ProQuest

Report Information from ProQuest

July 31 2016 01:30

Table of contents

1. Innovative lean: work practices and product and process improvements.. 1

Innovative lean: work practices and product and process improvements

Author: Angelis, Jannis; Fernandes, Bruno

Abstract: Purpose - Innovation is a key source of competitiveness in the knowledge economy, and continuous improvement (CI) is a key element of such corporate pursuit. The purpose of this paper is to explore links to prevalent shop floor conditions which support or prohibit the effective realisation of CI. Lean is a globally competitive standard for product assembly of discreet parts. Successful Lean application is conditioned by an evolutionary problem-solving ability of the rank and file. This is in itself contingent on employee involvement in improvement programs and the implementation of appropriate practices. But the challenge of operating innovative Lean systems lacks statistically valid guidance. Design/methodology/approach - This empirical study is based on 294 worker responses from 12 manufacturing sites in four industry sectors. Findings - The study identifies particular practices that impact employee participation in improvement activities and their performance outcomes. Process suggestions are driven by a combination of difficult working conditions that the workers seek to improve and team-based work. However, for suggestions on product improvements, significant practices are worker favorable industrial relations and human resource practices. Research limitations/implications - To test work practices, work practice variables were measured with single items, trading lower measurement reliability for increased scope. Also, there is a moderate sample size, if addressed by selecting sites with a variety of practices. Practical implications - The results indicate that the main business benefit is in enhanced product quality through process, rather than product, improvements, suggesting that management should pursue worker involvement on continuous process improvements, and employ designated design teams for product improvements. Originality/value - The paper empirically identifies the relationship between particular work practices and product and process improvement in a Lean setting.

Full text: 1 Introduction

Similar to the notion made by [14] Carroll (1871) in *Through the Looking Glass* , today's businesses can be described as operating in a Red Queen economy, where it takes all the running one can do to keep in the same place. Innovation is key source for competitiveness. It is through innovativeness that industrial managers devise solutions to business problems and challenges, which provide the basis for firm survival and future success ([32] Hulta *et al.* , 2004). Continuous improvement (CI) is a core element of such corporate pursuit ([61] Wu and Chen, 2005), and this study explores links to prevalent shop floor conditions which support or prohibit the effective realisation of CI.

CI can be summarized as a company-wide focus to improve process performance; using gradual step by step improvement ([11] Brunet and New, 2003) and organizational activities involving all people in the company while creating a learning environment ([46] Pervaiz *et al.* , 1999; [21] Delbridge and Barton, 2002). [39] Lillrank and Kano (1989) refer to CI, or kaizen as the "principle of improvement". CI programs were initially developed in organizations with product-focused processes or repetitive processes, i.e. with relatively high standardization of products and processes ([10] Bhuiyan and Baghel, 2005). Special teams were organized to work on improvement tasks, which were separate from their typical organizational tasks. As such, through their commitment and involvement employees become a source of sustainable competitive advantage ([31] Hoerl and Gardner, 2010).

CI activities are a key element of operations seeking long term competitive advantage. They are a core philosophy in lean operations as a means of improving product quality and reducing waste throughout the operations ([38] Liker and Hoseus, 2008). The activities are also a key part of Six Sigma, where regirious improvement methods are used to improve operations ([4] Antony, 2009; [58] Totterdill *et al.* , 2009). Both lean and Six Sigma are built on the principle that relentlessly pursuing the solving of problems that affect the customer generates a competitive advantage. Solving these problems becomes, in a mature lean or Six Sigma organization, an overall business goal. Both lean and Six Sigma have evolved into comprehensive management systems, encompassing features such as an emphasis on customer satisfaction, high quality, and comprehensive employee training and empowerment ([6] Arnheiter and Maleyeff, 2005). Lean techniques such as total quality management (TQM) have many commonalities with Six Sigma, such as employee empowerment and the use of cross-functional teams ([55] Snee and Hoerl, 2007; [4] Antony, 2009; [31] Hoerl and Gardner, 2010). Hence, lean (and indeed those employing Six Sigma) production plants generally have more extensive improvement program participation than traditional plants ([63] Forza, 1996).

