management. To be effective in utilizing new practices, middle managers must mobilize resources and make strategic adaptations (Dutton et al., 1997), such as creating actionable goals that move the firm towards its long term goals (Balogun & Johnson, 2004). So, it is hypothesized:

H1b: Middle management support is positively related to usage of technical practice.

Middle managers influence their employees' physical context (e.g., safety and health issues) by ensuring that necessary resources are available to allow employees to perform their work and non-work related activities without any safety or health related inhibitions (Brown, 1996; Martel & Dupuis, 2006). Middle managers are closer to daily operations than senior managers, so they can conceive, suggest, and set in motion new ideas that top managers may not have considered (Huy, 2001). In turn, this may help sustain or create jobs to implement and execute those new ideas. Furthermore, middle managers' help foster an environment in the work place that employees could perceive as interesting and stimulating (Rethinam & Ismail, 2008). So, it is hypothesized:

H1c: Middle management support is positively related to employees' QWL.

Middle managers facilitate information sharing practices by acting as a conduit of communication between their employees and senior management (Mintzberg et al., 2003; Block, 2002; O'Toole, 1995). They provide employees with appropriate training practices since they are in a better position to understand the problems their employees face on a day-to-day basis (Huy, 2001; Facteau et al., 1995). Middle managers make sure that performance measures and reward practices are not in conflict with each other (Lawler et al., 1995) and they

enhance employees' personal competence by authorizing employees to make work decisions and participate in problem solving activities (Spreitzer, 1995). These practices may increase employees' goal internalization since they help employees understand their role in the firm and how they can help the firm achieve its vision. This training, problem solving and decision making should increase perceived control and perceived competence as employees internalize the firm's goals, so they should be involved and empowered (Guzzo et al., 1985). So, it is hypothesized:

H1d: Middle management support is positively related to social practices (e.g., employee involvement and empowerment practices).

Employees who are engaged and empowered within an organization have the authority to stop the production line and seek improvements when defective parts are produced, and to keep it shut down until the root cause of the error is identified and counter measures are put in place (Stewart & Grout, 2001). Furthermore, employees who work downstream control inventory in the system by requesting goods as and when they are needed from employees working upstream (Schultz et al., 2010). Empowered employees also have the authority to sort and discard materials used on the shop floor. They can set protocols for signboards, walkways, and protective clothing needed on the shop floor to maintain a clean, organized workplace (Galsworth, 1997; Mann, 2005). Engaged and empowered employees can continuously update standard work practices (Spear & Bowen, 1999) and perform setup time reduction practices (Shingo, 1983). Empowered employees can respond quickly to changes in demand rates which affect their workloads (Mann, 2005) and are therefore involved in task design, and process layout of the cell work flows (Hyer et al., 1999). Lastly, empowered employees can perform basic inspection, cleaning, lubricating, and tightening of components of their machines, rather than wait for a maintenance team to do it for them (McKone et al., 1999; Psoinos & Smithson, 2002). So it is hypothesized:

H2a: Social practice (e.g., employee involvement and/or empowerment) usage is positively related to technical practice usage.

Employee involvement and empowerment increase employees' control and ownership of their process(es), which encourages them to make their physical work environment safer, healthier and cleaner (Barling et al., 2003; Brown et al., 2000). This active involvement also improves employee competence, which is valuable to managers. As employees recognize that their work is meaningful and challenging, and also valued and acknowledged by their managers, there is an increase in their job satisfaction levels (Cohen et al., 1997; Linden et al., 2000; Treville & Antonakis, 2006). So, it is hypothesized:

H2b: Social practice (e.g., employee involvement and/or empowerment) usage is positively related to employees' QWL.

As employees' autonomy to make quality improvements increases, they influence more decisions about how their work is done (Ohno, 1988). This empowerment drives employees to become more competent at their jobs, which reduces product defects, improves dependability and increases productivity (Menon, 2001). Empowered employees also find more meaning in their work, which in turn leads to a higher level of job performance (Sigler & Pearson, 2000; Spreitzer, 1995). So, it is hypothesized:

H2c: Social practice usage (e.g., employee involvement and/or empowerment) is positively related to EP.

