The relationships between shop floor management and QCCs to support Kaizen

Abstract

Purpose - The purpose of this study is to develop and redefine the 'classic' roles of shop floor management and Quality Control Cycles (QCCs) in Kaizen. In specific, it aims to examine the linkage between shop floor management and QCCs, and test the relationships among shop floor management, QCCs and long-term Kaizen improvement outcomes.
Design/methodology/approach – This study employs qualitative method by using a questionnaire to obtain data from 371 respondents in nine Sino-Japanese automotive joint-ventures. The data are analysed with the method of canonical correlation approach.
Findings – The study identifies important factors to assist the adoption of shop floor management and QCCs for Kaizen. The analysis on the survey indicates that not all the shop floor management tools could help to identify improvement opportunities. QCCs are effective in addressing large problems and challenging current policies in companies, however, they have low impacts on individual learning.
Research limitations/implications – The data of this study comes from nine Sino- Japanese automotive joint ventures. Therefore, the sample selection is limited in these companies. The findings are able to be applied for improving the similar problems which identified in this study.
Practical implications – The study has the following practical implications, include the first one which is small shop floor problems can be identified and rapid solved continuously at source by shop floor management. The second one is QCCs, or other similar group-based improvement approaches take long to be fully addressed and implemented. Thirdly, practical solutions can be achieved from small and gradual changes, and they can prevent the results backsliding to the pre-improvement stage. Finally, QCCs are hardly to achieve a better improvement alone. It requires other Kaizen approaches to support.
Originality/value – This study is probably the first to explore and investigate the implementation of the four building block tools of shop floor management in real business practise, and more specific the first to discuss the relationship among shop floor management, QCCs and long-term improvement outcomes based on empirical data from Sino-Japanese automotive joint-ventures.

Keywords: Kaizen, Shop floor management, QCCs

1. Introduction

In order to constantly meet new production goals and sharpen competitive advantages, focusing on improvement continuously is becoming more important (Fynes *et al.*, 2015). The Japanese Kaizen (Imai, 1986) is perhaps one of the best known tools which offers a cumulative, on-going improvement (Bessant & Francis, 1999) and sustained incremental changes (Bateman, 2005). It is derived from the unique Japanese culture (Liker & Hoseus, 2008; Recht & Wilderom, 1998) and grounded on the Japanese philosophy, awareness and knowledge about changes (Yoneyama, 2007). It is also a unifying and company-wide strategy, a management

philosophy (Suárez-Barraza *et al.*, 2011), and the basis for long-term incremental process improvement (Berger, 1997; Bhuiyan & Baghel, 2005).

Although Kaizen is not new, its implementation has been proved to be easier said than done (Dahlgaard-Park *et al.*, 2013; Sanchez & Blanco, 2014). It requires employee involvement, knowledge management and organisational culture change in driving and supporting the improvement (Bessant & Caffyn, 1997; Magnier-Watanabe, 2011). Therefore, it is difficult to sustain it in the long-term (Buchanan *et al.*, 2005; Marin-Garcia *et al.*, 2008), especially for deeper and more fundamental changes (Done *et al.*, 2011). The group-based Quality Control Circles (QCCs) is one of the most commonly used Kaizen approaches for sustaining long-term outcomes (Suárez-Barraza *et al.*, 2011). Prior studies have also suggested that the successful implementation of Kaizen needs to be originated from shop floor (Gapp *et al.*, 2008), supported by shop floor management (Brunet & New, 2003; Handyside, 1997; Ma *et al.*, 2017) and relay on a practice that can constantly bring issues up (Medinilla, 2014).

Shop floor management contains many tools (Feld, 2001), but many existing studies have devoted to describe their importance (Bessant et al., 1994; Brunet & New, 2003) rather than critically evaluate their Kaizen impacts. This study aims to develop a better understanding of the shop floor management. It uses a canonical correlation analysis to examine their support for QCCs in Kaizen. The findings should fulfil the needs of both academics and practitioners in the existing body of knowledge. They should provide some useful guidelines and methods that can be used by companies which wish to adopt and implement shop floor management and Kaizen. The objectives of this study are:

- to define the roles of shop floor management and QCCs in Kaizen;
- to examine the linkage between shop floor management and QCCs;
- to test the relationship between QCCs and long-term improvement outcomes.

