Quality improvement supported by the 5S, an empirical case study of Mexican organisations

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Global markets are continuously changing and demanding customised, low cost, and high quality products and services; organisations that offer these products and services are dealing with these issues on a daily basis to stay competitive. Among the quality tools used to achieve competitive advantage, the 5S practice plays an important role facilitating the introduction and development of other quality and continuous improvement methods and techniques. We present results of an empirical study applied to some Mexican organisations with the aim of understanding their implementation experience, empirical relationships, and ongoing challenges associated with the 5S practice.

\textbf{Keywords:} 5S; 5S principles; 5S practice; quality improvement

1. Introduction

Competitive strategy is about being different; it means delivering a unique mix of values. Some of the major competitive dimensions that form the competitive position of an organisation are: cost, quality, customisation, delivery speed, and delivery reliability (Stevenson 2009). To stay competitive, organisations deal with these dimensions on a daily basis in offering a mix of products and services. Among the quality tools used to achieve competitive advantage, the 5S methodologies play an important role facilitating the introduction and development of other improvement philosophies (Ho 1999a, Liker 2004, Liker and Hoseus 2008). In a study of the Toyota Production System (TPS), Liker (2004) explains:

‘On a daily basis, engineers, skilled workers, quality specialists, vendors, team leaders, and...operators are all involved in continuous problem solving and improvement.... One lean tool that facilitates this teamwork is called 5S.’ (p. 36).

In Toyota, 5S sets the standard for the first step of problem solving, and it is the foundation for setting a proper work environment for all team members. Liker and Hoseus (2008) explain ‘Often someone from Toyota will go to a supplier and ask them to do 5S’ (p. 161). Ansari and Modarress (1997) discuss that Boeing pursues 5S as a...
world-class strategy. Boeing uses 5S as a tool for safety process improvement. Osada (1991) defines 5S as the baseline for a total quality environment.

Melton (2005) considers 5S as one of the tools and techniques within the ‘lean’ system. In a recent study of ‘pull’ and ‘lean’ systems, Hopp and Spearman (2004) explain:

‘According to Ohno (1998), the Toyota Production System rests on... (1) “autonomation” and (2) just-in-time production (JIT)... [TPS] also promoted “5S,”... aimed at achieving Autonomation and Visual Control.’ (p. 134).

For recent discussions on 5S and other tools and techniques within the ‘lean’ system, also refer to Browning and Heath (2009), Julien and Tjahjono (2009), Suarez-Barraza et al. (2009), and Thomas et al. (2009). In TPS, 5S is a tool to help make problems visible and can be part of the process of visual control of a well-planned lean system (Hirano 1995); visual control systems are about improving value added flow (Liker 2004). In a recent study of 15 manufacturing companies plus Nissan Motor Manufacturing UK Ltd (NMUK) as identified exemplar, Herron and Braiden (2006) consider 5S as one of the most relevant tools for implementing lean manufacturing. Schonberger (2007) identifies 5S as a component of TPS, and TPS a constituent part of Japanese production management (JPM). Van Iwaarden et al. (2008) contemplate 5S as a prerequisite for implementation of six sigma. Durmusoglu and Nomak (2005) establish that cellular manufacturing systems require flexible labour, and in order to enhance the people involvement, training in 5S is required. Kulak et al. (2005) conclude that ‘One of the major reasons for failure in the lean journey is the lack of institutionalization of 5S activities... One way to insure the success of lean transition is to ensure the workers participation in 5S activities’ (p. 775). Ahuja and Khamba (2008) identify 5S as a tool to analyse and solve the equipment and process related problems which arise in total productive maintenance (TPM). Ahmed et al. (2005) present a systematic implementation-framework coupled with TPM, ecology oriented manufacturing (EOM) and 5S; and shows that the model enhances the accomplishment of organisational objectives beyond the equipment maintenance-subsystem goals and add an array of benefits in the value chain across the various functional areas. Farris et al. (2009) consider 5S as a critical success factor for human resources outcomes in kaizen. Bullington (2003) and Scherrer-Rathje et al. (2009) emphasise on 5S as a lean tool both at shop floor and supply chain. Finally, Pil and Fujimoto (2007) discuss 5S as a DNA part of TPS.

The 5S practice is broadly used by manufacturing and service industries. Osada (1991) developed the original concept of the 5S practice; he considers that this is valuable practice for everyday life, 5S engages improvement activities in any environment, including homes, schools and workplaces. The name of the practice arises from five Japanese words that constitute the implementation phases. Seiri, seiton, seiso, seiketsu, and shitsuke are the original words and have been referred to as the five keys to a total quality environment, when translated to English they mean organisation, neatness, cleanliness, standardisation, and discipline, respectively. Several English translations of these Japanese words have been used in the literature by different authors (Warwood and Knowles 2004). In an analysis of application of the 5S concept as a ‘business improvement strategy’ in Japan, the UK and the US, Kobayashi et al. (2008) explain:

‘Literature suggests... two major frameworks for understanding and applying 5S... one proposed by Osada (1989, 1991), the other by Hirano (1995, 1996)... 5S is widely understood in Japan as a method of improving lifestyle (Osada 1989). In Japan, the practice of 5S is... a group of... activities that shape basic morality and ethics in the workplace, at school, and in the home (De Mente 1994).’ (pp. 245–246).
Hirano (1995, 1996), on the other hand, develops an alternative version of 5S during the same period as Osada, but with a more practical focus. Hirano (1996, p. 28) explains the significance of 5S as a tool for ‘corporate survival’ that enables just-in-time (JIT) production, rather than a way of guiding action. In summary, Osada views 5S as a strategy for organisational development, learning and change, whereas Hirano (1996) considers 5S as an industrial formula that differentiates a company from its competitors (Kobayashi et al. 2008). In a study of implementing 5S within a Japanese context as an ‘integrated management system’ Gapp et al. (2008) emphasise ‘A primary objective of practising 5S is to maximise the level of workplace health and safety in conjunction with increased productivity’ (p. 567).

Since its introduction, the 5S practice has been identified as a foundation to more rigorous quality improvement programmes (Ho and Fung 1994, 1995; Ho 1997, 1998, 1999a, 1999c). The 5S practice has been used to improve the physical environment and the industrial management processes as well. Brown (1996) cites ‘The incorporation of 5S…efforts into many quality programs symbolizes the increasing interest in physical attributes of the operating environment and their effects on employee safety, health and well-being’ (p. 160).

The 5S implementation requires commitment from both the top management and everyone in the organisation. The 5S practice requires significant investment in time and if properly implemented it has a huge impact on organisational performance (Ho 1999a; Liker 2004; Liker and Hoseus 2008). Ho (1999b) has developed an auditing system to measure the performance of 5S practices. In a recent study, Pheng (2001) presents an integration and correspondence of the 5S principles with ISO 9001:2000. Ho (2006) introduces the 5S practice as the first step to achieve TQM, ISO 9000, ISO 14001, and OHSAS 18001; additionally, Ho (2006) shows a joined 5S and six sigma application. Furthermore, 5S has been identified as part of the green productivity techniques (Johannson 2006, pp. 3–20).

There is no doubt about the benefits of the 5S in practice. However, there is not any extensive research about its implementation, and obstacles to keep the 5S practice going everyday. Liker (2004) emphasised that:

‘the fifth S, sustain, is arguably the hardest…. This effort requires a combination of committed management, proper training, and a culture that makes sustaining improvement a habitual behaviour from the shop floor to management.’ (p. 36).