All of the lean technical practices affect how employees perform their jobs. Much of the prior operations management research on lean has investigated the effects of these lean practices on performance. For example, practices such as zero defects, standardization, 5S, and *kaizen* decrease quality defects in the production process (Stewart & Grout, 2001; Spear & Bowen, 1999). Visual control and standardized work jointly improve task

performance and increase productivity (Mann, 2005). Continuous flow, pull production, set-up time reduction, and production leveling reduce inventory, set-up time, processing time variance, and flow-time delays (Hopp & Spearman, 2004; Ohno, 1988). TPM practices increase machine uptime (Mckone et al., 1999). Since all of these practices focus on increasing productivity they should improve EP, so it is hypothesized:

H3a: Technical practice usage is positively related to EP.

The QWL is affected by many factors. Work place safety is important to an employee QWL and can be improved by providing visual cues to create a self-explaining and self-improving workplace so that the tools, raw materials, and component parts are all placed in their appropriate place (Brown et al., 2000). An employees' QWL is also increased when their job satisfaction is increased. When employees' corrective actions result in error free production and equipment maintenance and improvement activities improve performance, and their sense of job satisfaction with job well done increases (Cua et al., 2001; Rethinam & Ismail, 2008; Martel & Dupius, 2006; Sirgy et al., 2001). Social interaction among employees improves when team members engage in regular communication to coordinate production activities and complete various task(s) (Lawler et al., 1995). Job security also increases QWL and well there is no permanent job security, by routinely engaging technical practices that increase productivity employees do increase their job security and job retention. All of the lean practices potentially affect QWL, so it is hypothesized,

H3b: Usage of technical practices is positively related to employee QWL.

The QWL can also affect employee productivity. A safe physical work environment reduces workplace injuries, and their related costs, and also decreases employee absences due to illness and stress (Brown, 1996, 2000; Das et al., 2008). An improved QWL creates a work environment with positive employees' relationships, so they can collectively contribute to the accomplishment of organizational objectives/goals (Briscoe, 1980). While job satisfaction itself is not directly related to EP (Page & Wiseman, 1993), EP is improved when employees are committed (Phusavat et al., 2009; Vallario, 1997; Osterman, 1995). As stated earlier, QWL results from employee actions to improve safety, improve equipment performance and increase productivity, this demonstrates commitment, so it is hypothesized:

H4: Employee perceived QWL is positively related to EP.

5. Research Methodology

The survey instrument was developed using Menor and Roth's (2007) two stage methodology. First the items' construct validity was tested by having respondents match definitions to the construct until the hit rate exceeded 70%. Then, 11 experienced lean operations managers with 5-20 years of experience reviewed the items for readability and construct coverage. Finally, a pilot survey was conducted through Zoomerang, an online panel (www.zoomerang.com/online-panel/), and 60 usable survey responses were obtained from floor supervisors, manufacturing supervisors, production supervisors, and team leaders working in manufacturing in the U.S. For each construct in the model, the four items with the best psychometric properties were retained, and new items were written if there were fewer than four retained items for a construct. The final instrument had a total of 94 items. Since lean work design is often implemented using teams (Dankbaar, 1997; Shah &Ward, 2003), we chose "teams" as the unit of analysis in this study. In this study, a team is defined as a group of two or more people who each have a distinct work role.

The sample consisted of 955 U.S. manufacturing plants (NAICS codes 311-339), randomly selected from the

Association for Manufacturing Excellence member directory and Jigsaw, an online database (http://www.salesforce.com). Four rounds of emails with an electronic survey link were sent to middle managers with job titles such as operations manager, production manager, or quality manager using Dillman's (2000) survey design methodology. Respondents were asked to complete the survey and then forward the electronic survey link to their direct reports (e.g., floor supervisor, manufacturing supervisor, production supervisor, team leader, etc.) who supervised line workers.