Lean thinking has wide applicability in many different countries and industries ([64] Womack *et al.* , 1990; [50] Schonberger, 2007), with demonstrated potential for achieving high productivity and quality ([56] Snell and Dean, 1993; [24] de Treville and Antonakis, 2006; [54] Singh *et al.* , 2010). Empirical evidence by [51], [52] Shah and Ward (2003, 2007) and [29] Fullerton *et al.* (2003) shows that lean contributes substantially to the operating performance of plants. While there are studies on workforce effects of lean ([8] Berggren, 1993; [17] Conti *et al.* , 2006; [3] Angelis *et al.* , 2006; [42] Mehri, 2006), this study focuses on their involvement. [36] Lauder (2001) links the high performance work organization with lean, whereby some power is devolved to teams to engage in the constant process of innovation and improvement. Employee-driven innovation represents an inclusive and bottom-up approach to innovation that includes all the players in an organization, i.e. its employees, management and shop stewards ([58] Totterdill *et al.* , 2009; [19] Damanpour *et al.* , 2009; [48] Pot, 2011). [64] Womack *et al.* (1990) advocate that involved workers are necessary for the expanded roles effective CI program require, and that the worker involvement is enhanced by job enrichment such as improvement projects, self-inspecting tasks, and conducting routine maintenance. Improvement projects enable workers to use their creativity and knowledge, and improved quality can generate pride and job security ([35] Koenigsaecker, 2000). Contrary *et al.* (1992) and [12] Bruno and Jordan (2002) argue that lean implementation may diminish worker commitment through fast paced and high intensity operations, with close monitoring, de-skilling and low job autonomy ([22] Delbridge and Turnbull, 1992).

This study furthers this debate on the role of worker involvement and innovation in a lean setting by exploring the relationship between shop floor generated product and process improvement and particular work practices. As such, the study seeks to answer the following research question:

RQ . What role and impact do work practices in lean operations have on product and process improvements and their implementation?

To answer the question, the study covers a range of work practices typically prevalent in lean operations and improvements across four industries.

2 Method

[15] Conti and Gill (1998) developed the initial hypotheses by examining expected outcomes for a variety of lean practices that either are associated with lean production, such as CI programs; or are general practices, such as ergonomic difficulties, whose influences are magnified by lean production. This follows suggestions by [2] Anderson-Connolly *et al.* (2002) and [9] Bhasin and Burcher (2006). Particular practices included in this study were: work pace and intensity, resource removal, working longer hours than desired, cycle time, use of buffer inventory, doing work of absent workers, blame for defects, display of individual output, ergonomic difficulties, work pace control and autonomy for process change, consultation on changes in working conditions, output variability, job rotation, team working, peer and supervisor support, ill-fitting parts, work flow interruptions, adequate training and tools. The independent variables were 21 lean work practices and 13 control variables recorded on five-point Likert scales. The latter variables included demographic and life-style factors.

Several authors ([7] Becheikh *et al.* , 2005; Freel, 2003; [40] Linder *et al.* , 2003; [43] Michie and Sheehan, 2003) argue that product and process innovations need to be separate in studies of CI, since they not necessarily share determinants. Hence, the dependant variables consist of worker suggestions to improve existing products (i.e. specifications, design) and processes (i.e. how products are made, work layout, tool use). Specifically, the survey asked how often the respondent makes suggestions to improve existing products and processes, and how often these were being implemented. Avoiding an object approach (i.e. innovation count) also reduces the favor of radical innovations over incremental ones and product over process innovations ([27] Flor and Oltra, 2004; [34] Kleinknecht *et al.* , 2002). The independent lean implementation variable was measured using ten key elements, as suggested by [51], [52] Shah and Ward (2003, 2007): set-up reduction, inventory and waste reduction, kanbans, supplier partnerships, CI program, mixed-model production, TQM, foolproof or design-for-assembly, total preventive maintenance, and standard operating procedures. Survey result scale reliability as measured by Cronbach α was 0.816. Levels were estimated on a five-point scale in the management questionnaire, using categories of [49] Powell (1995).