There are only a few studies about industry experience of the 5S practice. Ho et al. (1995) surveyed 3000 companies in the UK and 200 in Japan, the results proved that 5S is an important base for TQM success. Ho and Cicmil (1996) presented two cases where the 5S practice showed to be a good basis for quality circle activities. Ho (1999a) presented a 5S auditing approach in 10 examples from the manufacturing and service sector. Nwabueze (2001) identified leadership style to implement 5S as support to a TQM model in the UK National Health Service. Warwood and Knowles (2004) applied a survey to 26 manufacturing and services organisations in the UK, where just 15 of them were practising the 5S principles.

Implementation cases in standalone industries are as follows. Hubbard (1999) describes implementation in a manufacturing company where 5S is a foundation for continuous improvement. O’hEocha (2000) presents a case in a manufacturing company where the 5S practice is seen as a technique to improve environmental performance and health and safety standards. Pheng and Khoo (2001) show how the 5S principles were applied to
enhance team performance setting management and staff personnel in a common organisational objective. Bryar and Walsh (2002) present a case in a management consultancy and training business; they report that the 5S practice was part of the strategic business plan. Melton (2005) discuss benefits of lean, in particular 5S, in process industry. Kumar et al. (2007) perform an implementation study in a manufacturing company operating in India with the aim to analyse the financial performance of the 5S. Pal and Byrom (2003) analyse application of 5S practice in retail operations. Several 5S successful applications have recently been reported in health care (Printezis and Gopalakrishnan 2007, Withanachchi et al. 2007, Gabow et al. 2008). In a recent paper, Herron and Braiden (2006) develop a model to direct and generate productivity improvement in a group of manufacturing companies, and consider 5S as some of the most relevant tools for implementing lean manufacturing.

Quality systems have different interpretation, implementation, and performance; they vary from country to country, from community to community, or even from organisational culture to organisational culture (Maull et al. 2001). Recent studies (e.g., Gapp et al. 2008, Kobayashi et al. 2008) show the different ways in which the 5S practice has been interpreted and implemented in different national cultures. ‘Japanese organisations see 5S as having two components, the first being a high level management and organisational system that has a complex and philosophical meaning... The second is the provision of a management portfolio of tools’ (Gapp et al. 2008, p. 576). Western cultures, specifically the UK and the US, see 5S as a technique or tool (Kobayashi et al. 2008, p. 260). The aim of this research is to understand the interpretation, implementation experience, empirical relationships, and ongoing challenges of the 5S practice in a small cluster of manufacturing and service organisations located in Hidalgo State, Mexico. The surveyed organisations, immersed in a Western culture, play an incipient role in one of the most important global markets defined by the North American Free Trade Agreement (NAFTA).

In the next section we present the research methodology, and then we present research questions as 19 hypotheses with their corresponding analyses and discussion. Finally, we present conclusions and future research.

2. Methodology


We created a 33 question survey (Appendix 1) with 14 questions aimed to gather general information and 19 questions related to the 5S practice. A total of 13 factors (Appendix 2) were extracted and studied from the 5S related questions; for instance questions 28, 29 and 30 are similar, therefore only question 30 was considered as a research factor.

The survey was answered through a personal interview with either the quality manager or general manager and a few employees. The survey instrument was pretested by two
volunteer managers (they did not participate in the final survey). The interview survey was applied in 20 well established business organisations in Hidalgo State, Mexico. The target of this research was a group of 66 registered organisations, and favourable responses were received from a total of 20 of them resulting in an overall 30% response rate. This sample is part of the group of manufacturing and service organisations in Hidalgo State, which face the huge challenge of improving quality, international business and productivity in the region.

3. Research questions and statistical analysis

3.1 Respondents

The survey was applied to 16 and four organisations from the manufacturing and service sectors, respectively. Only 13 out of 16 manufacturing firms declared having quality departments; and all service organisations did not have it; however, three out of four have implemented 5S. Only 12 out of 20 (60%) organisations state that they perform all their managerial and operational activities with quality and continuous improvement standards, six out of 20 (30%) perform just the important and relevant, and two out of 20 (10%) perform some of their activities under these criteria. There were no questions asked prior to the interviews; 14 out of 20 (70%) organisations turned out to have the 5S practice in place.

Pairs of factors were constructed to study the existence of simple linear relationships. The expectation was a simple model with ‘positive’ simple linear relationships (results confirmed this assumption). We used ANOVA (significance level < 0.1) to determine the significance of the relationship between factors; and Pearson product moment correlation coefficient to measure the strength of the relationship.

3.2 Hypotheses

While quality and manufacturing theories such as six sigma (Zu et al. 2008) and TPS (Liker 2004, Liker and Hoseus 2008), have been increasingly investigated; little academic research has been done on 5S and its interpretation, implementation, empirical relationships, and ongoing challenges. The 5S practice constitutes a foundation for organisational success. ‘[5S] is a teaching tool in the Toyota culture, and a building block toward more advanced standardization and problem solving’ (Liker and Hoseus 2008, p. 162). This research investigates the different relationships accompanying the 5S implementation with the aim of identifying quality management practices that affect both quality and business performance. ‘The 5S’s have been around a long time…. We just have not been that aware of them until now. So when we look around, there is a lot of room for improvement’ (Osada 1991, pp. 11–12).

3.2.1 5S practice implementation

Companies throughout the world, in search of competitive strategies, deliberately choose programmes as a means to engage their employees in improvement processes. ‘Some have used Six Sigma …, while others have concluded they need to ‘lean out processes’ … using simpler concepts of pull and flow’ (Liker and Hoseus 2008). Frequently these programmes are effective in achieving improvements such as driving down costs, improving quality,
and increasing delivery speed and reliability. Unfortunately there is usually something missing in these efforts. ‘Many companies have become frustrated with kaizen events and Six Sigma projects that yielded great short-term results but had no sustainability’ (Liker and Hoseus 2008). This section investigates specific relationships of 5S implementation aimed at identifying implementation success factors.

**H1.1.** The organisations that have implemented the 5S practice have a quality department.

The quality of a product or service is difficult to define; it is based on the people’s perception and measured against their own experiences. Since it is desirable to meet this ‘undefined or difficult-to-define’ quality, new quality philosophies look for constant improvement and dictate that it is the responsibility of all members of an organisation. From this point of view, the quality department should be the entire organisation, but in practice in the Mexican organisations, it is common to find the quality department as being responsible for quality results. The survey reveals 13 out of 20 (65%) organisations having quality departments. The four service organisations do not report a quality department, however three (75%) have implemented 5S. In the case of manufacturing firms 13 out of 16 (81%) have a quality department and 11 (69%) have implemented 5S. The service sector has a greater percentage in carrying out 5S when compared with manufacturing, this result agrees with Ho and Fung (1995). This relationship is not significant ($p$-value = 0.57). This result suggests a work environment orientation to the company’s philosophy rather than to the quality department’s philosophy. While some organisations show a quality department, most of them have a tendency to incorporate 5S in their everyday activities, as suggested by Osada (1991). Therefore, we identify these important relationships; the quality philosophy should be included in the organisational philosophy, and the 5S practice is not subdued to the quality department.