Responses were received from 230 firms for an overall 24% response rate. Responses from twenty six firms were deleted since respondents completed less than 50% of the survey, and responses from four additional firms were deleted as they were identified as statistical outliers. Of the 200 firms included in the final analysis, 54 had a paired response from manager-supervisor. Table 1 shows that the study respondents are from firms in multiple manufacturing industries. Of the 200 respondents, 184 had implemented lean practices to some extent.

Table 1 Industry Representation in Sample Data

Type of Industry	Frequency	%	Type of Industry	Frequency	%
Food	23	11.5%	Textile	6	3.0%
Printing	8	4.0%	Machinery	12	6.0%
Plastics and rubber	11	5.5%	Paper	6	3.0%
Fabricated metal products	20	10.0%	Chemical	14	7.0%
Computer and electronic	11	5.5%	Primary metal	5	2.5%
Transportation equipment	17	8.5%	Miscellaneous	36	18.0%
Electrical equipment	14	7.0%	Other industries [a]	17	8.5%

		Duration of implementation		
Lean Implementation	Frequency	1-3 years	4-7 years	> 7 years
Yes	184	78	64	42
No	16			

Note: [a] Other manufacturing industries include leather and allied products, non-metallic mineral products, petroleum and coal products manufacturing, apparel manufacturing, wood product manufacturing, furniture and related product manufacturing.

Non-respondent bias was assessed by splitting the final sample into two waves, early and late respondents, according to the dates that the responses were received (Armstrong & Overton, 1977). There were 110 early responses and 90 late responses. There was no statistically significant difference between the two groups based on the x^2 tests performed on the two constructs of MMS and EP. Next we assessed the inter-rater reliability of the 54 matched pairs for EP and lean technical practices using the average within group index (Rwg). This was greater than 0.8, indicating adequate inter-rater agreement (Boyer & Verma, 2000; Ketokivi & Schroeder, 2004).

Unidimensionality of the first order reflective constructs-MMS, information sharing, reward practices, training practices, perceived competence, perceived control, goal internalization, physical context, social context, job satisfaction, job security, and EP — was tested using Confirmatory factor analysis (CFA). The CFI values were all greater than 0.9, indicating satisfactory unidimensionality (Al-Hawari et al., 2005). Convergent and discriminant validity was assessed for all constructs using a scaled version of the Satorra-Bentler (SB) pairwise x^2 difference test, since the sample was not normally distributed (Satorra & Bentler, 1988). The fit indices of the constructs (CFI > 0.9, and RMSEA < 0.05) were acceptable and the average variance extracted (AVE) of the constructs was either equal to or exceeded the square of their standardized correlation (Fornell & Larker, 1981). These results indicated sufficient evidence for both convergent and discriminant validity (see appendix C).

The data had evidence of common method bias using the unmeasured latent method factor approach

(Podsakoff et al., 2003). The SB x^2 difference between the two models was significant (SB $\Delta x^2 = 73.5$, p = 0) and the change in the model fit (i.e., ΔCFI) was greater than the 0.01 criteria (Cheung & Rensvold, 2002). There were 12 items with loadings greater than 0.5 (see appendix B) on the method factor. So, the common method factor was retained in all future analyses.

6. Results

The statistical analysis is summarized in Figure 2. Hypotheses H1a and H1d — middle management support affects EP (β = 0.76, p < 0.001), and middle management support affects social practice usage (β = 0.54, p < 0.001), respectively — were supported. However, hypotheses H1b and H1c — middle management support affects technical practice usage (β = -0.15, p < 0.15), and middle management support affects employee QWL (β = 0.42, p < 0.15), respectively — were not supported. Hypothesis H2a — social practice usage affects technical practice usage (β = 0.77, p < 0.0001) — was supported, while hypotheses H2b and H2c — social practice usage affects employee QWL (β = - 0.664, p < 0.05), and social practice usage affects EP (= - 0.19, p < 0.05), respectively — were not supported. Hypotheses H3a and H3b — technical practice usage affects EP (β = 0.30, p < 0.01), and technical practice usage affects employee QWL (β = 0.9, p < 0.001), respectively — were supported. Lastly, hypothesis H4 — employee QWL affects EP (β = - 0.007, p < 0.95) — was not supported.