The sampling plan of [18] Cook and Campbell (1979) was used to recruit sites differing in work practices. Sample space is the population of Brazilian sites with 60 or more assemblers. All 12 sites are in four SICs: three in 35 (machinery), three in 36 (appliances and electronics), three in 37 (motor vehicles), and three in 38 (instruments), similar to the distribution reported by [29] Fullerton *et al.* (2003). Sites are a mix of union and non-union workplaces. While the operations director at each site was given the management questionnaire on lean and company operational conditions, employees were given questionnaires on the presence and form of specific work practices and their own actions. Plant tours and interviews helped to verify both management and employee responses. All assemblers received instructions and were given questionnaires in stamped envelopes for anonymous posting. 294 questionnaire responses were obtained out of 840, generating a response rate of 35 percent.

The study sample was limited regionally to Brazil, which has been considered a training "lab" for uncertainty and unfavourable conditions, where quality and productivity issues are being considered from the perspective of a globalised economy as a way for reducing costs and cycle times as well as improving sales and profits ([25] Fernandes *et al.* , 2000; [37] Lemos, 2000). Lean has been implemented across Brazil with little unions or worker resistance ([60] Wallace, 2004). While some efforts have been made to implement a local version, a lean operations system with Brazilian characteristics has not emerged ([26] Fleury and Fleury, 2003; [59] Tremblay and Rolland, 2000).

3 Results and discussion

Overall relationship

CI through worker participation is a core lean principle. Before exploring the specific work practices, the overall relationship between lean implementation and use of CI was tested. The study results reveal that there is a significant correlation between lean implementation and product and process suggestions (r =520, p <0.001), as well as their implementation (respectively r =582, p <0.001 and r =418, p <0.001). Analysis of variance was used to check the means and 95 percent confidence intervals for the five levels of affective commitment responses. Multiple regression using redefined variables identified relationships significant at 0.05 or less. The work practice hypotheses were tested using stepwise regression, with product and process suggestions as response variables. The former model F =7.281, p <0.001, adjusted R^2 0.041, and the latter is F =5.911, p <0.001, adjusted R 0.063. There is no evidence of collinearity, with VIF values well below the usual cut-off of ten ([30] Hair *et al.* , 1995). As for control variables, there were no significant relationships for age or years of employment at the site, or for perceived job security. It appears that demographic and life-style factors do not materially affect the study results. Having established the common use of CI initiatives in lean sites, the role of the given individual work practices is explored next.

Role of individual working practices

The relationship between process suggestions and the lack of proper tools is both significant and positive (*ß* =0.132, *p* =0.026). The lack of appropriate tools indicates inadequate technical support, and can also lead to quality problems, and raises managerial competence issues ([23] DeSantis, 1999). Similarly, the relationship between process suggestions and flow interruptions is significant and positive (*ß*=0.129, *p* =0.031). Flow interruptions are beneficial in that they may provide workers with more time to think about existing processes, or that workers' dislike for interruptions galvanize them into making improvement suggestions.

The relationship between process suggestions and the utilisation of team work is significant and positive (*ß* =0.117, *p* =0.041). Support from peers or supervisors is not significant. Team work allows for worker job task expansion and supports peer support for time and quality standards, and it also indicates management confidence in workers' ability to multi-task. Nonetheless, given some workers preference for working alone, it may be prudent to offer alternative choices. Moreover, there is a positive correlation between product suggestions and working longer hours than desired (*ß*=0.153, *p* =0.008). This suggests that the workers make more suggestion even when working longer hours than they would chose to. This contradicts with what [62] Cleveland *et al.* (2000) describes as the undesired overtime intrusion into private life which hampers worker commitment, and in turn involvement in improvement schemes. A similar view is held by [28] Francois *et al.* (2002), who claim that annualisation or modulation of work time have proved to be positively correlated with innovation. While there may be several explanations for this conflict, it does suggest that the role of log working hours may need further exploration.

The significant and positive relationship between pace and intensity and worker suggestions on process improvements (*ß* =0.162, *p* =0.005) fits the lean notion of employing resource removal as a change catalyst ([13] Buchanan, 1994). But a high pace and intensity may also be perceived as "unfair" and hence erode worker commitment and in turn their involvement. Related, there is a negative correlation between the feeling of being blamed for defects and product suggestions (*ß*=-0.171, *p* =0.003) and implemented product suggestions (*ß* =-0.158, *p* =0.006). Lean pinpoints specific defect locations which may make individual workers feel they are being blamed. Moreover, blame feelings persist long after actual defect episodes, perhaps due to lingering apprehension about future defects. For successful employee involvement, workers must be given the opportunity and responsibility for organizational change and improvement, but they must also be motivated to avail themselves of this opportunity and responsibility. Such worker motivation may be limited in an environment where they feel they are being blamed for defects.