**H1.2.** The organisations that have implemented the 5S practice have invested in 5S training for the personnel.

Personnel should be trained in their own job skills; and they should be trained to implement continuous improvement techniques as well. To achieve maximum results in 5S implementation, greater emphasis on training to all levels is required (Ho and Fung 1994, Ho and Cicmil 1996, O’Heocha 2000, Pheng and Khoo 2001, Liker 2004, Kumar et al. 2007, Liker and Hoseus 2008). From the organisations that have implemented the 5S practice, 86% have invested in personnel training: 100% and 82% of service and manufacturing organisations, respectively. This result shows congruency with hypothesis H1.1 and Ho and Fung (1995), the service sector has a greater percentage in carrying out 5S when compared with manufacturing. This relationship is significant ($p$-value = 0.05) and is in concordance with quality basic concepts; trained personnel are required to implement the organisation’s quality programmes (Ho and Fung 1994, Ho et al. 1995, Ho and Cicmil 1996, Ansari and Modarress 1997, Ho 1997, 1999a, O’Heocha 2000, Pheng and Khoo 2001, Nwabueze 2001, Warwood and Knowles 2004, Kumar et al. 2007, Withanachchi et al. 2007, Julien and Tjahjono 2009). Implementation of the 5S practice and personnel training in 5S are positively related.

**H1.3.** The organisations that have implemented the 5S practice have perceived that all their activities and operations are accordingly performed with reference to quality and continuous improvement.

‘Little research has been conducted into the different ways in which 5S has been interpreted and implemented in the UK and US compared with its original meaning’
(Kobayashi et al. 2008, p. 260). There are a few 5S related researches applied in different countries and regions: Australia (Bryar and Walsh 2002); Hong Kong (Ho 1998, Ho 1999a, 1999b); India (Kumar et al. 2007); Japan (Ho et al. 1995, Gapp et al. 2008, Kobayashi et al. 2008); Malaysia (Ho and Cimil 1996, Ahmed et al. 2005); Spain (Suarez-Barraza et al. 2009); Sri Lanka (Withanachchi et al. 2007); UK (Ho et al. 1995, Ho and Fung 1995, O’hEocha 2000, Nwabueze 2001, Warwood and Knowles 2004, Herron and Braid 2006, Kobayashi et al. 2008, Julien and Tjahjono 2009, Thomas et al. 2009); and US (Ho and Cimil 1996, Ansari and Modarress 1997, Hubbard 1999, Kobayashi et al. 2008, Browning and Heath 2009). This research is the first attempt to understand the way 5S is interpreted and implemented in a Mexican environment. Quality management is the responsibility of everyone in the organisation (Zu et al. 2008); it implies total personnel involvement, and activities and operations oriented to achieve the competitive strategies. Any organisation, with 5S implementation, should be perceived with both work related and no work related activities and operations performed with reference to quality and continuous improvement (Osada 1991). This relationship is not significant (p-value = 0.12). This result is explained by cultural issues, and it fits the two major frameworks described by Kobayashi et al. (2008). While for some countries, like Japan, the 5S practice is a lifestyle (Gapp et al. 2008, Kobayashi et al. 2008); for others such as the UK, the US (Kobayashi et al. 2008), and now Mexico, it is a quality tool. Further training is needed in Western organisations to enhance the perception of the 5S practice and adopt it as a lifestyle.

H1.3a. Organisations that have invested in 5S training for their personnel have perceived that all their activities and operations are accordingly performed with reference to quality and continuous improvement.

From the surveyed organisations three out of three (100%) and nine out of 11 (82%) are the service and manufacturing organisations that have invested in personnel training respectively. ‘The training process takes time and money, but it is essential . . . to increase employee safety awareness and the commitment to the creation of an injury free workplace’ (Ansari and Modarress 1997, p. 394). This relationship is not significant (p-value = 0.48). Important conclusions are that organisations should invest in personnel training, and they should offer training in quality and continuous improvement philosophies aimed at adoption as a lifestyle rather than as a tool.

3.2.2 Top management commitment with the 5S practice

Scherrer-Rathje et al. (2009, Suarez-Barraza et al. 2009). This section investigates particular relationships of top management commitment.

**H2.1.** Organisations with top management commitment to the 5S practice have included the 5S practice in their organisational strategic planning.

Leadership means developing a vision of the future and strategies for achieving that vision. ‘In order to meet and surpass customer expectations, many world-class companies have developed new strategies emphasizing . . . quality, cost and cycle time’ (Ansari and Modarress 1997, p. 389). A couple of researches identify 5S as a competitive strategy component: Ansari and Modarress (1997) present 5S as part of a safety world-class strategy, and Thomas et al. (2009) identify lean six sigma as key business process strategy and consider 5S as part of it. Bryar and Walsh (2002) investigate an organisation which included 5S in the strategic business plan. Public hospitals in Sri Lanka use TQM as a long-term strategy and 5S as a short-term plan (Withanachchi et al. 2007). Ho et al. (1995) identify the value of 5S in long-term strategic thinking. Furthermore, Ho (1999c) suggests a change in the traditional strategic planning process based on 5S. Gapp et al. (2008) recommend considering 5S in a more philosophical or at least strategic way and cite the difficulty the West has in appreciating 5S as an organisational strategy; 5S contributes to important strategic priorities such as productivity, quality, costs, delivery, safety and morale. ‘Japanese managers placed a strong emphasis . . . in the strategic and long-term organisational benefits of the application of this system [5S]’ (Gapp et al. 2008, p. 575). 5S is the platform for strategic planning required for the development of an integrated management system (Gapp et al. 2008). From the surveyed organisations one out of three (33%) service organisations perceive top management commitment to 5S and it has included 5S in its strategic planning. On the other hand, seven out 11 (64%) and six out of 11 (55%) are the manufacturing organisations with top management commitment and 5S included in their organisational strategic planning, respectively. Research findings show the most significant ($p$-value $= 2.2 \times 10^{-6}$) relationship between factors. However, incorporating the 5S practice in strategic planning is not enough to achieve the desired quality and continuous improvement environment; there is a risk to consider it just a tool and not a philosophy to lead everyday activities (Kobayashi et al. 2008). Based on the incipient comments in the literature and this research’s findings, the 5S practice should be included as a strategy in the organisational strategic planning.

**H2.2.** Organisations with top management commitment to the 5S practice have designed formal procedures to track, measure, and evaluate the 5S implementation.

Organisations that have achieved 5S implementation now have the challenge to ensure that the organisation remains aligned, which requires tracking, measuring and evaluation (Bryar and Walsh 2002). Organisations that have successful 5S programmes measure their performance through inspections conducted regularly (Withanachchi et al. 2007), ‘the dates of which [inspections] should, however, not be revealed . . . . The 5-S activities should be practised daily so that there should not be any anxiety during the inspections at all’ (Pheng and Khoo 2001, p. 110). For examples of audit sheets the reader is referred to Ho (1999b, 1999c, 2006). Authors that investigate 5S measuring and evaluation are Ho and Cicmil (1996), Ho (1997), O’hEocha (2000), Pheng and Khoo (2001), Kulak et al. (2005), and Gapp et al. (2008). Kumar et al. (2007) studies the financial performance of 5S. Performance evaluation examples of other 5S related quality programmes are: kaizen events (Farris et al. 2009), lean (Scherrer-Rathje et al. 2009), lean six sigma
(Thomas et al. 2009), TPM (Ahmed et al. 2005, Ahuja and Khamba 2008), TQM (Dreyfus et al. 2004), world-class strategies for safety (Ansari and Modarress 1997). From the surveyed organisations one out of three (33%) service organisations perceive top management commitment to 5S and it has designed formal procedures to track, measure, and evaluate the 5S implementation. On the other hand, seven out of 11 (64%) and eight out of 11 (73%) are the manufacturing organisations with top management commitment and which have designed formal procedures to track, measure, and evaluate the 5S implementation, respectively. This relationship is not significant ($p$-value $= 0.109$), there are formal procedures to measure and evaluate the 5S implementation but top management commitment is not perceived. Brown (1996, p. 165) explains that in Latin American countries, the power distance dimension plays a fundamental role in workforce attitudes and perceptions. An important conclusion is that it is necessary to measure and evaluate the 5S implementation and its success factor as well, such as commitment from top management.

