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Assessing the implementation and effectiveness of process management initiatives at technologically consistent firms

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Abstract

Purpose – A firm may be considered to be technologically consistent if its manufacturing technology is appropriate for its segment of its industry. The purpose of this research is to examine the relationship between technology consistency and both the rate of adoption and performance of six specific process management initiatives.

Design/methodology/approach – A mail survey was administered to CEO's at a total of 400 food processing, pharmaceutical/biotechnology, apparel and semiconductor firms in the USA. In total, 80 usable responses were returned, resulting in a response rate of 20 percent; 64 of these responses form the basis for the results presented in this paper.

Findings – The results indicate that there was a relationship between technology consistency and the adoption of only one of the six process management initiatives covered in this study. However, most of the respondents indicated that the initiatives that they had chosen were effective in meeting their needs.

Practical implications – This study concerns the adoption of six process management initiatives at firms in four industries. The results indicate that these initiatives appear to be just as relevant and beneficial to manufacturers regardless of the level of technology existent in their industry. However, examination of this phenomenon for a greater number of initiatives at a wider cross section of manufacturing industries is desirable.

Originality/value – This research is innovative in that it considers the impact of the implementation of various process management initiatives in the context of the technological consistency of the adopting firm. The reported results are relevant for small, moderate and large manufacturing concerns.

Keywords Process management, United States of America, Manufacturing systems

Paper type Research paper

Introduction

At this early stage of the twenty-first century, manufacturing competition continues to become more international in scope. Customers are more sophisticated and globally oriented, having virtually no restrictions or reluctance to search for better deals outside of their local, regional and national borders. Manufacturing responses to this increasingly competitive customer-oriented environment have been varied. Technological innovations such as: the introduction of new and advanced manufacturing technologies which

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engender greater uniformity and consistency in production; and the increased use of information technology (IT) to provide virtual and seamless links to share critical information with customers, suppliers and other key constituencies, have been prevalent. However, most organizations have found that improvements in technology alone are often not sufficient to achieve and sustain higher levels of competitiveness. Enhancements in other aspects of their operational systems, policies and procedures are required.

Over the past two decades, several process management initiatives have been developed to deal with manufacturing process issues that cannot be directly and totally addressed by hard technology. For example, initiatives such as total quality management (TQM) and ISO 9000 certification which are geared towards meeting or exceeding customer expectations rather than to merely conform to product specifications have evolved (Bayazit, 2003; Sebastianelli and Tamimi, 2003). Other initiatives, such as continuous improvement (CI) and lean manufacturing which aim to reduce all types of waste in the manufacturing system have also been adopted. Typically, the cost of implementing the management initiatives will be substantially less than the expenditures required for advanced manufacturing systems such as flexible manufacturing systems (FMS), computer integrated manufacturing (CIM) and enterprise resource planning (ERP) systems. As such, smaller and medium-sized manufacturers are often better positioned to afford an investment in a management initiative than in an advanced manufacturing technology. Furthermore, it has been suggested that manufacturers should consider investment in these initiatives instead of or prior to adopting the advanced manufacturing technologies (Beatty and Gordon, 1990).

Against this backdrop, this study investigates the adoption of six management initiatives by two groups of manufacturers that exhibit technology consistency – high-technology manufacturers in high-technology industries and moderate and low-technology manufacturers in industries that can be classified as predominantly moderate or low-technology users. It also examines the level of effectiveness of these process improvement initiatives in the chosen technology consistency groups. The conceptual framework for this exploratory study is shown in Figure 1. This figure illustrates that process management initiatives are, typically, adopted in response to competitive and operational challenges that are not directly addressed by manufacturing technology innovations. Once implemented, the output from these process management initiatives must be monitored to ensure that they are indeed addressing the strategic and operational challenges that sparked their implementation and that they contribute to the competitive advantage of the organization. With the ever changing competitive environment, the feedback from *competitive advantage* to *competitive and operational realities* is necessary to continuously assess the organization's competitive readiness especially in terms of the appropriateness of manufacturing and IT and the process management initiatives for any given industry.

The questions that guide this research are:

RQ1. Does the level of technology consistency in a firm influence the adoption of specific process management initiatives?

RQ2. Are there differences in the level of effectiveness of these initiatives that can be attributed to technology consistency?