The study is conducted based upon a survey of shop floor staff in nine Sino-Japanese automotive joint ventures. The questionnaire is developed based on previous research to measure the implementation of the shop floor management tools (Rahman, 2001; Terziovski & Sohal, 2000), the QCCs (Lillrank & Kano, 1989) and the improvement outcomes (Doolen *et al.*, 2008; Farris *et al.*, 2009). The study conducts canonical correlation analyses (CCA) to investigate the relationships between shop floor management, QCCs and the long-term improvement outcomes.

The study is organised as follows. Section 2 reviews the literature on Kaizen, QCCs and the four building block shop floor management tools. Sections 3 presents the research setting and methodology. Section 4 explains the steps involved in data collection, analysis and results. Finally, in Section 5 the conclusions and recommendations for future research are presented.

2. Literature review

2.1Implementation of Kaizen

Kaizen (Japanese for continuous improvement) (Lillrank & Kano, 1989) is "an ongoing improvement" (Imai, 1986, p.3), "[a] continual quest to make things better in products, processes, customer service, etc." (Bessant & Caffyn, 1997, p.7). The implementation of Kaizen aims to create a non-stop effort and incremental value in business (Singh & Singh, 2015), improve the process (by utilisation of worker's capabilities) (Hicks *et al.*, 2015) and eliminate Muda (Japanese for waste or non-value added work) (Chen & Shady, 2010). Kaizen is also one of the underlying principles of Lean Production (Brunet & New, 2003) and to support TQM (Suarez-Barraza *et al.*, 2009). Kaizen may apply the four-step PDCA (Plan-Do-Check-Act) problem-solving cycle to: (1) identify problems; (2) develop good solutions; (3) implement those solutions; and (4) standardise the results for future continuous improvement (Berger, 1997).

According to Imai (1986), improvement activities can be classified as being continuous or

one-off improvements. Kaizen is continuous and process-driven. It focuses on the course of the implementation (Suárez-Barraza & Lingham, 2008) and aims to produce cumulative results from an on-going and incremental change process (Ma *et al.*, 2017). The emphasis is on the involvement of everyone (Bhuiyan & Baghel, 2005) to stimulate improvement ideas (Distelhorst *et al.*, 2016) and sustain improvement outcomes (Rapp & Eklund, 2007) using common sense (Nihon HR Kyōkai, 1995) and low-cost methods (Bond, 1999) over a prolonged period (Laraia *et al.*, 1999). In this sense, although each small change in Kaizen "may not have a measurable impact, the cumulative effect can be quite profound" (Choi & Liker, 1995, p.590), "which in the end produce important and lasting results" (Marin-Garcia *et al.*, 2008, p.57).

In comparisons, the one-off improvement is goals/results-driven, and it is called Kaikaku in Japanese (Imai, 1986). It is characterised by its discontinuous, innovative and dramatic results (Choi, 1995). Its implementation may require large financial investment (Terziovski & Sohal, 2000) hence, generate large but infrequent gains (Bicheno, 2001) and hard to sustain in the long-term (Suárez-Barraza *et al.*, 2011). Such a discontinuous improvement activity may be easy to adopt, but the result could easily erode back to the pre-improvement level (Bateman & David, 2002; Bateman & Rich, 2003). Therefore, the high cost, short-term Kaikaku could easily jeopardise the whole improvement process.

2.2 Quality Control Circles (QCCs) in Kaizen

Kaizen can be implemented in different ways (Lillrank *et al.*, 2001; Singh & Singh, 2014) and QCCs are one of the most effective hence commonly adopted approaches (Masaki, 2006; Suárez-Barraza *et al.*, 2011). QCCs (or just QCs) are group-based improvement activities (Suárez-Barraza & Lingham, 2008) that include a small number (e.g., between 5 to 15) of volunteer employees (Lillrank & Kano, 1989) to meet regularly (e.g., once per week) (Sillince *et al.*, 1996) to identify, investigate, analyse and resolve problems (by using quality control tools) in workplace (Ishikawa, 1986). Applying QCCs does not always require large capital investments (Imai, 1986), but requires a high human component (Bessant & Caffyn, 1997). Mobilisation of employees to participate for quality is a foundation, and it requires strong support from upper management (Lillrank, 1995). By using team building and team efforts, QCCs, operate as part of a company-wide improvement approach, can effectively identify problems, share ideas and expertise (Ghosh & Song, 1991).