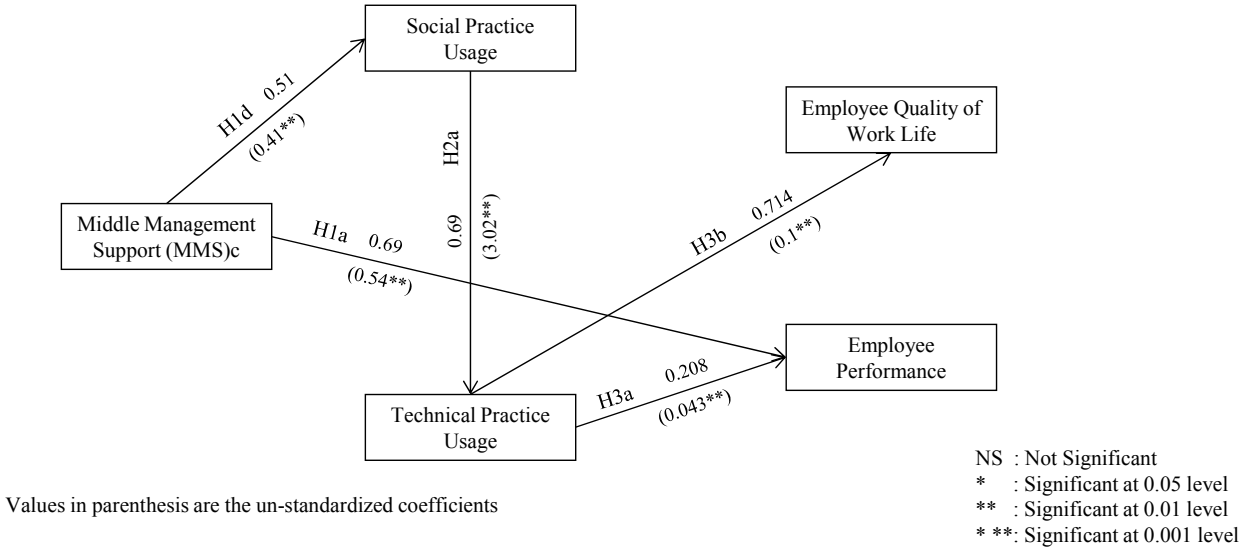

Figure 2 Parsimonious Research Model

Note that in Figure 2, the loadings on the arrows representing H2b and H2c were significant and negative, while the factor correlations (see appendix D) were significant and positive. This suggests that there is classical suppression in the model (Cohen et al., 2003). This was addressed by removing the arrow between social practice usage and employee QWL. The path from social practice usage to EP then became positive, but insignificant. The parsimonious model in Figure 2 containing only the significant direct effects was then tested. The fit of this model (CFI: 0.91, RMSEA: 0.044) was not significantly different than the fit of the full model, so the remaining discussion refers to Figure 2.

Table 2 decomposes the effect of the model in Figure 2. MMS does not directly affect the lean technical practices, it has a large indirect effect on them. Likewise it affects QWL and EP. Social practice usage has a

significant direct effect on technical practice usage but only indirect effect on QWL and EP. The lean technical practices directly affect both QWL and EP.

Table 2 Decomposition Effects of the Parsimonious Model

Causal Variables	Endogenous Variables			
	Social practices (unstd.)	Technical practices (unstd.)	QWL (unstd.)	EP (unstd.)
Middle management support				
Direct effect	0.41	NS	NS	0.54
Indirect effect	-	1.31	0.13	0.06
Total	***0.41***	***1.31***	***0.13***	***0.6***
Social practices usage				
Direct effect		3.203	NS	NS
Indirect effect		-	0.32	0.14
Total		***3.203***	***0.32***	***0.14***
Technical practice usage				
Direct effect			0.1	0.04
Indirect effect			-	NS
Total			***0.1***	***0.04***
QWL				
Direct effect				*NS*
Indirect effect				*NS*
Total				***NS***

7. Discussion

The findings in Figure 2 support the argument that lean management is a socio-technical system (Shah & Ward, 2003, 2007). Middle managers do control employee evaluation and appraisal within an organization (Pun et al., 2001) which may explain their direct effect on EP. However, their insignificant effect on technical practice usage suggests that middle managers institutionalize the use of technical practices by supporting social practices (e.g., employee involvement and empowerment). They provide resources (e.g., training, expertise, information, rewards and recognition) that encourage employee involvement and engagement in lean improvement projects.