On the implementation of suggestions, the relationship between ergonomics and implemented process suggestions (*ß* =-0.218, *p* <0.001) and product suggestions (*ß* =-0.163, *p* =0.006) is significant and negative. Positioning hard to handle items shows lack of technical support. Indirectly poor ergonomics restricts access to physically demanding jobs, and in turn fail to capture all potential innovators ([1] Adler *et al.* , 1997).

The relationship between comments on change and implemented process suggestions (*ß* =0.169, *p* =0.003) and product suggestions (*ß* =0.132, *p* =0.020) are both significant and positive. Such capture of suggestions indicates good management practice ([45] Millward *et al.* , 2000). Likewise, task expansion, as well as greater co-worker interaction, may lead to better suggestions through improved shared understanding. In the study, the relationship between implemented product suggestions and job rotation is significant and positive (*ß*=0.163, *p* =0.005). Nonetheless, the relationship between implemented process suggestions and pace control is significant and positive (*ß* =0.161, *p* =0.004). Similarly, the relationship between implemented product suggestions and worker change autonomy is significant and positive (*ß* =0.131, *p* =0.021). [20] Danford (2003) notes that job autonomy, rather than team working, can have a positive impact on workers' sense of trust, commitment and satisfaction. But to reduce the likelihood of errors induced due to human error probability, enhancement of worker autonomy must at the same time limited discretion ([16] Conti and Warner, 1997). Complexity can be minimised through product and assembly design, while variability can be minimised through poka-yoke systems and non-discretionary tasks.

[41] Martinez-Ros (1999) found that product and process innovations are interdependent. Neglecting process innovations can weaken firm capacity to develop new products, and undermine the innovation process entirely. The research results indicate the prevalence of three conditions. First, working conditions perceived to be harsh or difficult appear to motive workers to make (process) suggestions, as seen by the significant variables of lack of appropriate tools, high pace and intensity, and flow interruptions. The study results shows that worker commitment is significant for suggestions made on products (*ß*=0.171, *p* =0.003) but insignificant for process suggestions. This make sense, since a committed worker may have an interest in improving the product, while a non-committed worker may primarily be motivated to improve his or her immediate working conditions. Second, supportive work practices in the form of mutually beneficial human resource practices and industrial relations, such as team work, a flexible work schedule, and the absence of a blame culture strengthen worker improvement involvement. Third, poorly designed or implemented processes may make them easy improvement targets for the workers - an improvement form of low hanging fruit. This notion is supported by [62] Cleveland *et al.* (2000) who state that lean job tasks tend to become more routine as a result of foolproof assembly designs and standard operating procedures.

As [44] Midgley (1995) points out, there is limited advantage in developing worker commitment and involvement if there then is no commitment on the part of the management to provide the environment in which the workers' involvement can be applied. The relationship between workers making improvement suggestions on existing products or processes and worker participation in formal improvement schemes is not significant. Hence, formal participation in improvement exercises is not necessarily a good indication of worker involvement. Similarly, on a firm level, there appears to be weak links between a formal innovation strategy and actual worker involvement on the shop floor. This gap indicates poor management by-in to improvement through worker involvement ([44] Midgley, 1995). Also, the results indicate that managers should pursue employee involvement rather than intensification approach. [8] Berggren (1993) calls this a team-driven rather than JIT-driven lean approach, achieving gains through high employee commitment rather than through cost reduction and work intensification.

Impact on performance

There is a strong and positive correlation between productivity and quality (r =0.947, p <0.001) and delivery (r =0.993 p <0.001), and between delivery and quality (r =0.996 p <0.001). Following the Sandcone model, operational advantage is based on high product quality. There is a positive and significant correlation between product improvement suggestions and product quality (r =0.187, p =0.013) and there is a positive and significant correlation between process improvement suggestions and speed of delivery (r =0.210, p =0.005). But there are no other significant relationships between product and process improvement suggestions and realised improvements in quality, productivity or delivery. Perhaps unsurprising, speedy introduction of new products appears to have a negative effect on improvement suggestions from the workforce (r =-0.176, p =0.020 and r =-0.201, p =0.008 for product and process suggestions, respectively). Similarly, the relationship to implemented process improvements is significant and negative (r =-0.270, p <0.001).