Structurally, QCCs are self-governing, self-motivated (Bessant *et al.*, 1994) and applied by cross-functional teams (Lillrank & Kano, 1989), but simultaneously supported by line supervisors work towards improvement objectives established by top management (Lillrank *et al.*, 2001; Milakovich, 2006). They are largely used for department-wide/company-wide improvements (Harrington, 2006). Furthermore, Kaizen is "not of the breakthrough variety, but incremental in nature" (Bessant & Caffyn, 1997, p.10). It is "a habitual way of life in the organisation" (Handyside, 1997, p.14). Thus, QCCs have the advantage of encouraging individuals' willingness to participate in the improvements (van Dijk & van Den Ende, 2002) and focusing on group decisions that based on individuals' implementable (hands-on) experience (Handyside, 1997). With this regard, QCCs aim to investigate the problems exist in operations of workforce (Kumar, 2010), stimulate the enthusiasm of workforce attending in improvement, and collate their improvement ideas into the organisational transformation so that successful and visible outcomes lead on to motivation for further improvements (Bessant *et al.*, 1994). Therefore, QCCs can be an effective approach for delivering Kaizen in organisations (Ma *et al.*, 2013).

2.3 Shop Floor Management

Kaizen is underpinned by shop floor management (Bateman & Brander, 2000). Shop floor (or Gemba in Japanese) is a place where workforce adds value to a business (Handyside, 1997;

Ohno, 1988b), hence it is one of the most important areas within an organisation (Ma, 2014). Imai (1986, p.5) defined shop floor management as "activities directed toward maintaining current technological, managerial, and operating standards". Therefore, shop floor management provides the basis for maintaining production standards (Handyside, 1997). In fact, shop floor is also the first port of call if a problem (i.e., abnormality) arises (Macduffie, 1997), hence, managing shop floor also needs to identify 'root cause' of problems and propose solutions (Ghalayini *et al.*, 1997). Different with upper level management, the performance in shop floor management not only improves continuously, but also strives for workers' satisfaction in improvements (Shingo & Bodek, 1988; Singh & Singh, 2009). Therefore, shop floor management also refers to a system which enables workforce to gather their wisdom to solve work-related problems (Suárez-Barraza *et al.*, 2012), motive them to accept Kaizen (Brunet & New, 2003) and support continuous improvement (Daniels, 1995). This is in line with the studies by Hirano (1988), Bateman & Brander (2000), and Modarress *et al.*(2005), shop floor management is a common approach to standardise production processes, reduce variation, identify problems at source and provide improvement.

Shop floor management contains many tools (Handyside, 1997), and many of them are also used as the foundation to implement Lean Production (Herron, 2006; Huda, 1992; Pavnaskar *et al.*, 2003), Lean transformation (Bicheno & Holweg, 2009; Feld, 2001) and support continuous improvement (Hyland *et al.*, 2000; Moore, 2007). Among these tools, four are mentioned many times and developed as the 'building blocks' (Figure 1) (Bateman, 2005; Bateman & Brander, 2000; Suzaki, 1993; Toshiko & Shook, 2007). They are 5S practice (sorting, streamlining, systematic cleaning, standardisation and sustaining) to ensure the shop floor is well-organised to create the best possible working environment (Osada, 1991); waste reduction to minimise or eliminate non-value added work (Ohno, 1988a); visual management to use visual communication devices for planning, communicating information and monitoring performance (Liker, 2004) and standard operation procedures to set rules and methods for producing quality products safely and inexpensively (Tamura, 2006).