This may occur because employees who perceive their managers to be supportive (i.e., fair and just) respond favorably to managers and improve their work performance as suggested by social exchange theory (Rhoades & Eisenberger, 2002). This suggests that the physical implementation of lean is only the beginning of the transformation. Management must remain focused on ensuring that social practices are strong. A second very important finding is that middle managers improve employees QWL and EP by supporting social practices that encourage the use of technical practices. Figure 2 suggests that there is a critical chain of events that need to occur to improve QWL. This means that a successful lean management system needs not only physical change (technical practices), but also changes in management practices (e.g., Mann, 2005). The significant indirect effect of MMS on QWL supports prior research that MMS is essential to lean (Mann, 2005; Rethinam & Ismail, 2008; Treville & Antonakis, 2006; Sumukadas, 2005). Further, the finding that technical practices mediate the effect of social practices on both QWL and EP supports the STS argument that the social and technical practices should be jointly implemented to create an efficient and effective work system (Cherns, 1976, 1987), and it also supports

Shah and Ward's (2007) argument that lean is a "socio-technical system". The different outcomes of various lean implementations may be due to the extent to which the firm implemented the social practices to support the technical practices. These technical practices are recognized as affecting both EP and employee QWL (e.g., Lewchuk & Robertson, 1997; Mackelprang & Nair, 2010; Menezes et al., 2010) but they have not been fully examined as joint practices.

One interpretation of why employee QWL had no effect on EP is that employees use their own individual culture and values to evaluate their QWL (Sirgy et al., 2001; Daniels, 2000), so they are individually predisposed to certain work attitudes and values (Staw et al., 1986). These values differ based on age, gender, culture, and education, which were not measured here. There may be significant effects here which could not be tested in this study.

8. Conclusion

This study supports contentions that lean is a socio-technical system (Shah & Ward, 2007; Dennis, 2007; Manz & Stewart, 1997) that creates benefits through the synergy of implementing both social and technical practices. In addition, it supports recent practitioner arguments that middle managers are essential to successfully implementing lean systems and that lean systems cannot thrive without significant changes in the supporting management system (Mann, 2005). The model in Figure 2 suggests that the middle manager implements technical practices through the social practices of involving and empowering employees. It is through this process that both EP and QWL increase. While the direct path from MMS to EP exists because of the manager's role in employee evaluation and reward, it is the indirect path through the implementation of the social and lean practices that is critical to lean. Adler et al. (1999) observed that at the NUMMI plant, managers sought to increase employee satisfaction as they implemented lean, indicating that social practices are not separate from the lean practices in lean operations. Further research is needed to examine how managers actually integrate these social and technical practices. For example, research about how middle managers control and facilitates empowered employee teams to improve cross-functional work within their organization would be valuable.

There were two major limitations in this study. The first was common method bias due to the use of a single respondent. The shop floor supervisor was asked to assess the levels of middle management support, social and technical practices usage by front line employees' in their departments, and the system outcomes (i.e., employees' QWL and work performance). A second limitation of the study was the cross-sectional survey methodology. This did not allow for the examination of the possible causal direction between middle management support and usage of social practices and technical practices, and their impact on employees' QWL and performance. Future research can address these limitations in multiple ways. First, obtaining a larger sample size would allow the use of multi-trait multi-method (MTMM) analysis to fully understand the source of common method bias. Second, obtaining multiple respondents from companies would help eliminate the common method variance. Third, conducting longitudinal case research study would allow a fuller understanding of the causal direction and possible reciprocal relationship between the independent variables.

