

ETHICAL AND PSYCHOLOGICAL FACTORS IN 5S AND TOTAL  
PRODUCTIVE MAINTENANCE ON PRODUCTION  
LINE EFFECTIVENESS

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*Specially dedicated to:*

*My dear parents*

*My wife*

*My siblings*

*My friends*

*For their love, understanding and support through my endeavour*

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## ABSTRACT

Sort, Set, Shine, Standardize and Sustain (5S) and Total Productive Maintenance (TPM) are recognized as key techniques in lean and world class manufacturing models. However, after implementing these techniques, organizations find it difficult to achieve the desired results to maximise the effectiveness of their production lines. In their implementation, the role of employees has not been taken into attention. The benefits of their implementation which accrued to organizations have also identified the fact that successful implementation is largely based on the efforts and motivation of employees and these are affected by ethical and psychological factors. Therefore, this study investigated the role of ethical and psychological factors, and diagnosed their states of implementation and their cumulative impact on the overall production lines effectiveness in the implementation of 5S and TPM at cement plants in Kurdistan Region of Iraq. Within the case study framework, mixed methods were used in three phases. Firstly, a survey questionnaire and semi-structured interviews were used to identify the role of ethical and psychological factors in the implementation. Secondly, observations integrated with a checklist method was used to diagnose the state of implementation, and obstacles that hinder their implementation. Finally, documents review with Overall Lines Effectiveness (OLE) metrics were integrated to study the cumulative impact of the implementation on production lines effectiveness. The results showed that ethical factors had a larger role than psychological factors in the implementation. The findings also showed that the successful state of 5S and TPM implementation to overcome the obstacles depends largely on the extent of trust and mutual cooperation between management and relevant employees of an organization. In addition, the major challenges behind the decline of positive cumulative impact on production lines effectiveness were identified as breakdown time, less speed time, idling time and minor stoppage time. Finally, based on the findings, organisations are recommended to provide financial and moral support to employees to enable a comprehensive implementation of 5S and TPM aimed at obtaining the desired results.

## ABSTRAK

Sisih, Susun, Sapu, Seragam dan Sentiasa Amal (5S) dan Penyelenggaraan Produktif Menyeluruh (TPM) diiktiraf sebagai teknik utama dalam model lean dan model pembuatan bertaraf dunia. Namun begitu, setelah pelaksanaan teknik tersebut, organisasi mendapati adalah sukar untuk mendapatkan hasil yang diharapkan bagi memaksimumkan keberkesanan lini pengeluaran mereka. Dalam pelaksanaannya, peranan pekerja tidak diberi perhatian. Faedah pelaksanaannya yang terakru kepada organisasi juga telah mengenal pasti fakta bahawa kejayaan pelaksanaannya, sebahagian besarnya adalah berasaskan usaha dan motivasi pekerja dan ini dipengaruhi oleh faktor-faktor etika dan psikologi. Oleh itu, kajian ini mengkaji peranan faktor-faktor etika dan psikologi, serta mendiagnosis tahap pelaksanaan dan kesan kumulatifnya terhadap keberkesanan keseluruhan lini pengeluaran dalam pelaksanaan 5S dan TPM di kilang-kilang simen dalam Wilayah Kurdistan di Iraq. Dalam kerangka kajian kes, kaedah campuran digunakan dalam tiga fasa. Pertama, tinjauan soal selidik dan temu bual separa berstruktur digunakan untuk mengenal pasti peranan faktor-faktor etika dan psikologi dalam pelaksanaan tersebut. Kedua, pemerhatian bersepadu dengan kaedah senarai semak digunakan untuk mendiagnosis tahap pelaksanaan dan hambatan yang menghalang pelaksanaannya. Akhir sekali, semakan dokumen dengan metrik Keberkesanan Keseluruhan Lini (OLE) disepadukan untuk mengkaji kesan kumulatif pelaksanaan keberkesanan lini pengeluaran. Dapatan kajian menunjukkan bahawa faktor etika mempunyai peranan lebih besar daripada faktor psikologi dalam pelaksanaan tersebut. Dapatan kajian juga menunjukkan bahawa tahap kejayaan pelaksanaan 5S dan TPM dalam mengatasi hambatan yang ada sebahagian besarnya bergantung kepada sejauh mana kepercayaan dan kerjasama antara pihak pengurusan dengan pekerja berkaitan dalam sesebuah organisasi. Di samping itu, cabaran utama di sebalik kemerosotan kesan kumulatif positif terhadap keberkesanan lini pengeluaran yang dikenal pasti adalah masa kerosakan, masa kurang kepantasan, masa melahu dan masa henti minor. Akhir sekali, berdasarkan dapatan kajian, organisasi dicadangkan menyediakan sokongan kewangan dan moral kepada pekerja bagi membolehkan pelaksanaan 5S dan TPM yang komprehensif bertujuan untuk mendapatkan hasil yang diharapkan.