Responses from a sample of 80 manufacturing organizations drawn from four industries were used to provide answers to these research questions. Of these organizations, 64 met

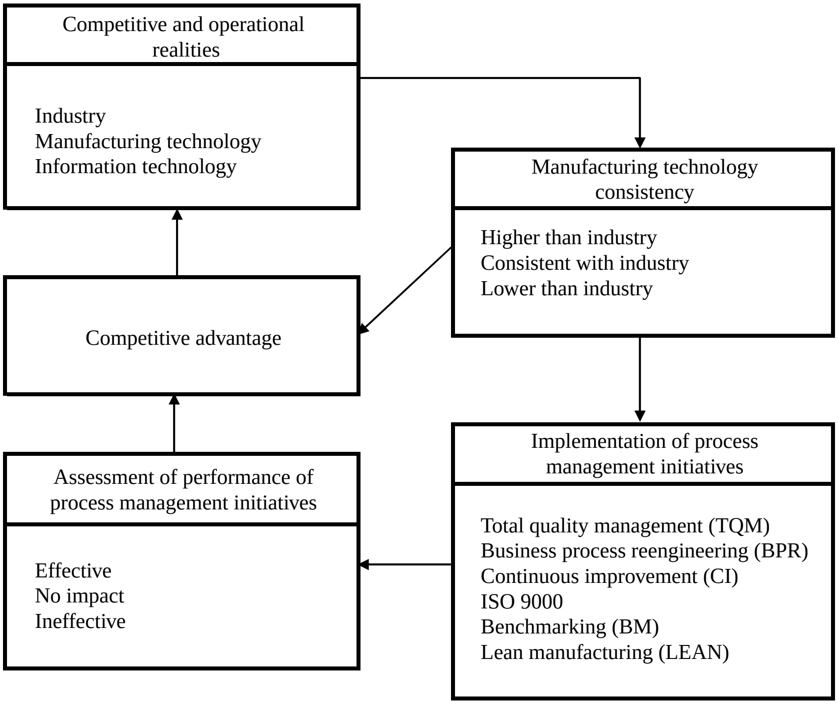

Figure 1.
Research framework

the requirements for inclusion in the two technology consistency groups covered by this study – high-technology users in high-technology industries and moderate to low-technology users in industries that utilize moderate and low manufacturing technology. The remaining 16 organizations were classified as technologically inconsistent having either significantly higher or lower levels of hard technology than the norm for their industry. This paper contributes to our understanding of the dispersion and effectiveness of these manufacturing improvements programs across firms with the two different technology consistency profiles.

Background

It is widely acknowledged that the adoption of advanced manufacturing technologies have helped to improve the quality of manufactured goods especially in terms of conformance to specifications (Bayazit, 2003). However, it is a widely held notion that other manufacturing practices are required to extract other manufacturing process benefits. The development of philosophies about quality and CI has, generally, been directed at manufacturing as opposed to service companies (Kundu and Vora, 2004). Furthermore, the improvement of production quality has been adjudged to be a long-term commitment to CI in every aspect of the production process (Talha, 2004). In this regard, the success of major Japanese companies since the 1980s is believed to be rooted in their long-term commitment to the improvement of quality. Following the success of Japanese manufacturers in world markets, Western manufacturers started to develop and implement quality and CI programs (Nilsson-Witell *et al.*, 2005).

Beginning in the early 1990s, the manufacturing industry as a whole took the initiative to restructure its basic methods of operation. Since then, many companies have adopted manufacturing improvement programs as a reaction to their challenging and constantly changing competitive environments (Lee, 2002). Programs such as TQM, benchmarking (BM), business process re-engineering (BPR), lean manufacturing, International Standard Organization Certification (ISO 9000) and CI have been implemented. Summary details of each of these practices are detailed in the following paragraphs.

Total quality management

TQM was one of the earliest approaches to improving the quality of manufactured products (Ehigie and McAndrew, 2005). TQM is an integrated management philosophy and set of practices that promotes an organization-wide focus on quality starting with top management, but involving workers at all levels of the organization. The major objective of TQM is the development of a business strategy that harnesses all of the company's resources to achieve world-class quality at reasonable costs (Pheng and Teo, 2004). Operationally, TQM combines a quality-oriented culture with intensive use of management and statistical tools to design and deliver quality products to customers (Daily and Bishop, 2003). Some of the benefits attributed to the implementation of TQM includes:

- improved quality of products and services;
- improvement in production performance; and
- cost reduction (Yang, 2006).

Continuous improvement

CI or *Kaizen* is a set of philosophies and programs that encourages improvement in the quality of manufactured products and delivered services (Briley *et al.*, 2000). The basic theme in CI is that managers should continuously search for and implement ways to improve quality and reduce waste (Reid and Koljonen, 2003). CI is often viewed as a prerequisite or constituent part of all the popular process improvement approaches such as TQM and lean manufacturing (Sahin, 2000). The primary drivers for CI strategies are the reduction of the triad of waste through the cutback of:

- valueless time;
- valueless activity; and
- valueless variance in a process (Tersine, 2004).

CI can be achieved using a number of tools and techniques dedicated to searching for sources of waste, sources of variation and sources of other operational problems and then finding ways to mitigate or minimize them (Bhuiyan and Baghel, 2005). CI methods have been widely adopted and are credited with providing an important component of increased company competitiveness (Hyland *et al.*, 2003).