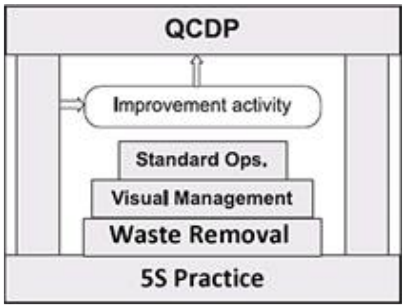

Figure 1. The building block shop floor management tools (Bateman & Brander, 2000, p242)

Different from the model for Lean transformation (Bicheno & Holweg, 2009) and the model for rapid shop floor innovation (Suárez-Barraza *et al.*, 2012), Bateman's (2000) building block model (Figure 1) constitutes a system for providing guidance on incremental, continuous improvement measured by quality, cost, development and partnership (QCDP). The development of the building block tools decomposes the shop floor management to a systematic procedure (Bateman and David, 2002), and benefits shop floor with a visual process of maintenance and improvement, which include both analytical and empirical approaches (Márquez *et al.*, 2009). The application of these tools requires large shop floor data to identify problems and develop solutions. Therefore, improvements on any building block tools can influence shop floor performance, or the addition and removal of any building block can cause the failing of shop floor management and QCCs. This aspect has not been fully discussed in recent studies, especially missed an analyse on shop floor management supporting the

improvement of QCCs.

3. Methodology

3.1 Theoretical models

Based on the underlying characteristics of the shop floor management and QCCs, two theoretical models are developed to support the study (Figure 2 and 3). They represent the relationships between the four building block shop floor management tools, QCCs and the improvement outcomes.

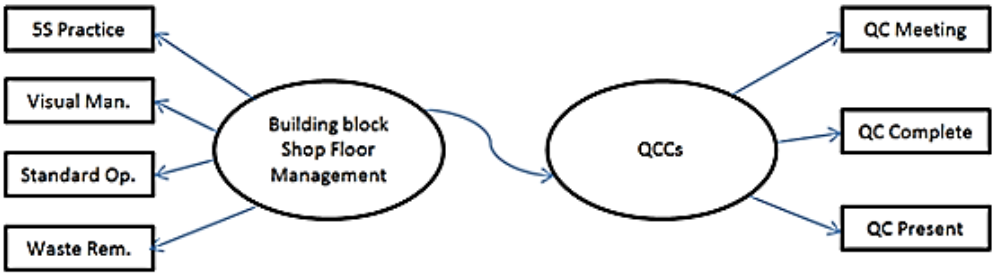

Figure 2. The proposed theoretical model of building block shop floor management tools and QCCs

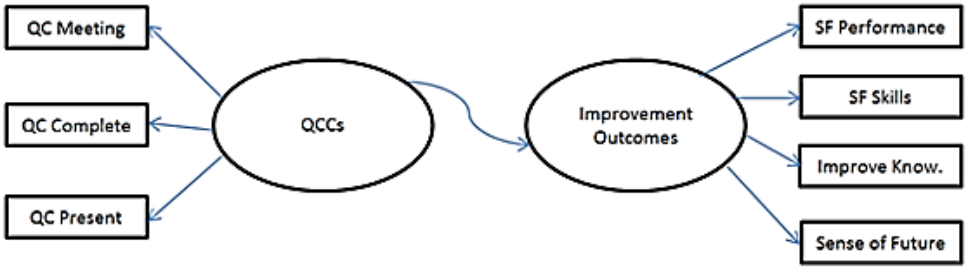

Figure 3. The proposed theoretical model of QCCs and long-term improvement outcomes

3.2 Questionnaire and measures

According CINET (2002), Terziovski and Sohal (2000), one of the most commonly used measures for the utilisation of the shop floor management tools is their frequency of use, hence a set of 16 seven-point Likert-type scale questions, ranging from 1 (Never) to 7 (Always), is used as an indicator to reveal the utilisation of the four building block tools (a higher score indicates greater utilisation of the tool).

For the implementation of QCCs, previous research has suggested that their successful implementations are based on few factors (Miina, 2012; Seyedhosseini *et al.*, 2011), including the number of ideas have been submitted (Karlsson & Ahlstrom, 1996), implemented (Baides & Moyano–Fuentes, 2012; Winfield, 1994), and the time improvement participants spent in developing ideas (Marin-Garcia *et al.*, 2008). This study followed Ma *et al.* (2014) that the number of QCC meetings is a proxy to measure the quantity of QCCs, whilst the number of completed and presented QCCs is a proxy for quality of QCCs.