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Appendix A

Work Practice	STS Principles Adapted from Cherns (1976, 1987)	Lean Principles Adapted from Dennis (2007)
Management Support Middle Management Support	**Compatibility**: The process of designing a system should be consistent with the goals of the design	**Production decisions based on meeting customer expectations**: Identify and address the critical production needs
Employee Involvement Information sharing practice Training Practices Reward Practices	I**nformation Flow**: Flow of work related information to individuals who need it most	**Participatory Management**: Build a culture that engage and involve employees in decision making on decisions that affect their jobs/tasks
	Support Congruence: Social support structures such as reward systems, training policies, conflict resolution mechanisms, designed to reinforce behaviors which the organization structures is designed to elicit.	
	Transitional Organizations: Involve the design team to transition into new systems based on STS approach	
	Multi-functionality: Work design should avoid highly fractionalized jobs, individuals should be trained to perform a range of tasks	**Labor Utilization**: Cross train workers so that they can perform multiple tasks
Employee Empowerment Perceived Control Perceived Competence Goal Internalization	**Minimal critical specification**: In the design of jobs, specify no more than what is absolutely essential	**Stop Production**: Employees can stop the production line to prevent defective parts from being transferred to the subsequent process
	Power and Authority: Ability of employees to access and exercise authority over resources to carry out responsibilities	
Technical Practices Standardized work Pull production Continuous flow production Production leveling Setup time reduction Total preventative maintenance Zero defects Visual Control Kaizen 5-S Cellular manufacturing	**Variance Control**: Work should be designed to control variances as close to their source as possible **Incompletion**: Examine, critique, and improve the system the moment it is implemented	**Process stability and standardization are the foundations for continuous improvement**: Continuous improvement processes through which employees identify and then eliminate the 'waste' in the system Just-in-Time production: Focus on customer pull so that there is value flow rather than material flow

Appendix B

			Method Factor	
Scales Used	Hit Rate	Factor Loading	Factor Loading	Method Loading
Middle Management Support *My Manager….*				
provides me with the necessary resources to accomplish my tasks effectively	0.88	0.84	0.77	0.33
provides me with the necessary recourses to improve product quality	0.75	0.85	0.78	0.34
facilitates in the implementation of quality improvements in my department	0.90	0.71	0.68	0.26
Information Sharing (Top-down)				
information regarding company policies & procedures is shared with team members	0.88	0.8	0.72	0.34
my team members are kept informed when something occurs in the department	0.71	0.7	0.55	0.59
Information Sharing (Bottom-Up)				
share information about their work processes with each other in this department	0.75	0.89	0.73	0.55
share information regarding best practices with each other in this department	0.76	0.82	0.68	0.44
Reward Practice *My team members are rewarded….* when they make an extra effort to improve overall performance in this department	1.00	0.89	0.78	
when they learn additional skills related to their work	0.90	0.87	0.43	

(To be continued)

(Continued)

			Method Factor	
Scales Used	Hit Rate	Factor Loading	Factor Loading	Method Loading
Training Practice *My team members…*				
are provided with training in specific job skills needed to do their work	0.85	0.74	0.55	0.50
are provided with training in problem solving skills related to their work	0.90	0.72	0.71	0.38
are provided with training in quality improvement skills related to their work area	0.88	0.81	0.74	0.45
Perceived Competence *My team members….*				
demonstrate competence in meeting their job tasks	1.00	0.83	0.72	0.40
have their capabilities to meet their job demands	1.00	0.79	0.71	0.44
are confident that they can do their job well	1.00	0.81	0.62	0.50
Perceived Control *My team members…*				
influence process changes that affect their work	1.00	0.85	0.49	0.72
influence changes in their work methods	1.00	0.81	0.57	0.60
influence decisions about issues that affect their work	1.00	0.85	0.68	0.55
influence the ways in which tasks are completed in their work area	0.90	0.74	0.56	0.53
Goal Internalization				
Working towards the goals of this department is important to my team members	1.00	0.83	0.65	0.53
My team members are inspired by the goals of this department	1.00	0.79	0.61	0.54
My team members are willing to help this department achieve its goals	1.00	0.8	0.61	0.54
My team members are enthusiastic about working towards the goals of this department	1.00	0.78	0.79	0.31
Physical Context				
Eating areas within the plant are clean and hygienic	1.00	0.71	0.71	0.19
Restrooms within the plant are clean and hygienic	1.00	0.8	0.77	0.32
Social Context *My team members….*				
Can always count on their colleagues for support at work	0.75	0.75	0.67	0.29
Are friendly with each other	1.00	0.72	0.67	0.26
Job Satisfaction *My team members….*				
Enjoy coming to work everyday	1.00	0.88	0.70	0.55
Enjoy performing their daily job activities	1.00	0.91	0.75	0.50
Job Security *My team members….*				
Do not worry about losing their jobs	1.00	0.70	0.70	0.11
Have job stability within this organization	1.00	0.81	0.75	0.26
Have job security within this organization	0.88	0.83	0.77	0.30
Employee Performance *My team members….*				
Ability to deliver work output on time has improved over the past three years	1.00	0.85	0.74	0.42
Work quality has improved over the past three years	1.00	0.70	0.75	0.15
Overall performance has improved over the past three years	1.00	0.80	0.72	0.39
Dependability in meeting the department goals have improved over the past three years	1.00	0.83	0.59	0.59