There is a significant and positive relationship between the implementation of suggestions on process improvements and manufacturing unit cost (r =0.152, p =0.044), ability to change product mix (r =0.207, p =0.006) and speed of delivery (r =0.350, p <0.001). [5] Appelbaum *et al.* (2000) and [47] Pil and MacDuffie (1996) state that high involvement practices employ workers in improvements activities to improve quality and not to achieve cost reductions. The results show that worker suggestions on process improvements mainly have an impact on product quality (r =0.157, p =0.008), which indicates that the involvement aspect on lean may fit into the same category. This shows both the importance of tracking implementation of suggestions and the use of appropriate product design and process design other than on the shop floor. For instance, product improvements can be pursued through dedicated design teams while workers on the shop floor focus their suggestions to error proofing activities. This has the benefit of reducing the probability of human error and reducing discretion while at the same time retaining a degree of job autonomy and capturing employee skills and knowledge.

4 Conclusion

The study set out to explore the role and impact of work practices in realising improvements in lean operations. As one can expect given the importance of CI techniques in lean, the results show that there is a significant correlation between lean implementation and product and process suggestions and their implementation. This holds even when controlling for firm size or age, unionized workforce and compensation systems.

On the role of individual work practices, the study results indicate that process suggestions are driven by a combination of difficult working conditions that the workers seek to improve and team-based work. While management may have less ability to influence staff natural interest in being involved in CI projects, there should be greater ability to enable team work. For suggestions on product improvements the significant working practices primarily can be clustered into favourable industrial relations and human resource practices.

In terms of implementation of suggestions, both product and process suggestions are significantly and positively correlated with management capturing ideas voiced by the workers, worker discretion in pace and task, and job rotation. To control for human error probability and ensure product quality and consistency, a degree of job autonomy may be needed but adverse effects of job discretion on product quality need to be built out through poka-yoke fool-proofing designs. The results also indicate that the main direct business benefit is in enhanced product quality through process, rather than product, improvements. This suggests that management should pursue worker involvement on continuous process improvements, and employ designated design teams for product improvements.

For the unfavourable practices, managerial action should be taken to minimise any negative effects. First, if possible, overtime should be voluntary, aided by cross-training of workers to expand the pool of volunteers ([33] Kam *et al.* , 2003). Second, task time standards should be set with pace and intensity set at "normal" levels as defined by industrial practice. Third, process designs should emphasise eliminating ergonomic difficulties, providing adequate tools and minimising flow interruptions. Finally, supervisory training and disciplinary policies must emphasise "blame free" defect investigations.

As for limitations and future work, to test the given work practices we measured work practice variables with single items, trading lower measurement reliability for increased scope. The moderate sample size was addressed by selecting sites with a variety of practices. The use of Brazilian sites provides cultural control but may limit applicability to other countries. Moreover, the region where a firm is based may have a significant effect on its innovative capacity, due to factors such as particular infrastructure and a specialized-workforce ([57] Sternberg and Arndt, 2001; [53] Shefer and Frenkel, 2005).

References

1. Adler, P., Goldoftas, B. and Levine, D. (1997), "Ergonomics, employee involvement, and the Toyota production system", Industrial &Labor Relations Review, Vol. 50 No. 3, pp. 416-35.

2. AndersonConnolly, R., Grunberg, L., Greenberg, E. and Moore, S. (2002), "Is lean mean? Workplace transformation and employee well-being", Work, Employment &Society, Vol. 16 No. 3, pp. 387-411.

3. Angelis, J., Conti, R., Cooper, C. and Gill, C. (2006), "Building a high commitment lean production culture", working paper, Institute for Manufacturing, University of Cambridge, Cambridge.

4. Antony, J. (2009), "Six Sigma vs TQM: some perspectives from leading practitioners and academics", International Journal of Productivity and Performance Management, Vol. 58 No. 3, pp. 274-9.