H2.2a. Organisations that have included the 5S practice in their organisational strategic planning have designed formal procedures to track, measure, and evaluate the 5S implementation.

From the surveyed organisations one out of three (33%) service organisations has included the 5S practice in its organisational strategic planning and it has designed formal procedures to track, measure, and evaluate the 5S implementation. On the other hand, six out of 11 (55%) and eight out of 11 (73%) are the manufacturing organisations that have included the 5S practice in their organisational strategic planning and have designed formal procedures to track, measure, and evaluate the 5S implementation, respectively. This relationship is not significant ($p$-value $= 0.109$). There is more operative than strategic work done on the 5S. Strategic planning should be first and then the design of action to implement, measure, and evaluate the 5S strategy. Service and manufacturing organisations should include 5S in their strategic planning.

H2.3. Organisations with top management commitment to the 5S practice have positively impacted the organisational culture.

How to identify the culture of the organization? ‘It is hard because we have to decipher what is in people’s heads’ (Liker and Hoseus 2008, p. 5). Organisational culture includes many observations: how people live, interact, work, behave, feel, among others (Liker and Hoseus 2008). In Mexico, the organisational culture is immediately associated to the work environment. ‘Management should try to develop an environment which the workers enjoy their work and take pride in it... It is simply the 5-S environment!’ (Ho 1997, p. 187). Top management convinced that quality benefits actively leads in the creation of an organisational culture (Dreyfus et al. 2004). A pleasant working environment and 5S has been investigated by Ho et al. (1995), Ho and Cicmil (1996), Ho (1997, 1998, 1999b, 1999c), and Withanachchi et al. (2007). A 5S workshop is held to forge better personal relationships and significantly improve the working environment (Kumar et al. 2007). Ahmed et al. (2005) report a delightful working environment as a result of 5S and other improvement programmes implementation. Ansari and Modarress (1997) identify 5S as essential for the creation of a safety culture. Furthermore, the success and failure of 5S depends upon an organisation’s culture, communications and employee attitudes (O’hEocha 2000, Warwood and Knowles 2004, Kumar et al. 2007). Ahuja and Khamba (2008) conclude TPM is not a maintenance specific policy, it is a culture, a philosophy and
a new attitude towards maintenance; in the same way 5S is a culture itself, a philosophy and a new attitude towards continuous improvement. From the surveyed organisations one out of three (33%) service organisations perceive top management commitment to 5S and it considers the practice has positively impacted the organisational culture. On the other hand, seven out of 11 (64%) and eight out of 11 (73%) are the manufacturing organisations with top management commitment and which consider the practice has positively impacted the organisational culture, respectively. This relationship is significant (p-value = 0.002). This result agrees with Ho (1997), and Dreyfus et al. (2004); top management convinced that 5S benefits actively leads in the creation of an organisational culture. However, the risk detected in the analysis of previous relationships remains: ‘When 5S is used as technique or tool, it may assist in employee motivation or empowerment. However, it neither influences organisational culture nor achieves synergies’ (Kobayashi et al. 2008, p. 261).

**H2.3a.** Organisations that have included the 5S practice in their strategic planning have positively impacted the organisational culture.

The quality policy statement is a guide for personnel in the organisation about how products and services should be produced and provided. This quality policy establishes core values that define the culture of the organisation. Core values include such principles as quick response, customer-driven quality, six sigma, continuous improvement, and employee participation. Organisations able to survive fierce competition show a strong culture based on the described principles. From the surveyed organisations one out of three (33%) service organisations has included the 5S practice in strategic planning and it considers the practice has positively impacted the organisational culture. On the other hand, six out of 11 (55%) and eight out of 11 (73%) are the manufacturing organisations that have included 5S in their strategic planning and which consider the practice has positively impacted the organisational culture, respectively. This relationship is significant (p-value = 0.002). It looks like that when 5S is included in the strategic planning, the organisational culture is significant and positively impacted.

**H2.4.** Organisations with top management commitment to the 5S practice have perceived high commitment from personnel to the 5S practice.

Improvement and quality systems are implemented by people. TPM requires long-term commitment from management and workforce (Ahmed et al. 2005, Ahuja and Khamba 2008). Personnel commitment is a main factor to guarantee the implementation of TQM a success (Ho and Fung 1994, Ho et al. 1995). Involvement from everyone in the organisation is essential when implementing lean (Scherrer-Rathje et al. 2009, Julien and Tjahjono 2009). Positive attitudinal outcomes from kaizen events increase employee commitment to change and lean philosophy (Farris et al. 2009). Cultural issues arise again, employee involvement is the first aspect of JPM; it furthers the second (quality) and third (JIT/lean). ‘The versatility and involvement that JIT/TQC requires of shop-floor associates was in direct conflict with rigidities of Western job descriptions’ (Schonmerger 2007, p. 411). Safety is meaningful to employees, and its selection as a first priority demonstrates company commitment to their well-being; safety professionals suggest that an injury-free environment creates a positive employee attitude, commitment and a sense of awareness and responsibility (Brown 1996, Ansari and Modarress 1997). Related and training courses are suggested to enhance the people involvement and to remove the resistance against change (Durmusoglu and Nomak 2005). Successful 5S implementation requires
commitment from top management and employees (Ho and Cicmil 1996, Ansari and Modarress 1997, Ho 1997, 1998, 1999b, 1999c, O’hEocha 2000, Bryar and Walsh 2002, Warwood and Knowles 2004, Withanachchi 2007). ‘There are many examples of successful implementation of ...the 5-S,...The difference between the Japanese and western approach lies mostly in the degree of employee involvement’ (Ho 2006, p. 64). ‘Japanese managers placed a strong emphasis on the involvement of individuals and workgroups’ (Gapp et al. 2008, p. 575). Committed personnel should feel ownership of the processes they work with, they must feel the empowerment, the authority to make decisions and take action in their work areas without obtaining prior approval. From the surveyed organisations one out of three (33%) service organisations perceive top management commitment to 5S and three out of three (100%) perceive high employee commitment. On the other hand, seven out of 11 (64%) and only two out of 11 (18%) are the manufacturing organisations with top management and employee commitment, respectively. This relationship is not significant (p-value = 0.61). This result agrees with previous research. The service sector has a greater percentage in carrying out 5S (Ho and Fung 1995), therefore higher personnel involvement. On the other hand, manufacturing organisations have greater work at the top management level rather than that at the operative level (Ho 2006, Schonmerger 2007, Gapp et al. 2008). Important conclusions arise; service organisations should work harder at the management level; and manufacturing firms should implement actions to enhance motivation and commitment at the operative level.

**H2.5.** Organisations with top management commitment to the 5S practice have implemented official channels to know personnel suggestions to improve their jobs.