Business process reengineering

Hammer (1990) defines BPR as:

> [...] the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service, and speed.

He suggested that the major challenge for managers was not the use of technology to eliminate work but rather the obliteration of non-value adding work. BPR is a continuum of change initiatives with varying degrees of radicalness, typically supported by IT systems. The major objective of BPR is the delivery of superior performance standards through establishing process sustainable capability (Al-Mashari and Zairi, 2000). The overall theme of BPR is the quest for improvement through quick and substantial gains in organizational performance by starting from scratch in designing or redesigning the core business process (Attaran and Wood, 1999).

ISO 9000

ISO 9000 is a series of international standards dealing with quality systems that can be used for external quality assurances purposes. This set of standards was promulgated by the International Organization for Standardization in 1987 and was patterned after the UK Standard BS 5750. Revised and updated standards were developed in 1994, 2000 and 2008. ISO 9000 standards serve as the basis for establishing quality management systems providing guidelines on how to develop systems for managing quality products or services at manufacturing and service firms (Guler *et al.*, 2002; Simmons and White, 1999). ISO 9000 standards are basically management tools that are geared towards the systematization and formalization of processes and tasks in order to obtain uniformity in the product and consistency of procedures (Viadiu *et al.*, 2006; Chow-Chua *et al.*, 2003). Achievement of ISO 9000 certification signifies that the organization's processes are capable of producing products or providing services with constant or consistent quality (Singels *et al.*, 2001).

Benchmarking

Benchmarking seeks out, internalizes and improves upon competitors' best-practice capabilities (Drew, 1997). Benchmarking is a process by which an organization evaluates various aspects of its operational processes in relation to best practices, typically but not necessarily, within its own manufacturing sector (Voss *et al.*, 1997; Griffin, 1997). Moreover, Yasin (2002) indicates that the scope of benchmarking has expanded to include strategies and systems. Where significant deficiencies exist, the organization can develop plans to move towards desirable best practices (Balm, 1996). Although benchmarking can be viewed as a one-time event, organizations are likely to garner more benefits if they are willing to review the operations of best practice companies on a continuous basis. Voss *et al.* (1997) link benchmarking to the identification and adoption of improved operational practices and an increased understanding of competitive positioning. It has also been suggested that benchmarking can actually generate broadly based change in organizational thinking and action (Drew, 1997).

Lean manufacturing

Lean manufacturing is the systematic removal of waste by all members of the organization from all areas of the value stream (Worley and Doolen, 2006). Waste is anything other than the minimum amount of equipment, materials, parts and working time that are absolutely essential to enable production. The waste concept includes all possible defective work/activities, not only defective products (Taj and Berro, 2006). Operationally, lean manufacturing places significant focus on collaborating with suppliers, requiring a high degree of communication and interaction between manufacturers and first-tier suppliers.

It also emphasizes improved relationships between management, customers and employees. In addition, lean manufacturing places a major emphasis on sustainable improvements through the promotion of maximum visibility of information across the organization to effect improvements in planning and real-time scheduling (Tinham, 2005; Klier, 1995).

Reports on the successes and failures of many of these process management initiatives have been recorded in academic journals and the popular press. In seeking to answer the question about why firms that are applying identical initiatives are achieving different results, authors suggest that many failures result from a misfit between the initiative and the operational realities of the organization especially as it relates to people-centered issues. For example, it has been suggested that placing too much emphasis on implementing the technical aspects of the initiative and too little emphasis on the fundamental people changes that are needed to effectively support the initiative can result in failure (Dreilinger, 1994). Ironically, similar people-centered reasons are advanced for the failure to successfully implement advanced manufacturing technologies such as ERP, CIM and FMS (Baldwin and Lin, 2002; Small *et al.*, 2009; Udo and Ehie, 1996; Upton, 1995).

Previous studies have focused almost exclusively on the implementation process or implementation factors (including human factors) surrounding the adoption of either hard manufacturing technologies or management initiatives. Very little research effort has been expended on examining the relationship between the level of hard technology existent in an organization and the types of management initiatives that it has adopted. This research attempts to address this shortcoming. Since competing organizations may have dissimilar manufacturing technologies, rather than focusing on individual technologies this research will focus on the technological consistency of the organizations. In this regard, an organization will be deemed to be technologically consistent if its level of manufacturing technology is similar to the level of technology predominantly being used in its industry. Three technological consistency groups will be defined: high tech – high-tech firms operating in high-tech industries, moderate tech – moderate-tech firms operating in moderate-tech industries and low tech – low-tech firms operating in low-tech industries. We will examine the differences, if any, between these groups in:

- their adoption rates for the management initiatives; and
- the level of effectiveness of their adoptions.