For the improvement outcomes, the study by Doolen et al. (2003) identified that the KSA (knowledge, skills and attitude) framework from the industrial/organisational (I/O) psychology literature (Muchinsky, 2000) can be used to measure the long-term improvement outcomes, such as of shop floor performance, skills, improvement knowledge and attitude (sense of future participation). These measurement items are empirically validated by subsequent studies (Doolen *et al.*, 2008; Farris *et al.*, 2009) and adopted by related research to measure continuous improvement outcomes (Glover, 2010; Glover *et al.*, 2014). A set of 17 seven-point Likert-type scale questions, ranging from 1 (Strongly disagree) to 7 (Strongly agree), is used as an indicator to evaluate the change in the improvement outcomes (a higher score indicates stronger positive impacts). Table 1 shows the summary of the questionnaire and example items.

Table 1 Summary of questionnaire and example items

Variable	*Example items*	*No. of items*
Building block tools	• Implementation of 5S - (sorting) • Implementation of 5S – (systematic cleaning) • Implementation of waste removal – (Waste identification)	16
QCCs implementation	• In general, how many times do you meet every month for QCC? • How many times did you present in the meetings?	4
Improvement outcomes	• My improvement activities have a positive effect on the shop floor area • This shop floor area is improved measurably as a result of my improvement activities • My improvement activities have improved the performance of this shop floor area	17

3.3 Sample

The data of this study are collected from nine leading Sino-Japanese automotive joint ventures in Guangzhou, Southern China. They are chosen based on location, accessibility and researchers-to-company relationships. Despite the non-random nature of the organisations selection, the individual participants are randomly sampled within each organisation. Several boundaries and criteria are also applied to increase the reliability and validity of the study construct and the measurement of data quality (Eisenhardt, 1989; Yin, 2003). The boundaries and criteria are: these organisations are Sino-Japanese joint ventures; they have adopted and implemented QCCs and shop floor management; and most of their employees have had experience of participating in Kaizen.

The questionnaire are translated into Chinese using Usunier's 'mixed back-translation technique' (Usunier, 1998) and pilot-tested to 12 shop floor workers. The final version of the questionnaire is distributed to 900 employees. In total, 371 valid samples are returned, giving a response rate of 41.2%.

3.4 Statistical tests

Descriptive statistics are presented as follows. The respondents reported a wide variation in the utilisation of the four shop floor management tools. From Table 2, the responses spanned from 1.4 (below "use very rarely") to 7 ("always use") on a 7-point Likert-type scale. Nevertheless, the majority of the respondents rated it above the midpoint of 4 ("use occasionally"). In addition, the mean responses of 5S Practice and Standard Operations were above 5 ("use frequently"). Thus, the result can imply a high frequency of utilisation of the four shop floor management tools for the majority of respondents.

Table 2 Descriptive statistics of sample respondents (sample size=371)

	Mean	*Standard Deviation*	*Minimum*	*Maximum*
5S Practice	5.35	.77	1.40	7.00
Visual Man.	4.52	.87	1.75	6.50
Standard Op.	5.02	.92	2.00	6.75
Waste Rem.	4.24	1.02	1.00	7.00
QC Meeting	2.16	.83	1.00	4.00
QC completed	1.69	1.00	0	4
QC Presented	.63	.68	0	4
SF Performance	5.65	.78	2.00	7.00
SF Skills	5.17	.95	2.00	7.00
Improve Know.	5.28	.80	2.50	7.00
Sense of Future	5.59	.79	1.50	7.00

For the of QCC improvements, a large proportion of the respondents reported that they usually meet at least twice per month. However, for their implementation, although most respondents have completed more than one QCC improvements on an annual basis, just over half of them are accepted and presented to the company.

As also shown in Table 2, for all improvement outcomes, although the responses spanned from 1.50 (below "disagree") to 7 ("strongly agree") on a 7-point Likert-type scale, the majority of respondents reported positive perceptions and they selected 5 ("slightly agree") or above. These results suggest that, for the participating organisations, most, although not all, of the shop floor respondents viewed the improvement outcomes positively.

Non-response bias is also tested. This study follows Pearl and Fairley (1985) and assumes that the respondents who have significant experience (say, ≥5 years) are more likely to respond. F-statistic (F-test) is employed to compare the respondents with limited improvement experience (<5 years, n=100) and those with significant experience (≥5 years, n=271) in terms of their improvement quality and quantity. F-statistic is the ratio of two sample variances (Singh & Singh, 2012). It provides a measure of the probability that they have differences and the threshold value (*p*) below 0.05 can indicate the differences are significant with a 95% confidence interval. Table 3 shows that all of the significance values are above the threshold value of 0.05. This indicates that the differences between these two groups of respondents are not statistically significant. It, therefore suggests that non-response bias is not a problem with regard to the data collected in this study.