Appendix C Correlation Analysis, Reliabilities and Average Variance Extracted (AVE)

		Mean/ SD	Reliability	AVE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Middle Management Support		5.58/1.18	0.88	0.64	**0.80**														
Social practice usage	2. Information Sharing (top-down)	5.96/1.12	0.73	0.57	0.50	**0.75**													
	3. Information Sharing (Bottom-Up)	5.53/1.00	0.85	0.73	0.41	0.42	**0.86**												
	4. Training	5.24/1.31	0.84	0.57	0.48	0.59	0.55	**0.76**											
	5. Rewards	4.51/1.57	0.88	0.78	0.46	0.43	0.40	0.51	**0.88**										
	6. Perceived Control	5.38/1.07	0.90	0.66	0.52	0.61	0.61	0.66	0.45	**0.81**									
	7. Perceived Competence	6.00/0.83	0.85	0.66	0.32	0.44	0.55	0.47	0.17	0.53	**0.81**								
	8. Goal Internalization	5.52/1.05	0.88	0.64	0.52	0.52	0.54	0.56	0.48	0.62	0.41	**0.80**							
9. Technical practice usage		5.15/1.43	0.82	0.67	0.48	0.42	0.56	0.65	0.39	0.67	0.41	0.49	**0.82**						
Quality of Work Life	10. Physical context	5.51/1.31	0.75	0.57	0.32	0.30	0.23	0.35	0.21	0.32	0.27	0.36	0.32	0.37	**0.76**				
	11. Social context	5.67/0.92	0.69	0.54	0.43	0.33	0.53	0.39	0.33	0.40	0.35	0.52	0.47	0.49	0.28	**0.73**			
	12. Job satisfaction	4.99/1.20	0.89	0.80	0.37	0.35	0.59	0.48	0.53	0.53	0.39	0.58	0.41	0.54	0.35	0.51	**0.89**		
	13. Job security	4.84/1.67	0.82	0.55	0.24	0.17	0.18	0.32	0.32	0.30	0.15	0.23	0.20	0.29	0.14	0.18	0.35	**0.74**	
14. Employee Performance		5.68/1.07	0.88	0.63	0.77	0.43	0.43	0.50	0.40	0.54	0.39	0.55	0.54	0.49	0.40	0.45	0.40	0.24	**0.79**

Appendix D Factor Correlations

	1	2	3	4	5
1. Middle Management Support	1.00				
2. Social practice usage	0.54 (CI: 0.40 – 0.68)	1.00			
3. Technical practice usage	0.27 (CI: 0.13 – 0.41)	0.69 (CI: 0.55 – 0.83)	1.00		
4. Quality of Work Life	0.24 (CI: 0.10 – 0.38)	0.08 (CI: - 0.06 – 0.22)	0.54 (CI: 0.40 – 0.68)	1.00	
5. Employee performance	0.74 (CI: 0.60 – 0.88)	0.43 (CI: 0.29 – 0.57)	0.38 (CI: 0.24 – 0.52)	0.30 (CI: 0.16 – 0.44)	1.00