Two-way communication with employees provides opportunities for feedback and is essential towards successful implementation of lean initiatives. ‘[Toyota] establishes the environment and systems where employees feel comfortable expressing their opinions, ideas, and concerns which are viewed as data used for improvement ...All leaders ...stay in touch with the concerns of team members firsthand and respond by reducing barriers to growth and performance’ (Liker and Hoseus 2008, p. 315). During lean implementation, ‘Communication to the employees was the single biggest lesson learned’ (Scherrer-Rathje et al. 2009, p. 87). Strategic TPM is about communication; it mandates that operators, maintenance people, workers and engineers collectively participate in decisions, acceptance of ideas, and frequent feedback as catalysts that drive improvement (Ahmed et al. 2005, Ahuja and Khamba 2008). Communication is important for TQM (Ho et al. 1995, Dreyfus et al. 2004), safety programmes (Ansari and Modarress 1997), kaizen events (Farris et al. 2009). The 5S practice helps to create an environment where workers make suggestions on how to improve the work process (Ho and Cicmil 1996, Ho 1997, Withanachchi et al. 2007). Kumar et al. (2007) present a model for converting the communication capability gained by a member of a 5S team into financial value. The success and failure of 5S depends upon communication; to ensure good communication, a suitable performance measuring system of 5S should be employed (O’hEocha 2000, Kumar et al. 2007). Employees welcome shorter lines of communication with fast and effective feedback mechanism; ‘management structure should be flattened and more power given to all employees to make decisions quickly’ (O’hEocha 2000, p. 326). From the surveyed organisations one out of three (33%) service organisations perceive top management commitment to 5S and three out of three (100%) perceive official communication channels. For manufacturing firms, seven out of 11 (64%) and nine out of 11 (82%) are the manufacturing organisations with top management commitment and
official communication channels, respectively. This relationship is not significant ($p$-value = 0.55). The communication channels are perceived but top management commitment perception is missing. Top management should increase efforts to enhance two-way communication; furthermore, lack of communication constrains any empowerment effort.

**H2.6.** Organisations with top management commitment to the 5S practice have perceived benefits such as quality improvement.

The practice of 5S results in higher quality and productivity, lower costs, faster delivery, safer workplace, and higher employee morale (Ho and Cicmil 1996, Ho 1997). Brown (1996) highlights the incorporation of 5S on the operating environment and its effects on employee safety, health and well-being as one of its quality improvement goals. Authors that investigate 5S as quality improvement system are Ho (1998, 1999b, 1999c, 2006), Hubbard (1999), O’hEocha (2000), Warwood and Knowles (2004), Withanachchi *et al.* (2007), Kumar *et al.* (2007), Pil and Fujimoto (2007), and Gapp *et al.* (2008). Other improvement systems and philosophies related to 5S and their impact in quality are: ISO 9000 (Ho and Fung 1994, 1995, Schonberger 2007), kanban (Hopp and Spearman 2004), lean (Kulak *et al.* 2005, Pil and Fujimoto 2007), lean kaizen (Suarez-Barraza 2009), TPM (Ahmed *et al.* 2005, Ahuja and Khamba 2008), TQM (Ho *et al.* 1995, Dreysfus *et al.* 2004, Schonberger 2007). From the surveyed organisations one out of three (33%) service organisations perceive top management commitment to 5S and three out of three (100%) perceive quality improvement. In the case of manufacturing firms, seven out of 11 (64%) and 11 out of 11 (100%) are the manufacturing organisations with top management commitment and that perceive quality improvement, respectively. This relationship is significant ($p$-value = 0.055). Overall, organisations that have implemented 5S perceive quality improvement; but top management needs further strategies to achieve total commitment. Gapp *et al.* (2008) detected a problem that could affect top management understanding and commitment, ‘some definitions applied to 5S in the West may confuse practitioners….., compounding the difficulty the West has in fully appreciating the benefits of 5S as an organisational wide strategy for improving organisation decision making and performance’ (p. 566).

**H2.6a.** Organisations that have included the 5S practice in the organisational strategic planning have perceived benefits such as quality improvement.

From the surveyed organisations one out of three (33%) service organisations has included the 5S practice in its organisational strategic planning and three out of three (100%) perceive quality improvement. In the case of manufacturing firms, six out of 11 (55%) and 11 out of 11 (100%) are the manufacturing organisations that have included the 5S practice in organisational strategic planning and that perceive quality improvement, respectively. This relationship is significant ($p$-value = 0.055). This result agrees with the new paradigm of strategic planning proposed by Ho (2006), first action and then strategic planning. However, this new paradigm is aligned to cultures like Japan where quality is a lifestyle, Western cultures need attachment to techniques and tools (Gapp *et al.* 2008, Kobayashi *et al.* 2008). Therefore, the 5S practice should be considered in the strategic planning.

**H2.7.** Organisations with top management commitment to the 5S practice have used the 5S practice as a basis for advanced quality and continuous improvement systems.

Ahuja and Khamba (2008, p. 716) present 5S as the basis for any lean manufacturing philosophy. Research that considers lean philosophies and has 5S foundation are: 5S for

**H2.7a.** Organisations that have included the 5S practice in the organisational strategic planning have used the 5S practice as a basis for advanced quality and continuous improvement systems.

The survey reveals that one out of three (33%) service organisations has included 5S in its organisational strategic planning and one out of three (33%) has used 5S as a basis for advanced quality and continuous improvement systems. In the case of manufacturing firms, six out of 11 (55%) and eight out of 11 (73%) are the manufacturing organisations that have included 5S in their organisational strategic planning and that have used 5S as a basis for advanced quality and continuous improvement systems, respectively. This relationship is significant ($p$-value $= 0.031$). The 5S practice is the foundation for continuous improvement; it should be included in the organisational strategic planning and identified as a basis for advanced quality and manufacturing philosophies.

**H2.7b.** Organisations where the 5S practice has positively impacted organisational culture have used the 5S practice as a foundation for advanced quality and continuous improvement systems.