Table 3 F-test to compare respondents based on improvement experience (sample size=371)

Characteristics of the respondents	F-statistics	Significance *p*
QC_Meet_Times	1.005	0.317
QC_Meet_Length	0.012	0.911
QC completed	1.591	0.208
QC Presented	0.008	0.985

Two Canonical correlation analyses (CCA) are conducted to investigate the proposed relationships. CCA is a technique to test the significance of the correlations between one set of multiple dependent variables and a second set of multiple independent variables (Hair *et al.*, 2010). It can also determine which variables are the most important (canonical loading > 0.30) in a given pair of canonical variates (Harlow, 2005).

4. Results and implications

4.1 Shop floor management and QCCs

Table 4 shows that the canonical correlation between the 4 shop floor management tools and QCCs implementing measures is statistically significant. The results also indicate that the 5S Practice and Standard Operations are significantly and positively correlated with QCC Meeting Time and QCC Presentation. These may appear to disagree with some of the previous studies (Bateman & Brander, 2000), as not all of the four building block tools support the QCCs implementation.

Table 4 Canonical loadings for shop floor management tools and QCC implementation

	First Canonical Pair
Canonical Correlation	0.283
Level of Significance	<0.001
Wilks' Lambda	0.890
Appox. F Value	3.600
Loading of Shop Floor Tools on Their Canonical Variate	

5S Practice	0.634
Visual Management	0.167
Standard Operations	0.645
Waste Removal	0.161
Loading of QCC Implementation on Their Canonical Variate	
QCC Meeting Time	0.666
QCC complete	0.294
QCC Present	0.436

The results indicate that only two of the building block shop floor management tools (i.e., 5S Practice and Standard Operations) provided an environment to encourage the implementation of QCCs and support Kaizen implementation. The implementation of these tools can create a framework for participants to better identify improvement opportunities and construct improvement ideas. This confirms the results of previous studies that these tools are important for supporting continuous improvement (Handyside, 1997; Hino, 2006). Therefore, these shop floor management tools may have been employed as a "common approach" to solve shop floor problems (Bateman & Brander, 2000).

The results also imply that QCCs can be used to address problems relating to the implementation of Standard Operation procedures. As defined in previous research (St. Pierre *et al.*, 2011), Standard Operation procedures are organisation-wide detailed written instructions developed for achieving the uniformity of the performance of some specific functions. Therefore, making changes in these procedures may need to be carried out after conducting careful statistical analysis and should also be approved by senior management. Thus, they need to be improved by a formal improvement body like QCCs which are led by shop floor supervisors and involve middle or senior managers. The results also suggest that QCCs have capabilities to address large problems, challenge company policies, develop and implement improvement for making wider-ranging changes.

The results may provide following new insights into the relationship between the shop floor management tools and QCCs. In the current study, the implementation of the four shop floor tools is measured by their frequency of use, and the implementation of QCCs is measured by their quality and quantity. As such, it appears that only the utilisation of 5S practice and standard operation procedures can provide a framework for longer QCCs meeting and more improvement presentations. This may indicate that not all of the shop floor tools could help to uncover large problems or identify improvement opportunities, and hence participants may require more time/longer meeting time in QCCs to response to the identified problems.

4.2 QCCs and improvement outcomes

Table 5 shows that there are two significant canonical correlations between the QCCs implementing measures and improvement outcomes. For the first canonical pair, QCC Meeting Time and QCC Presentation are significantly and positively correlated with Shop Floor Performance and Improvement Knowledge. Where for the second canonical pair, QCC Meeting Time and QCC Presentation are also significantly and positively correlated with Shop Floor Performance but negatively correlated with Improvement Knowledge. These findings are in line with some previous studies in showing that QCCs could involve short-term holistic shop floor changes and enhance improvement participants' problem-solving capabilities (Liker & Hoseus, 2008), but not necessarily affect their senses of future improvement participations (Marin-Garcia *et al.*, 2008).