Research methodology

The purpose of this study is to determine to what extent each of the technologically consistent groups covered in our survey had adopted each of these process management practices and then to discern how effective these practices have been in meeting the objectives set out by management for their adoption. Four manufacturing industries were chosen: apparel, food processing, pharmaceutical and biotechnology, and semiconductors. These choices represent a mix of both traditional and growing manufacturing sectors. The selected industries are also diverse in terms of variations in the types of operations and types of technology being used.

The food processing and kindred products industry in the USA accounts for more than 14 percent of the total value of manufacturing sector output and although many manufacturers in this sector use moderate technology the industry has recently become very responsive to the adoption of new technologies (Morrison, 1997). The semiconductor industry is very competitive and subject to constant process innovations, especially by smaller firms and latecomers (Almeida and Kogut, 1997; Cho *et al.*, 1998). This presents a major challenge for incumbents who often have to depend on innovative management practices to hold back market share challenges (Iansiti, 2000). The pharmaceutical and biotechnology industries are concentrated in North America and Europe. It has been suggested, however, that US producers have the advantage of significantly larger investments in the medical science research base than their European counterparts, resulting in a higher rate of startups in the USA (Madhok and Osegowitsch, 2000).

All of the industries are global in scope. For example, although the apparel industry in the USA remains strong and vibrant, competition from and strategic alliances with producers in the pacific-rim and the Caribbean are growing. The level of technology in the semiconductor and pharmaceutical/biotechnology industries is comparatively higher than that being utilized in the food processing and apparel industries.

Instrument

The survey instrument used in this research was developed after an extensive literature review of the components, benefits and problems associated with the use of each of the six process management improvement practices. The instrument consisted of some questions requiring Likert-scaled responses, in addition to several questions which allowed open-ended and categorical responses. A group of manufacturing practitioners and academicians examined the instrument for face validity and clarity. They suggested a few changes which were incorporated into the survey instrument that was eventually administered.

Sample

The research instrument was mailed to CEOs at a random sample of 400 apparel, food processing, semiconductor and pharmaceutical/biotechnology manufacturing organizations in the USA. Several national manufacturing directories were used to develop the sample frame. The sample size was limited by budget constraints. The cover letter accompanying the survey contained a note assuring respondents about the confidentiality of the information that they were being asked to provide. In addition, the letter addressed the nature of the study, and provided brief descriptions of the process management improvement initiatives. The CEO's were asked to either complete the survey or pass it on to the officer in the company that would have oversight of or primary responsibility for implementing the types of improvement initiatives mentioned in the survey. A total of 80 usable responses were returned, resulting in a response rate of 20 percent. In total, 64 of these responses form the basis for the results presented in this paper.

Results

Profile of respondents

The majority of respondents (40 percent) were from the food processing industry, while 25 percent were from the apparel industry. The average CEO tenure at these firms was 13.68 years with no significant differences in CEO tenure that could be attributed to the type of industry. On average, the primary respondents to the survey had spent 17.65 years in their respective industries and had been in executive positions for an average of

13.10 years. Respondents were asked to indicate the level of technology in their industry and in their firms. Crosstabulation of the results from these two questions revealed that 27 of the respondents could be classified as high-technology firms operating in high-technology industries. Another 37 of the respondents were classified as moderate to low-technology firms operating in industry segments that were classified as predominantly low or moderate technology users. Hence, these two technology consistency groups will be used in this study.

Demographic information on the CEO's and other respondents from these 64 organizations is presented in Table I. All of the semiconductor producers and 75 percent of the pharmaceutical/biotechnology firms were classified as high-technology producers in high-technology industries. Conversely, 92.0 and 84.6 percent, respectively, of the food processing and apparel producers were classified as moderate or low-technology producers in moderate to low-technology industries. While the high-technology producers across all industries were large and moderate size companies, the moderate and low-tech producers would better be classified as small and medium enterprises.

Implementation of management process initiatives

Respondents were asked to indicate whether or not they had implemented each of the six process management initiatives covered in this study and if not, whether they planned to implement in the future. Table II shows the extent of implementation of the process management improvement initiatives among the 64 respondents in our study. In general, high-technology respondents had lower implementation rates than low-technology respondents for all of the initiatives. They had adopted CI at a higher rate than any other improvement initiative with a CI adoption rate of 72 percent but the adoption rates for all other initiatives were between 19.23 and 48 percent. In contrast, the low-technology respondents while having a higher adoption rate of 75.68 for CI, had adoption rates of between 50 and 58.33 percent for TQM, BPR, CI and benchmarking. The low-technology group had the lowest adoption rate for ISO 9000 with a rate 32.43 percent.