From the surveyed organisations in one out of three (33%) service organisations the 5S practice has positively impacted the organisational culture and in one out of three (33%) the practice has been used as a basis for advanced quality and continuous improvement systems. On the other hand, eight out of 11 (73%) and eight out of 11 (73%) are the manufacturing organisations which consider the practice has positively impacted the organisational culture and that have used the practice as the basis for advanced quality and continuous improvement systems. This relationship is significant ($p$-value $= 0.013$). When the 5S practice has permeated the organisation, the implementation of advanced quality systems is straightforward. Organisations should use the 5S practice as a competitive organisational strategy to support advanced quality and continuous improvement philosophies.
One of the problems of introducing change through improvement philosophies is the maintenance of any improved levels of performance (Herron and Braiden 2006). ‘In this improvement method [5S], the fifth S, sustain, is arguably the hardest’ (Liker 2004, p. 36). There is a difficulty in maintaining 5S which requires large management resources (Ho and Fung 1995). The literature reveals that monitoring and evaluating 5S programmes has to be done at regular intervals to maintain and improve its performance (Kumar et al. 2007). Warwood and Knowles (2004) highlight management participation commitment as vital to keep a 5S programme going. Ho and Cicmil (1996) identify that it is difficult to make 5S as part of the daily routine; workplace evaluations and other means are needed to keep everyone abreast of what is happening and to detect problems; the objective is to ensure that a 5S implementation leads to a conductive total quality environment. It is essential, in the 5S activities, to train people to be able to devise and implement their own solutions; progress that is not self-sustaining is not real progress; the workforce needs to study maintenance techniques and, oddly enough, the more problems they are capable of solving, the more problems they will identify (Ho and Cicmil 1996, Ho 1997). ‘All employees must therefore on a regular basis be involved and participate in the 5S steps’ (Julien and Tjahjono 2009, p. 325). O’hEocha (2000) investigates a case where middle management dwindled in certain areas, the 5S lost momentum because people lost interest and it fell down on custom and practice/self-discipline (the fifth S). From the surveyed organisations one out of three (33%) service organisations perceive top management considers 5S as priority and three out of three (100%) consider the organisation has as the biggest concern of how to keep the 5S practice going. In the case of manufacturing firms, seven out of 11 (64%) and five out of 11 (46%) are the manufacturing organisations with top management that considers 5S as priority and organisation with the biggest concern of how to keep the 5S practice going. This relationship is significant ($p$-value $= 0.031$). Managers must sustain the level of enthusiasm necessary for 5S to remain a top priority goal, and further efforts are needed to keep the 5S going. ‘Japanese managers placed a strong emphasis on the involvement of individuals and workgroups’ (Gapp et al. 2008, p. 575). A greater degree of commitment and follow-up by top management and employees is needed to keep the momentum going and assure the 5S’s success in the long run. ‘It is easy to start the 5S activities, but it is very difficult to maintain a steady pace and become truly proficient in all their aspects.... It is essential that everyone be committed to implementing the 5Ss all the time’ (Osada 1991, pp. 40–41).

Organisations that have included the 5S practice in the strategic planning have as biggest concern of how to keep the 5S practice going.

The survey reveals that one out of three (33%) service organisations has included 5S in its strategic planning and three out of three (100%) consider the organisation has as the biggest concern of how to keep the 5S practice going. In the case of manufacturing firms, six out of 11 (55%) and five out of 11 (46%) are the manufacturing organisations that have included 5S in their strategic planning and that consider the organisation has as the biggest concern of how to keep the 5S practice going, respectively. This relationship is significant ($p$-value $= 0.031$). Organisations have a need for sustaining a 5S culture over the long run, it implies they should explicit this desire in the company’s strategic planning.

Organisations that have used the 5S practice as a basis for advanced quality and continuous improvement systems have as biggest concern of how to keep the 5S practice going.
From the surveyed organisations one out of three (33%) service organisations use the 5S practice as the basis for advanced quality and continuous improvement systems and three out of three (100%) consider the organisation has as the biggest concern of how to keep the 5S practice going. On the other hand, eight out of 11 (73%) and five out of 11 (46%) are the manufacturing organisations that have used the practice as the basis for advanced quality and continuous improvement programmes and consider the organisation has as the biggest concern of how to keep the 5S practice going, respectively. This relationship is not significant ($p$-value $= 0.57$). It is common for organisations to pay a lot of attention in advance to quality programmes/systems and forget about the basis programme chiefly represented by the 5S practice. For instance, organisations are struggling with six sigma (the reader is referred for an example to Thomas and Barton 2006, pp. 419–420, where the problem is identified, and Thomas et al. (2009) where a new solution is proposed using 5S as basis for six sigma) and lean manufacturing (Scherrer-Rathje 2009, pp. 79–80), and they cease to work with the ongoing of the 5S practice. Organisations should give high importance to the 5S practice as a success factor for advanced quality and continuous improvement methodologies.

### 3.3 Correlation between factors

Correlations between factors, discussed in Section 3.2.2 *Top management commitment with the 5S practice*, are determined; Figure 1 shows the relationships between factors, their significance, and their corresponding correlation coefficients. All hypotheses tested in Section 3.2.2 can be read in Figure 1. Let us consider hypothesis H2.1: ‘Organisations with top management commitment to the 5S practice have included the 5S practice in the organisational strategic planning’; the line connecting the two factors compounding this hypothesis is bold and continuous meaning that the relationship is highly significant ($p$-value $\leq 0.05$). Additionally, the correlation coefficient between these two factors is indicated beside the hypothesis’ name (H2.1, 1.0), in this case 1.0 meaning a perfect correlation between ‘Organisations with top management commitment to the 5S practice’ and ‘Organisations that have included the 5S practice in the organisational strategic planning’. Statistically, the two factors considered in H2.1 are equivalent modulo scaling (correlation coefficient equals 1); these two factors have the strongest linear relationship.

A strong relationship (correlation coefficient $> 0.5$) is also identified in the following significant relationships: H2.3 (correlation coefficient 0.75); H2.3a (correlation coefficient 0.75); H2.7 (correlation coefficient 0.58); H2.7a (correlation coefficient 0.58); H2.7b (correlation coefficient 0.65); H2.8 (correlation coefficient 0.58); and H2.8a (correlation coefficient 0.58).

A second case is hypothesis H2.6a, ‘Organisations that have included the 5S practice in the strategic planning have perceived benefits such as quality improvement’; the line connecting the two factors compounding this hypothesis is continuous meaning that the relationship is significant ($p$-value $= 0.06$). Additionally, the correlation coefficient between these two factors is indicated beside the hypothesis’ name (H2.6a, 0.52), in this case 0.52 meaning a strong correlation between them. A similar and strong relationship is found in H2.6 (correlation coefficient 0.52).

Two relationships that were close to being significant are indicated by H.2.2 and H2.2a. These relationships are identified by a dash dotted line meaning that the relationship is not significant ($p$-value $= 0.11$), but it is close to being significant; these are
some of the relationships demanding attention from top management. In this case the correlation coefficient is 0.45; they are relationships of medium strength.

Last case is hypotheses H2.4, H2.5, and H2.8b. The line connecting these relationships is dotted meaning that there is no relationship at all. Again, as the previous case, these kinds of relationships are the ones demanding immediate attention from top management.

This research found that the factors depicted in Figure 1 are the factors that top management should consider as fundamental for the 5S implementation. First of all, top management commitment to the 5S practice is required. Then top management should pay attention to factors such as: the organisation has perceived benefits such as quality improvement from the 5S implementation; the 5S practice is included in the organisational strategic planning; the 5S practice is used as the basis for advanced quality and continuous improvement philosophies; the 5S practice is positively impacting the organisational culture; and there is an organisational concern about how to keep the 5S practice going; for the surveyed organisations top management commitment shows a significant and large correlation with these factors. Equally important, but missed by the surveyed organisations, top management should pay attention to the following factors: the organisation has developed high commitment from personnel through the 5S implementation; the organisation has implemented communication channels to know personnel suggestions for improvements; and the organisation has designed procedures to track, measure, and evaluate the 5S implementation.
4. Conclusions

The 5S practice is both a philosophy and a set of guiding principles that lead to a continuously improving organisation. The 5S implementation is not an easy task. The surveyed organisations identified the following success implementation factors: investment in 5S training for top management and workforce; top management commitment to the 5S practice; the 5S practice is included in the organisational strategic planning; the organisation is focused on how to keep the 5S practice going; the organisation measures the positive impact of the 5S implementation in the organisational culture; the 5S practice is used as the basis for advanced quality and continuous improvement philosophies; and the organisation measures the benefits from 5S implementation such as quality improvement. Additionally, the surveyed organisations showed as opportunities to enhance the 5S implementation: personnel commitment with the 5S practice; the design of official communication channels to know personnel suggestions to improve their jobs; quality and continuous improvement orientation of all activities and operations; the design of processes to track, measure, and evaluate the 5S implementation; and how to keep the 5S practice going while implementing advanced quality programmes systems.