5. Appelbaum, E., Bailey, T., Berg, P. and Kalleberg, A. (2000), Manufacturing Advantage, Cornell University, Ithaca, NY.

6. Arnheiter, E. and Maleyeff, J. (2005), "The integration of lean management and Six Sigma", The TQM Magazine, Vol. 17 No. 1, pp. 5-18.

7. Becheikh, N., Landry, R. and Amara, N. (2005), "Lessons from innovation empirical studies in the

manufacturing sector", Technovation, Vol. 10, pp. 1-21.
8. Berggren, C. (1993), "Lean production: the end of history?", Work, Employment &Society, Vol. 7, pp. 163-88.
9. Bhasin, S. and Burcher, P. (2006), "Lean viewed as a philosophy", Journal of Manufacturing Technology Management, Vol. 17 No. 1, pp. 56-72.
10. Bhuiyan, N. and Baghel, A. (2005), "An overview of continuous improvement", Management Decision, Vol. 43 No. 5, pp. 761-71.
11. Brunet, A. and New, S. (2003), "Kaizen in Japan", International Journal of Operations &Production Management, Vol. 23 No. 12, pp. 1426-46.
12. Bruno, R. and Jordan, L. (2002), "Lean production and the discourse of dissent", Working USA, Vol. 6 No. 1, pp. 108-34.
13. Buchanan, D. (1994), "Cellular manufacturing and the role of teams", in Storey, J. (Ed.), New Wave Manufacturing Strategy, Paul Chapman, London.
14. Carroll, L. (1871), Through the Looking Glass (And What Alice Found There), Macmillan, London.
15. Conti, R. and Gill, C. (1998), "Hypothesis creation and modelling in studies", International Journal of Employment Studies, Vol. 6 No. 1, pp. 149-73.
16. Conti, R. and Warner, M. (1997), "Technology, culture and craft", New Technology, Work and Employment, Vol. 12 No. 2, pp. 123-35.
17. Conti, R., Angelis, J., Cooper, C., Faragher, B. and Gill, C. (2006), "Lean production implementation and worker job stress", International Journal of Operations &Production Management, Vol. 26 No. 9, pp. 1013-38.
18. Cook, C. and Campbell, R. (1979), Quasi-experimentation, Houghton and Mifflin, Boston, MA.
19. Damanpour, F., Walker, R. and Avellaneda, C. (2009), "Combinative effects of innovation types and organizational performance", Journal of Management Studies, Vol. 46 No. 4, pp. 650-75.
20. Danford, A. (2003), "Workers, unions and the high performance workplace", Work, Employment &Society, Vol. 17 No. 3, pp. 569-73.
21. Delbridge, R. and Barton, H. (2002), "Organizing for continuous improvement", International Journal of Operations &Production Management, Vol. 22 No. 6, pp. 680-92.
22. Delbridge, R. and Turnbull, P. (1992), "Human resource maximisation", in Blyton, P. and Turnbull, P. (Eds), Reassessing Human Resource Management, Sage, Newbury Park, CA.
23. DeSantis, S. (1999), Life on the Line, Doubleday, New York, NY.
24. de Treville, S. and Antonakis, J. (2006), "Could lean production design be intrinsically motivating?", Journal of Operations Management, Vol. 24, pp. 99-123.
25. Fernandes, A., Cortes, M. and Oishi, J. (2000), "Innovation characteristics of small and medium sized technology-based firms in Sao Paulo, Brazil", paper presented at 4th International Conference on Technology Policy and Innovation, Curitiba, 28-31 August.
26. Fleury, A. and Fleury, M. (2003), "Competitive strategies and core competencies: perspectives for the internationalization of industry in Brazil", Integrated Manufacturing Systems, Vol. 14 No. 1, pp. 16-25.
27. Flor, M. and Oltra, M. (2004), "Identification of innovating firms through technological innovation indicators", Research Policy, Vol. 33, pp. 323-36.
28. Francois, J., Favre, F. and Negassi, S. (2002), "Competence and organization: two drivers of innovation", Economics of Innovation and New Technology, Vol. 11 No. 3, pp. 249-70.
29. Fullerton, R., McWatters, C. and Fawson, C. (2003), "An examination of the relationships between JIT and financial performance", Journal of Operations Management, Vol. 21, pp. 383-404.
30. Hair, J., Anderson, R., Tatham, R. and Black, W. (1995), Multivariate Data Analysis, Prentice-Hall, Englewood Cliffs, NJ.
31. Hoerl, R. and Gardner, M. (2010), "Lean Six Sigma, creativity, and innovation", International Journal of Lean Six Sigma, Vol. 1 No. 1, pp. 30-8.