With respect to the individual process management initiatives, CI was the most popular initiative with 74.19 percent of all respondents reporting that they had already implemented the technology and another 14.52 percent indicating their intent to adopt the technology. ISO 9000 had the lowest adoption rates across all respondents with 32.43 percent for the moderate to low-technology group and only 19.23 percent for the

Table I. Profile of sample by industry

				Statistics for firms with high/low technology profiles					
				Mean CEO tenure		Respondent profile			
Industry	No. of high and low tech. firms in sample	High tech.	Low tech.	Years	s.e.	Years as executive	s.e.	Years in industry	s.e.
Semiconductor	14	14	0	12.57	1.86	9.79	1.26	14.64	1.83
Food processing	25	2	23	14.64	2.19	14.68	1.56	21.44	1.97
Apparel	13	2	11	11.62	1.91	10.31	1.64	13.00	1.92
Pharmaceutical/biotech	12	9	3	12.25	3.32	12.00	2.27	16.92	2.84
Total	64	27	37						
Average				13.14		12.22		17.39	

Table II.
Process management implementation status and effectiveness by level of technology consistency in the firm

Type of process management initiative	Technology consistency	Implementation status: Never plan to implement n	%	Plan to implement n	%	Already implemented n	%	χ^2-value p-value	Level of effectiveness n	Mean	s.e.	t-value	p-value
TQM	High tech. firm in high tech. industry	11	44.00	2	8.00	12	48.00	1.4729	12	3.92	0.193	1.059	0.298
	Mod/low tech. firm in mod/low tech. industry	11	29.73	5	13.51	21	56.76	0.4788	21	4.10	0.066		
	Total	22	35.48	7	11.29	33	53.23						
BPR	High tech. firm in high tech. industry	9	37.50	4	16.67	11	45.83	0.9223	11	4.18	0.182	1.698	0.101
	Mod/low tech. firm in mod/low tech. industry	9	26.47	8	23.53	17	50.00	0.6305	17	3.88	0.081		
	Total	18	31.03	12	20.69	28	48.28						
CI	High tech. firm in high tech. industry	3	12.00	4	16.00	18	72.00	0.1094	18	4.22	0.129	1.021	0.313
	Mod/low tech. firm in mod/low tech. industry	4	10.81	5	13.51	28	75.68	0.9468	28	4.04	0.120		
	Total	7	11.29	9	14.52	46	74.19						
BM	High tech. firm in high tech. industry	13	54.17	1	4.17	10	41.67	9.1122	10	4.10	0.100	1.106	0.278
	Mod/low tech. firm in mod/low tech. industry	7	19.44	8	22.22	21	58.33	0.0105	21	3.86	0.143		
	Total	20	33.33	9	15.00	31	51.67						
ISO 9000	High tech. firm in high tech. industry	14	53.85	7	26.92	5	19.23	1.5077	5	4.60	0.400	1.745	0.101
	Mod/low tech. firm in mod/low tech. industry	18	48.65	7	18.92	12	32.43	0.4706	12	3.92	0.193		
	Total	32	50.79	14	22.22	17	26.98						
Lean	High tech. firm in high tech. industry	15	62.50	1	4.17	8	33.33	4.8600	8	4.12	0.227	0.197	0.846
	Mod/low tech. firm in mod/low tech. industry	10	33.33	4	13.33	16	53.33	0.0880	16	4.06	0.193		
	Total	25	46.30	5	9.26	24	44.44						

high-technology group. It is interesting to note, however, that another 27 percent of the high-technology respondents indicated an interest in pursuing ISO 9000 certification. Overall, evidence from our sample indicates that there was no significant relationship between technology consistency and the adoption of process management initiatives for five of the six initiatives. The only exception was for BM, where the low-technology group had a higher adoption rate and the high-technology group had a lower adoption rate than would be expected under a hypothesis of independence (χ^2-value = 9.1122 and p-value = 0.0105).

CI (72 percent), TQM (48.0 percent) and BPR (45.83 percent) were the most popular initiatives adopted by the high-technology group. CI (75.68 percent), BM (58.33 percent) and TQM (56.76 percent) were the most popular initiatives adopted by the low-technology group. In assessing the level of implementation of these initiatives across the two technology consistency groups, it is also important to determine if a particular group adopts more initiatives than others. We performed an independent samples t-test for equality of the mean number of initiatives across the two groups. The results are presented in Table III. While the mean number of adoptions in the high-technology group (2.37) was lower than for the moderate/low-technology group (3.11), the difference was not found to be statistically significant. Hence, it was concluded that differences in technology consistency did not contribute to explaining differences in the average number of initiatives adopted.

Effectiveness of the implementations

Given that many of these initiatives provide similar benefits, it is often difficult if not impossible for an independent observer, after the fact, to ascribe a particular benefit to a particular initiative. For example, if a company that has implemented TQM and lean manufacturing reports a reduction in waste it will not be clear to what extent this improvement was due to TQM or lean manufacturing activities. On the assumption that management will more likely be able to tie outcomes to particular activities in each implementation, we asked the respondents who had implemented one or more initiatives to provide an assessment of the outcomes from each initiative that they had adopted on a five-point Likert-type scale anchored at one end by a score of 1 for a response of "very0 ineffective" and at the other end by a score of 5 for a response of "very effective." The midpoint, with a score of 3 represented a neutral outcome that was labeled, "neither effective nor ineffective."