It looks like that obtaining commitment from top management and personnel could help to face the 5S implementation challenges. How can everyone in the organisation buy the idea of quality? Furthermore, how to buy the idea of quality as a lifestyle rather than an operational tool? This research found that the first step is to have a greater commitment from the top management to lead in the creation of an organisational culture, and include the 5S practice in the strategic planning of the organisation. Secondly, further training is needed to enhance the perception of the 5S practice and adopt it as a lifestyle rather than a management tool. Finally, further efforts should be performed to: track, measure and evaluate the 5S implementation; design communication channels and enhance two-way communication; and to take advantage of the 5S practice and implement advanced quality and continuous improvement philosophies.

A common answer from the companies we investigated was the leading role of the 5S practice to support other quality and improvements methods. An interesting result is that both employee empowerment and continuous improvement were drawn from the survey as supported by the 5S practice, but none of the surveyed organisations has reached this operational level. Our findings suggest that the 5S practice is worthwhile for production and service organisations and is universal to all organisations (Ho and Cicmil 1996). The big challenge is how to incorporate the 5S practice in everyone’s life.

The study also has a few limitations. It is an investigation in a single Mexican State; this research should be repeated in different Mexican environments to validate the findings and obtain greater insight. Another limitation of this study was the lack of response by the target organisations. Though 66 organisations from both manufacturing and service sectors received letters requesting their participation in this study, almost two thirds never responded. A higher number of participating organisations in the investigation would have definitely affected the findings. A complete set of manufacturing and service companies from Hidalgo State would have given a more complete picture of the impact of the 5S practice in this region. Finally, given the small response rate, no difference was considered between service and manufacturing organisations; specific surveys should be considered in order to increase the understanding of the experiences and challenges faced by organisations belonging to different economic sectors.
The results of this research motivate the investigation of other manufacturing and service environments in different cultural contexts; since different cultures have different perception and maturity levels of quality systems implementation and the strengths and weaknesses of their current quality systems vary. The authors expect to investigate other regions of Mexico and some very interesting areas such as neighbouring cities in the border between USA and Mexico where everyday the fusion of two different cultures coexists. Further research also includes investigating specific factors that influence the significant role of top management commitment in the implementation of the 5S practice, such as the two-way communication, management feedback, long-term and short-term planning, and employee empowerment among others.

Acknowledgements
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References


Appendix 1. 33 Questionnaires used in the interview process:

QUALITY IMPROVEMENT SUPPORTED BY THE 5S, A CASE STUDY OF MEXICAN ORGANIZATIONS

Organization’s Name: ______________________________________________________________________
Address: __________________________________________________________ Zip Code:______________
Contact: ______________________________________________ Position: ___________________________
Phone number: _________________   Extension: ______ e-mail: ___________________________________

The survey is designed to get data about knowledge, adequacy, importance, implications, and benefits of the
5S practice in organizations established at Hidalgo State, Mexico; with the aim to identify helpful information
that could be used in quality management issues for any organization.

1. How many employees does the organization have? _______________________________

2. Employees per area:
   a. Administrative
   b. Production
   c. Operations

3. Total revenue per year ($ pesos) ___________________

4. Total production value per year ($ pesos) __________________

5. What technologies does the organization use?
   - Information systems
   - MRP
   - ERP
   - CAD
   - CAM
   - SIM
   - CIM
   - Other: ______________________

6. Does the organization have Quality Department? □ Yes □ No
   a. If yes, to whom reports? ________________

7. How do you classify the production process?
   - Product focus
   - Process focus
   - Repetitive

8. Annual budget percent used for personnel development? _________________

9. Which factors are the most related to quality costs?
   __________________________________________________________________________
   __________________________________________________________________________

10. What is your industrial activity?
    a. Metal-Mechanics industry
    b. Plastic industry
    c. Garment manufacturing
    d. Furniture manufacturing
    e. Service industry: ______________________________
    f. Other: ____________________________

11. Which of the following do you use as quality programs?
    a. Just in time (JIT)
    b. ISO 9000/2000
    c. Quality award (national or international)
    d. 5S
    e. 9S
    f. Statistical process control (SPC)
    g. Other ______________________________

12. Talking about quality, employees receive formal training and instruction in:
    a. JIT
    b. ISO 9000/2000
    c. Quality award (national or international)
    d. 5S
    e. 9S
    f. SPC
    g. Other ____________________________

13. When identifying improvement opportunities, the tools and methodologies used to define and
    structure improvement proposals are:
    a. Diagnostic tools
    b. Strategic planning
    c. FMEA (failure modes and effects analysis)
    d. Seven quality tools
    e. Process management
    f. SPC
    g. Other ____________________________

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<table>
<thead>
<tr>
<th>Question</th>
<th>Answer Options</th>
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<tbody>
<tr>
<td>14. Managerial and operative activities are performed with quality and</td>
<td>a. All of them</td>
</tr>
<tr>
<td>continuous improvement standards:</td>
<td>b. Just the important and relevant</td>
</tr>
<tr>
<td></td>
<td>c. Some of them, sometimes</td>
</tr>
<tr>
<td></td>
<td>d. Not at all</td>
</tr>
<tr>
<td>15. Has the organization implemented (partial or totally) the 5-S practice?</td>
<td>Yes ☐ (Next question)</td>
</tr>
<tr>
<td></td>
<td>No ☐ (Go to question 16a)</td>
</tr>
<tr>
<td>16. Indicate and order the steps that were performed to implement the</td>
<td>Obtaining top management commitment ☐</td>
</tr>
<tr>
<td>5S practice:</td>
<td>Creation of a team to advertise the 5S practice ☐</td>
</tr>
<tr>
<td></td>
<td>Implementation of a 5S advertisement plan ☐</td>
</tr>
<tr>
<td></td>
<td>Promotional campaign ☐</td>
</tr>
<tr>
<td></td>
<td>Training and instruction ☐</td>
</tr>
<tr>
<td></td>
<td>Management of implementation records ☐</td>
</tr>
<tr>
<td></td>
<td>Implementation assessment ☐</td>
</tr>
<tr>
<td></td>
<td>Management of following records ☐</td>
</tr>
<tr>
<td></td>
<td>Other ☐</td>
</tr>
<tr>
<td>17. Is the 5S practice a top management priority for quality programs?</td>
<td>Yes ☐</td>
</tr>
<tr>
<td></td>
<td>No ☐</td>
</tr>
<tr>
<td>18. Was the 5S practice included in the organizational strategic plan?</td>
<td>Yes ☐</td>
</tr>
<tr>
<td></td>
<td>No ☐</td>
</tr>
<tr>
<td>19. What is the current 5S practice implementation level?</td>
<td>25% ☐</td>
</tr>
<tr>
<td></td>
<td>50% ☐</td>
</tr>
<tr>
<td></td>
<td>75% ☐</td>
</tr>
<tr>
<td></td>
<td>100% ☐</td>
</tr>
<tr>
<td>20. Are there permanent processes to evaluate the ongoing of the 5S</td>
<td>Yes ☐</td>
</tr>
<tr>
<td>practice?</td>
<td>No ☐</td>
</tr>
<tr>
<td>If yes, which?</td>
<td>a. Check lists ☐</td>
</tr>
<tr>
<td></td>
<td>b. Meetings ☐</td>
</tr>
<tr>
<td></td>
<td>c. Audits ☐</td>
</tr>
<tr>
<td></td>
<td>d. Other ☐</td>
</tr>
<tr>
<td>21. What is the personnel commitment level to work in a 5S ambience?</td>
<td>High ☐</td>
</tr>
<tr>
<td></td>
<td>Medium ☐</td>
</tr>
<tr>
<td></td>
<td>Low ☐</td>
</tr>
<tr>
<td>22. Are there specific processes that employees can use to suggest</td>
<td>Yes ☐</td>
</tr>
<tr>
<td>improvement ideas?</td>
<td>No ☐</td>
</tr>
<tr>
<td>If yes, which?</td>
<td>a. Meetings ☐</td>
</tr>
<tr>
<td></td>
<td>b. Mailbox ☐</td>
</tr>
<tr>
<td></td>
<td>c. Individual proposal ☐</td>
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<tr>
<td></td>
<td>d. Team proposal ☐</td>
</tr>
<tr>
<td></td>
<td>e. Other ☐</td>
</tr>
<tr>
<td>23. Did the 5S practice have a positive effect in labor culture?</td>
<td>Yes ☐</td>
</tr>
<tr>
<td></td>
<td>No ☐</td>
</tr>
<tr>
<td>24. After the 5S implementation, did the production process improve?</td>
<td>Yes ☐</td>
</tr>
<tr>
<td></td>
<td>No ☐</td>
</tr>
<tr>
<td>Explain</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>25. Do you think the 5S practice implementation produced integration</td>
<td>Yes ☐</td>
</tr>
<tr>
<td>between different areas?</td>
<td>No ☐</td>
</tr>
<tr>
<td>26. Has the 5S practice produced positive effects in the way to do</td>
<td>Yes ☐</td>
</tr>
<tr>
<td>businesses and relationship with customers?</td>
<td>No ☐</td>
</tr>
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(continued)
Appendix table continued.