32. Hulta, G., Hurleyb, R. and Knight, R. (2004), "Innovativeness: its antecedents and impact on business performance", Industrial Marketing Management, Vol. 33, pp. 429-38.
33. Kam, W., Kiese, M., Singh, A. and Wong, F. (2003), "The pattern of innovation in Singapore's manufacturing sector", Singapore Management Review, Vol. 25 No. 1, pp. 1-34.
34. Kleinknecht, A., Van Montfort, K. and Brouwer, E. (2002), "The non-trivial choice between innovation indicators", Economics of Innovation and New Technology, Vol. 11 No. 2, pp. 109-21.
35. Koenigsaecker, G. (2000), "Multiple sites multiply change and management challenges", Lean Manufacturing Advisor, June, pp. 3-7.
36. Lauder, H. (2001), "Innovation, skill diffusion, and social exclusion", in Brown, P., Green, A. and Lauder, H. (Eds), High Skills: Globalization, Competitiveness and Skill Formation, Oxford University, Oxford, pp. 161-203.
37. Lemos, C. (2000), "Innovation and industrial policies for small firms in Brazil", paper presented at 4th International Conference on Technology Policy and Innovation, Curitiba, 28-31 August.
38. Liker, J. and Hoseus, M. (2008), Toyota Culture, McGraw-Hill, New York, NY.
39. Lillrank, P. and Kano, N. (1989), Continuous Improvement: Quality Control Circles in Japanese Industry, Center for Japanese Studies, University of Michigan, Ann Arbor, MI.
40. Linder, J., Jarvenpaa, S. and Davenport, T. (2003), "Toward an innovation sourcing strategy", MIT Sloan Management Review, Summer, pp. 43-9.
41. Martinez-Ros, E. (1999), "Explaining the decisions to carry out product and process innovations", Journal of High Technology Management Research, Vol. 10 No. 2, pp. 223-42.
42. Mehri, D. (2006), "The darker side of lean: an insider's perspective of the realities of the Toyota production system", Academy of Management Perspectives, Vol. 20 No. 2, pp. 21-42.
43. Michie, J. and Sheehan, M. (2003), "Labour market deregulation, 'flexibility' and innovation", Cambridge Journal of Economics, Vol. 27 No. 1, pp. 123-43.
44. Midgley, D. (1995), "How can Australia improve?", Enterprising Nation: Renewing Australia's Managers to Meet the Challenges of the Asia-Pacific Century, AGPS, Canberra.
45. Millward, N., Bryson, A. and Forth, J. (2000), All Change at Work?, Routledge, London.
46. Pervaiz, K., Loh, A. and Zairi, M. (1999), "Cultures for continuous improvement and learning", Total Quality Management, Vol. 10 Nos 4/5, pp. 426-34.
47. Pil, F. and MacDuffie, J. (1996), "The adoption of high-involvement work practices", Industrial Relations, Vol. 35 No. 3, pp. 423-55.
48. Pot, F. (2011), "Workplace innovation for better jobs and performance", International Journal of Productivity and Performance Management, Vol. 60 No. 4, pp. 404-15.
49. Powell, T. (1995), "Total quality management as competitive advantage", Strategic Management Journal, Vol. 16, pp. 15-37.
50. Schonberger, R. (2007), "Japanese production management", Journal of Operations Management, Vol. 25, pp. 403-19.
51. Shah, R. and Ward, P. (2003), "Lean manufacturing: context, practice bundles, and performance", Journal of Operations Management, Vol. 21 No. 2, pp. 129-50.
52. Shah, R. and Ward, P. (2007), "Defining and developing measures of lean production", Journal of Operations Management, Vol. 25, pp. 785-805.
53. Shefer, D. and Frenkel, A. (2005), "R&D, firm size and innovation", Technovation, Vol. 25, pp. 25-32.
54. Singh, B., Garg, S., Sharma, S. and Grewal, C. (2010), "Lean implementation and its benefits to production industry", International Journal of Lean Six Sigma, Vol. 1 No. 2, pp. 157-68.
55. Snee, R. and Hoerl, R. (2007), "Integrating lean and Six Sigma: a holistic approach", Six Sigma Forum Magazine, Vol. 6 No. 3, pp. 15-21.
56. Snell, S. and Dean, J. (1993), "Integrated manufacturing and human resource management: a human