The results on the mean level of effectiveness of the initiatives are also presented in Table II. The average effectiveness scores across all initiatives ranged from 3.86 to 4.60. With a score of 5 being indicative of very effective performance this suggests that, on average, firms that implemented each of the initiatives concluded that they had performed

Technology consistency	Number of initiatives implemented 6	5	4	3	2	1	0	n	Mean	s.e.	t-value	p-value
High tech. firm in high tech. industry	2	0	5	6	5	4	5	27	2.370	0.33	−1.667	0.101
Mod/low tech. firm in mod/low tech. industry	2	7	9	6	5	4	4	37	3.108	0.29		
Total	4	7	14	12	10	8	9	64				

Table III. Frequency of implementation of process management initiatives by technology consistency effectively. The high-technology group had achieved higher average levels of effectiveness for all management initiatives except TQM. It should be noted, however, that the *t*-test results for differences in the level of effectiveness between the two groups revealed no statistically significant differences in effectiveness for any of the individual initiatives.

Further analysis of the effectiveness results was obtained by recoding the effectiveness variable into the three groups "effective or very effective," "neither effective nor ineffective" and "ineffective or very ineffective" as reported in Table IV. These results indicate that there were no instances where the high-technology consistency group considered the adoption of any of the initiatives to be ineffective or very ineffective. Indeed, the percentage of these firms that reported effective or very effective results ranged from a low of 69.2 percent for TQM to 100 percent for benchmarking. In contrast while 100 percent of the TQM adopters from the moderate to low-technology grouping reported effective or very effective results only 65.2 percent of the benchmarking adopters in this group reported effective or very effective results. Overall, the results were mixed with greater percentages of the adopters from the high-technology group reporting effective results for CI, BM and ISO 9000. Greater percentages of the adopters from the moderate and low-technology group indicated effective results for TQM and BPR. However, the reader should again be cautioned that on average, there were no statistically significant differences in the level of average effectiveness across technology consistency groups for any of the management initiatives.

Findings and conclusion

The purpose of this paper was to seek answers to two basic questions:

1. Does the level of technology consistency in a firm influence the adoption of specific process management initiatives?
2. Are there differences in the level of effectiveness of these initiatives that can be attributed to technology consistency?

Some conclusions from the analysis of our derived sample follow:

- There were some differences in the types of initiatives being adopted based on technology consistency. For example, high-technology respondents lagged behind their counterparts in the adoption of each of the six initiatives. However, the difference in adoption rates was only significant for BM. Further analysis of this phenomenon revealed that the majority of respondents from the semiconductor

		Process management initiative					
Technology consistency	Level of effectiveness	TQM (%)	BPR (%)	CI (%)	BM (%)	ISO (%)	Lean (%)
High tech. firm in high tech. industry	Effective or very effective	69.2	76.9	94.4	100.0	80.0	87.5
	Neither effective nor ineffective	30.8	23.1	5.6	0.0	20.0	12.5
	Ineffective or very ineffective	0.0	0.0	0.0	0.0	0.0	0.0
	Respondents	13	13	18	11	5	8
Mod/low tech. firm in mod/low tech. industry	Effective or very effective	100.0	83.3	86.2	65.2	75.0	87.5
	Neither effective nor ineffective	0.0	16.7	10.3	34.8	25.0	6.3
	Ineffective or very ineffective	0.0	0.0	3.5	0.0	0.0	6.2
	Respondents	19	18	29	23	12	16

Table IV.
Level of effectiveness of process management initiatives by technology consistency

industry who were all classified into the high-technology group had eschewed the adoption of benchmarking. Given the high level of competition in the semiconductor industry and hence the natural reluctance to share information that might give a competitor even a slight advantage, it is not surprising that benchmarking is not a popular initiative among organizations in the semiconductor industry. This is in stark contrast to the pharmaceutical and biotechnology firms where six of the eight adopters of benchmarking were classified into the high-technology group.

- While some respondents across the two technology consistency groups have signaled their intent to adopt some of these initiatives in the future, there are still a significant number of responding firms that have no intention of ever implementing some of the initiatives. Such decisions may be based on legitimate questions and concerns about the actual usefulness of the technology in a given industry. However, the fact that over 48 percent of the respondents in each technology consistency classification do not intend to pursue ISO certification may be a cause for some concern. It does appear, however, that CI can be considered to be a technology that may be germane to most industries since almost 89 percent of all respondents have either adopted this technology or intend to adopt it in the future.
- Once a company implemented an initiative, it appears that it had a reasonable chance of achieving an effective outcome. They were, however, a minority of firms that had neutral or negative perceptions about the effectiveness of these initiatives particularly for TQM among the high-technology users and BM for the moderate/low-technology users. While assessing the reasons for failures to achieve effective results is beyond the scope of this paper, it is plausible that typical implementation problems such as inadequate organizational or personnel preparation for the implementation or attempting to implement a technology that has a misfit with the organizational norms may have played a part in the implementation failing to produce effective results.