Table 5 Canonical loadings for QCC implementation and improvement outcomes

	First Canonical Pair	**Second Canonical Pair**
Canonical Correlation	0.412	0.246
Level of Significance	< 0.001	0.001
Wilks' Lambda	0.778	0.937
Appox. F Value	8.011	4.047
Loading of QCC Implementation on Their Canonical Variate		
QCC Meeting Time	0.412	-0.645
QCC complete	0.100	-0.485
QCC Present	0.809	0.648
Loading of Improvement Outcomes on Their Canonical Variate		
Shop Floor Performance	0.363	-0.699
Shop Floor Skills	-0.026	-0.487
Improvement Knowledge	0.877	0.668
Sense of Future Participation	0.094	0.006

For the improvement outcome measure: shop floor performance is used to measure the perceived overall impact on the shop floor area (Doolen *et al.*, 2003). Therefore, from the results, implementing QCCs are important for improving shop floor performance. These findings confirm some previous studies (Liker & Hoseus, 2008; Terziovski, 2002) that QCCs could involve holistic changes, and they could generate profound outcomes on the shop floor. Therefore, the outcomes are always achieved immediately and may easy to be noticed (Marin-Garcia *et al.*, 2008).

Outcomes that relate to the technical aspects of problem-solving are measured using shop floor skills and improvement knowledge. These measure the extent of the change arising from being involved in the improvement activities. The results suggest that the QCCs only had impacts on improvement knowledge but not on shop floor skills. This is inconsistent with some previous studies which suggest that QCCs should enhance both problem-solving and team development capabilities (Gabriel, 2003; Lillrank *et al.*, 2001; Suárez-Barraza & Lingham, 2008). Many previous studies have indicated shop floor skills are hands-on knowledge which is a learn-by-doing process (Neagoe & Marascu_Klein, 2009; Schuring, 1996). This process is based on the use of participants' shop floor experience, and skills to identify problems and develop solutions (Ma, 2014). Therefore, the results imply that QCCs could only promote collaboration and facilitate team-based learning, but would have less impact on the individual. Other Kaizen approach, such as Teian suggestions (i.e., personal improvements) are needed as a complement to support group-based improvements (Rapp & Eklund, 2007).

5. Conclusion and recommendations

This study investigates the relationships between the four building block shop floor management tools, QCCs and the long-term improvement outcomes. The results have profound implications for both practice and theory. The study has identified some important factors to assist the adoption of shop floor management and QCCs for Kaizen.

This study has three theoretical contributions: a) developing two generic models for examining the relationships between shop floor management and QCCs; b) providing statistical evidence to determine the relationships; and c) confirming that implementing shop floor management could provide a framework to maintain shop floor orders and discipline, although not all of the shop floor management tools can lead to the outcomes of continuous

improvement. Practical implications are also threefold: a) the shop floor management tools should be implemented on a continuous and regularly basis to rectify small shop floor problems, eliminate waste and reduce variations; b) QCCs should be applied for holistic changes to generate profound outcomes; however, c) more efforts may be needed to motivate employees to also participate in other types of improvement approaches, as QCCs have low abilities to promote individual learning.

Although this study has not found significant evidence to prove all of the assumed relationships, this does not preclude them from having some other impacts or indirect relationship. It is possible that some unmeasured building block shop floor tools had been used by the respondents for implementing continuous improvement. One possible reason is that the chosen measures did not fully capture all the building block shop floor management tools and their sequence of implementation in the case companies. In particular, using only a clear-cut way of measuring the use of shop floor management tools could simply have missed out some other potential building block tools, as the actual ways of shop floor management may vary from one company to another. To test this proposition, a holistic set of company-specified scales with sequence of implementation could be used in future research to measure the implementation of the shop floor management tools.

In sum, this study has some important implications: firstly, small shop floor problems need to be identified and solved quickly and continuously at source by shop floor management; secondly, group-based improvement methods like QCCs may take long to fully address and implement; thirdly, only the innovative and large-scale improvements that based on the results of small and gradual changes are able to provide practical solutions and prevent the results backsliding to the pre-improvement stage; and finally, QCCs may be implemented with other Kaizen approaches, e.g., Teian or personally suggestion approach. Future study may use other statistical methods such as structural equation modelling to test these relationships. A larger sample size would help to generalise the results.

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