capital perspective", Academy of Management Journal, Vol. 35, pp. 467-504.
57. Sternberg, R. and Arndt, O. (2001), "The firm or the region: what determines the innovation behaviour of European firms?", Economic Geography, Vol. 77 No. 4, pp. 364-82.
58. Totterdill, P., Exton, O., Exton, R. and Sherrin, J. (2009), Workplace Innovation Policies in European Countries, UKWON, Nottingham.
59. Tremblay, D. and Rolland, D. (2000), "Labour regime and industrialisation in the knowledge economy", Labour and Management in Development, Vol. 1 No. 7, pp. 2-16.
60. Wallace, T. (2004), "Innovation and hybridization: managing the introduction of lean production into Volvo do Brazil", International Journal of Operations &Production Management, Vol. 24 No. 8, pp. 801-19.
61. Wu, C. and Chen, C. (2005), "An integrated structural model towards successful continuous improvement activity", Technovation, Vol. 20, pp. 1-11.
62. Cleveland, J., Stockdale, M. and Murphy, K. (2000), Women and Men in Organizations: Sex and Gender Issues at Work, Erlbaum Associates, Mahwah, NJ.
63. Forza, C. (1996), "Work organization in lean production and traditional plants: what are the differences?", International Journal of Operations &Production Management, Vol. 16 No. 2, pp. 42-62.
64. Womack, J., Jones, D. and Roos, D. (1990), The Machine that Changed the World, Rawson Associates, New York, NY.

Appendix

About the authors

Jannis Angelis is an Associate Professor of Operations Strategy at the Royal Institute of Technology. He holds a Diploma in Economics and Economic History (Lund and Stockholm Universities), a BA Philosophy (Stockholm University), a BSocSc Political Science (Uppsala and Stockholm Universities), a MSocSc International Relations (Stockholm University), a MA China Studies (SOAS), MPhil (Cambridge) and a PhD (Cambridge). His research and teaching is in operations strategy, behavioral operations, servitisation and operational risk. Jannis Angelis is the corresponding author and can be contacted at: jannis.angelis@indek.kth.se
Bruno Fernandes heads the Business Management Graduation Course at Positivo University (UnicenP) and lectures disciplines such as Strategic Planning and Human Resource Management. He holds a BA in Business Administration (University of Sao Paulo), a MSc in Business Administration (Federal University of Paraná), and a PhD in Business Administration (University of Sao Paulo). He also works as a Consultant in the field of strategic planning and human resource management.

AuthorAffiliation

Jannis Angelis, Industrial Economics &Management, Royal Institute of Technology, Stockholm, Sweden
Bruno Fernandes, Centro Universitario Positivo, Curitiba, Brazil

Subject: Innovations; Studies; Human resource management; Competition; Competitive advantage; Working conditions; Workforce; Workers; Product quality; Job rotation; Job enrichment; Six Sigma; Human error; Lean manufacturing;

Classification: 9130: Experimental/theoretical; 5320: Quality control

Publication title: International Journal of Lean Six Sigma

Volume: 3

Issue: 1

Pages: 74-84

Publication year: 2012

Publication date: 2012

Publisher: Emerald Group Publishing, Limited

Place of publication: Bingley

Country of publication: United Kingdom

Publication subject: Business And Economics--Management

ISSN: 20404166

Source type: Scholarly Journals

Language of publication: English

Document type: Feature

DOI: http://dx.doi.org/10.1108/20401461211223740

ProQuest document ID: 939248718

Document URL: http://search.proquest.com/docview/939248718?accountid=35812

Last updated: 2012-05-03

Database: ProQuest Central