This paper addressed the issue about whether or not there was a critical link between technology consistency and the adoption of process management initiatives. Our results suggest that there are very few differences in adoption and effectiveness of the surveyed management initiatives that can be attributed to differences in the level of hard technology that exists in a firm. Moreover, our respondents across both technology groupings indicated a relatively high level of effectiveness for each of the initiatives. Therefore, it is plausible to assume that these management initiatives are indeed providing benefits that go beyond those obtainable from hard technology alone.

This study concerns the adoption of process management initiatives at firms in only four industries. Our results indicate that these process management initiatives appear to be just as relevant and beneficial to manufacturers regardless of the level of technology existent in their industry. While the results of the study are consistent with expectations, examination of this phenomenon at a wider cross section of manufacturing industries is desirable. Furthermore, the results obtained in this study can be used to help develop testable hypotheses.

References

Al-Mashari, M. and Zairi, M. (2000), "Revisiting BPR: a holistic review of practice and development", *Business Process Management Journal*, Vol. 6 No. 1, pp. 10-42.

Almeida, P. and Kogut, B. (1997), "The exploration of technological diversity and geographic localization in innovation: start-up firms in the semiconductor industry", *Small Business Economics*, Vol. 9 No. 1, pp. 21-31.

Attaran, M. and Wood, G.G. (1999), "How to succeed at reengineering", *Management Decision*, Vol. 37 Nos 9/10, pp. 752-7.

Baldwin, J. and Lin, Z. (2002), "Impediments to advanced technology adoption for Canadian manufacturers", *Research Policy*, Vol. 31 No. 1, pp. 1-18.

Balm, G.J. (1996), "Benchmarking and gap analysis: what is the next milestone?", *Benchmarking: An International Journal*, Vol. 3 No. 4, pp. 28-33.

Bayazit, O. (2003), "Total quality management (TQM) practices in Turkish manufacturing organizations", *TQM Magazine*, Vol. 15 No. 5, pp. 345-50.

Beatty, C. and Gordon, J.R.M. (1990), "Advanced manufacturing technology: making it happen", *Business Quarterly*, Vol. 54 No. 4, pp. 46-53.

Bhuiyan, N. and Baghel, A. (2005), "An overview of continuous improvement: from the past to the present", *Management Decision*, Vol. 43 No. 5.

Briley, R., Fowler, P. and Teel, J. (2000), "Continuous improvement", *Journal of Environmental Health*, Vol. 62 No. 6, pp. 39-40.

Cho, D-S., Kim, D-J. and Rhee, D.K. (1998), "Latecomer strategies: evidence from the semiconductor industry in Japan and Korea", *Organization Science*, Vol. 9 No. 4, pp. 489-505.

Chow-Chua, C., Goh, M. and Wan, T.B. (2003), "Does ISO 9000 certification improve business performance?", *International Journal of Quality & Reliability Management*, Vol. 20 No. 8, pp. 936-53.

Daily, B.F. and Bishop, J.W. (2003), "TQM workforce factors and employee involvement: the pivotal role of teamwork", *Journal of Managerial Issues*, Vol. 15 No. 4, pp. 393-412.

Dreilinger, C. (1994), "Why management fads fizzle", *Business Horizons*, November-December, pp. 11-15.

Drew, S.A.W. (1997), "From knowledge to action: the impact of benchmarking on organizational performance", *Long Range Planning*, Vol. 30 No. 3, pp. 427-41.

Ehigie, B.O. and McAndrew, E.B. (2005), "Innovation, diffusion and adoption of total quality management (TQM)", *Management Decision*, Vol. 43 No. 6, pp. 925-40.

Griffin, A. (1997), "PDMA results on new product development best practices: updating trends and benchmarking best practices", *Journal of Product Innovation Management*, Vol. 14, pp. 429-58.

Guler, I., Guillen, M.F. and MacPherson, J.M. (2002), "Global competition, institutions, and the diffusion of organizational practices: the international spread of ISO 9000 quality certificates", *Administrative Science Quarterly*, Vol. 47 No. 2, pp. 207-32.

Hammer, M. (1990), "Re-engineering work: don't automate, obliterate", *Harvard Business Review*, July-August, pp. 104-12.

Hyland, P.W., Soosay, C. and Sloan, T.R. (2003), "Continuous improvement and learning in the supply chain", *International Journal of Physical Distribution & Logistics Management*, Vol. 33 No. 4, pp. 316-35.

Iansiti, M. (2000), "How the incumbent can win: managing technological transitions in the semiconductor industry", *Management Science*, Vol. 46 No. 2, pp. 169-85.