27. The most important benefits from the 5S practice implementation are:
   a. Quality improvement
   b. Productivity improvement
   c. Cost reduction
   d. Production time reduction
   e. Work environment improvement
   f. Reliability in production and delivery time
   g. Other _______________________

28. Has the organization combined the 5S practice with other quality programs/systems?
   Yes ☐ No ☐

29. Has the 5S practice made easier the implementation of other quality programs/systems?
   Yes ☐ No ☐

30. Has the 5S practice been used as basis for other quality programs/systems?
   Yes ☐ No ☐
   If yes, which?
   a. Lean Manufacturing ☐
   b. ISO 9001:2000 ☐
   c. TPM (Total productive maintenance) ☐
   d. TQM (Total quality management) ☐
   e. JIT (Just in time) ☐
   f. SPC (Statistical process control) ☐
   g. Seven quality tools ☐
   h. Quality award
      I. National _____________________
      II. International _____________________
   i. Other _____________________________

31. From the following factors, which are the most important for the 5S implementation success? Order the factors from most important (1) to least important.
   a. Top management commitment
   b. Advertisement campaign
   c. Training and instruction
   d. Continuous evaluation and assessment
   e. Creation of self-directed teams
   f. Other _____________________________

32. What are the main challenges after the 5S practice implementation?
   a. Guarantee activities performance under the 5S practice philosophy
   b. Enhancement of labor culture
   c. Keep top management commitment
   d. Customer service
   e. Keep the 5S practice as basis for quality
   f. Making easier to achieve top management goals
   g. Other ___________________________________________________________________

33. What was the source for the 5S practice implementation project?
   a. Corporative ☐
   b. Consulting process ☐
   c. College/University ☐ Which? _____________________________
   d. Other ___________________________________________________________________

16a. Are there specific processes that employees can use to suggest improvement ideas?
   Yes ☐ No ☐
   If yes, which?
   a. Meetings ☐
   b. Mailbox ☐
   c. Individual proposal ☐
   d. Team proposal ☐
   e. Other _____________________________

(continued)
Appendix table continued.

17a. The 5S practice have not been implemented because:
   a. We don’t know the 5S practice
   b. There is not top management commitment
   c. We don’t consider the 5S practice helpful for the organization
   d. We don’t have a person with the instruction and guidance to implement it
   e. We don’t have time
   f. It is hard to implement
   g. Other

If your answer is we don’t know the 5S practice, the survey is over, thank you.

18a. What are the benefits you expect from the 5S practice implementation?
   a. Quality improvement
   b. Productivity improvement
   c. Cost reduction
   d. Production time reduction
   e. Improvement of working environment
   f. Reliability in production and delivery time
   g. Other

19a. Do you consider the 5S practice a priority for the quality programs/systems?
   Yes [ ] No [ ]

20a. Do you include the 5S practice in the organizational strategic plan?
   Yes [ ] No [ ]

21a. Do you think the 5S practice could be helpful as a basis to implement other quality programs/systems?
   Yes [ ] No [ ]

If yes, which?
   a. Lean Manufacturing
   b. ISO 9001:2000
   c. TPM (Total productive maintenance)
   d. TQM (Total quality management)
   e. JIT (Just in time)
   f. SPC (Statistical process control)
   g. Seven quality tools
   h. Quality award
   III. National _____________________
   IV. International _____________________
   i. Other ________________________________

22a. Do you think the 5S practice can be combined with other quality programs/systems?
   Yes [ ] No [ ]

23a. Consider the following factors, which are the most important for the 5S implementation success? Order the factors from most important (1) to least important.
   a. Top management commitment _______
   b. Advertisement campaign _______
   c. Training and instruction _______
   d. Continuous evaluation and assessment _______
   e. Creation of self-directed teams _______
   f. Other ____________________________ _______

24a. Are you interested to implement the 5S practice?
   Yes [ ] No [ ]

25a. If yes (question 24a), when?
   Months ____________ Years ____________
Total of 13 factors were studied.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The organization has implemented the 5S practice.</td>
</tr>
<tr>
<td>2</td>
<td>The organization has quality department.</td>
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<tr>
<td>3</td>
<td>The organization has invested in 5S training for the personnel.</td>
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<tr>
<td>4</td>
<td>The organization has perceived activities and operations performed with reference to quality and continuous improvement.</td>
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<tr>
<td>5</td>
<td>The organization’s top management considers priority the 5S practice.</td>
</tr>
<tr>
<td>6</td>
<td>The organization has included the 5S practice in the strategic planning.</td>
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<tr>
<td>7</td>
<td>The organization has designed formal procedures to track, measure, and evaluate the 5S implementation.</td>
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<tr>
<td>8</td>
<td>The organization’s culture has been positively impacted by the 5S implementation.</td>
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<tr>
<td>9</td>
<td>The organization has developed high commitment from personnel through the 5S implementation.</td>
</tr>
<tr>
<td>10</td>
<td>The organization has implemented official communication channels to know how personnel work at improving their jobs.</td>
</tr>
<tr>
<td>11</td>
<td>The organization has received benefits such as quality improvement.</td>
</tr>
<tr>
<td>12</td>
<td>The organization has used the 5S practice as foundation for advanced quality systems.</td>
</tr>
<tr>
<td>13</td>
<td>The organization has as biggest concern how to keep the 5S practice going.</td>
</tr>
</tbody>
</table>