Klier, T.H. (1995), "The geography of lean manufacturing: recent evidence from the US auto industry", *Economic Perspectives*, Federal Reserve Bank of Chicago, Chicago, IL, November.

Kundu, S.C. and Vora, J.A. (2004), “Creating a talented workforce for delivering service quality”, *Human Resource Planning*, Vol. 27 No. 2, pp. 40-51.

Lee, P.M. (2002), “Sustaining business excellence through a framework of best practices in TQM”, *TQM Magazine*, Vol. 14 No. 3, pp. 142-9.

Madhok, A. and Osegowitsch, T. (2000), “The international biotechnology industry: a dynamic capabilities perspective”, *Journal of International Business Studies*, Vol. 31 No. 2, pp. 325-36.

Morrison, C.J. (1997), “Structural change, capital investment and productivity in the food processing industry”, *American Journal of Agricultural Economics*, February, pp. 110-25.

Nilsson-Witell, L., Antoni, M. and Dahlgaard, J.J. (2005), “Continuous improvement in product development: improvement programs and quality principles”, *International Journal of Quality & Reliability Management*, Vol. 22 No. 8, pp. 753-68.

Pheng, L.S. and Teo, J.A. (2004), “Implementing total quality management in construction firms”, *Journal of Management in Engineering*, Vol. 20 No. 1, pp. 8-15.

Reid, R.A. and Koljonen, E.L. (2003), “Co-existence of paradigms as a manufacturing management strategy”, *Journal of Materials Processing Technology*, Vol. 138 Nos 1-3, pp. 9-15.

Sahin, F. (2000), “Manufacturing competitiveness: different systems to achieve the same results”, *Production and Inventory Management Journal*, Vol. 41 No. 1, pp. 56-65.

Sebastianelli, R. and Tamimi, N. (2003), “Understanding the obstacles to TQM success”, *Quality Management Journal*, Vol. 10 No. 3, pp. 45-56.

Simmons, B.L. and White, M.A. (1999), “The relationship between ISO 9000 and business performance: does registration really matter?”, *Journal of Managerial Issues*, Vol. 11 No. 3, pp. 330-43.

Singels, J., Ruel, G. and van de Water, H. (2001), “ISO 9000 series: certification and performance”, *International Journal of Quality & Reliability Management*, Vol. 18 No. 1, pp. 62-75.

Small, M., Yasin, M.M. and Czuchry, A. (2009), “Enhancing competitiveness through effective adoption and utilization of advanced manufacturing technology: implications and lessons learned”, *International Journal of Business and Systems Research*, Vol. 3 No. 1, pp. 34-57.

Taj, S. and Berro, L. (2006), “Application of constrained management and lean manufacturing in developing best practices for productivity improvement in an auto-assembly plant”, *International Journal of Productivity and Performance Management*, Vol. 55 Nos 3/4, pp. 332-45.

Talha, M. (2004), “Total quality management (TQM): an overview”, *The Bottom Line: Managing Library Finances*, Vol. 17 No. 1, pp. 15-19.

Tersine, R.J. (2004), “The primary drivers for continuous improvement: the reduction of the triad of waste”, *Journal of Managerial Issues*, available at: www.highbeam.com/doc/1G1-115036681.html (accessed September, 2008).

Tinham, B. (2005), “Taking lean thinking into your supply chains”, *Manufacturing Computer Solutions*, Vol. 11 No. 5, pp. 16-19.

Udo, G.J. and Ehie, I.C. (1996), “Critical success factors for advanced manufacturing systems”, *Computers & Industrial Engineering*, Vol. 31 Nos 1-2, pp. 91-4.

Upton, D. (1995), “What really makes factories flexible”, *Harvard Business Review*, Vol. 74 No. 4, pp. 74-84.

Viadiu, F.M., Fa, M.C. and Saizarbitoria, I.A. (2006), “ISO 9000 and ISO 14000 standards: an international diffusion model”, *International Journal of Operations & Production Management*, Vol. 26 No. 2, pp. 141-65.

Voss, C.A., Åhlström, P. and Blackmon, K. (1997), "Benchmarking and operational performance: some empirical results", *International Journal of Operations & Production Management*, Vol. 7 No. 10, pp. 1046-58.

Worley, J.M. and Doolen, T.L. (2006), "The role of communication and management support in a lean manufacturing implementation", *Management Decision*, Vol. 44 No. 2, pp. 228-45.

Yang, C.C. (2006), "The impact of human resource management practices on the implementation of total quality management: an empirical study on high-tech firms", *TQM Magazine*, Vol. 18 No. 2, pp. 162-73.

Yasin, M.M. (2002), "The theory and practice of benchmarking: then and now", *Benchmarking: An International Journal*, Vol. 9 No. 3, pp. 217-43.

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