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## LIST OF ABBREVIATIONS

TPM	-	Total Productive Maintenance
OEE	-	Overall Equipment Effectiveness
OLE	-	Overall Line Effectiveness
LA	-	Line Availability
LPQP	-	Line Production Quality Performance
OT	-	Operating Time
LT	-	Loading Time
CT	-	Calendar Time
PD	-	Planned Downtime
DT	-	Downtime
D	-	Number of Defects
R	-	Rework Production
JIT	-	Just-in-Time
TQM	-	Total Quality Management
STS	-	Socio-Technical Systems
KMO	-	Kaiser-Myer-Olkin
VIF	-	Variance Influence Factor

## LIST OF SYMBOLS

$OT_n$	-	Operating time of the nth Process
$OT_1$	-	Operating time of the first Process
$PD_1$	-	Planned Downtime in the first process
$DT_1$	-	Downtime in the first process
$G_i$	-	Number of Good production in the process
$G_n$	-	A number of good products produced at the nth process
$cyt_i$	-	Idle Cycle time in the Process ( $i$ )
CYT	-	The largest process (bottle-neck) cycle time (cyt) among all the processes (1 to n)
$n_i$	-	Number of products actually produced from the line
$n$	-	Line
$i$	-	Process
$N_i$	-	The number of units possible to product in the process
$\leq$	-	Less than or equal to
$>$	-	Greater than

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

This chapter briefly highlights the research outline along with the research background, problem statement, research objectives, research questions as well as the scope of the research and the issues regarding the choice of the research topic and definitions of important terms; as well in this chapter, the organization of the study was explained; finally, this chapter was closed with a chapter summary.

#### **1.2 Research Background**

Most of the companies nowadays seek to improve their financial situation by improving their profits without increasing the sale price of their products throughout the world. This can only be done by minimizing the manufacturing cost of products by increasing the productivity and reducing losses during production (Habib *et al.*, 2008). On the other hand, these industrial companies are also trying to improve their



competitive position by gaining a competitive advantage. A competitive advantage is a consequence of low costs, high work efficiency and customer-oriented operations (Gajdzik, 2009). However, with today's global economy, the changing circumstances and the growing customer demands, increase the pace of competition and organizations' survival through relying on their ability to innovate and improve. These obstacles have made most of the industrial organizations realize the need for proper use (efficient and effective) of resources for each production facility and systems in a way that leads to overcome these obstacles (Sabry Shaaban and Awni, 2014; Stephen, 2000). But, the industrial plants, machinery, and equipment that owned are more complicated and difficult to control as a result of recurring breakdowns and the risks associated with these malfunctions (Ohunakin and Leramo, 2012).

The global industrial community has adopted many strategies that help to overcome problems associated with the production line; maintenance is one of such strategies used in this battleground (Murthy *et al.*, 2002; Tsang and Chan, 2000). It is a business function that serves and supports the primary process in an organization (Zhu *et al.*, 2002). Nevertheless, the maintenance task is becoming increasingly more complex due to the changes in the production and the environment of the industrial organizations. These changes can be described by factors such as the level of automation and capital intensity associated with automated production lines, globalization, restructuring and downsizing strategies, organizational structures, personal competence development and the difficulty of assessing the impact of maintenance on the companies' competitiveness (Alsyouf, 2004).

Therefore, the companies and plants have realized that the typical manufacturing system does not solely depend on the traditional maintenance program in order to work in the form which leads to the reduction of production cost and increased production with appropriate quality and reasonable price, thus meeting the needs of customers and consumers in the markets, but also depends on the elements, such as electronics, software and humans. This means that unplanned downtime and deviations previously in the production process may occur due to

different factors. For example; the failure of significant components of equipment, the quality of material and spare parts that are purchased, design, manufacturing process control, management systems and human errors (Al-Najjar and Alsyouf, 2003; Starr *et al.*, 2010).

Based on the above factors, there has emerged a new concept for maintenance, which is called Total Productive Maintenance (TPM). TPM was introduced and developed in Japan in 1951 (Aziz *et al.*, 2013). This came in response to the problems of maintenance prevailing at that time in most Japanese companies and factories (Gosavi, 2006). TPM is now considered one of the most well-liked maintenance models that are currently discussed among the researchers and practitioners over the past two decades (Habib *et al.*, 2008). Although TPM was propagated during 1971, it became popular among researchers and practitioners only after late 1980 (Pramod *et al.*, 2006).

According to Singh and Ahuja (2015) TPM emanated due to the realization that the maintenance activities should not only be technologically improved, but also administratively improved. It means to blend with the administrative concepts, such as Total Quality Management (TQM). Today, TPM is being implemented in numerous countries and fields (Ahmed, *et al.*, 2005; Chan, *et al.*, 2005). The maintenance function has become more important than ever before when the TPM program appeared (Bevilacqua and Braglia, 2000). It is because of the role it has in maintaining and improving the availability, performance efficiency, quality products, on-time deliveries and the environment (Sharma *et al.*, 2006). Furthermore, it improves the level of effectiveness of production processes (Al-Najjar, 1996).

According to Parida (2006) and Alsyouf (2007), an increasing awareness of TPM and its influence for both industrial enterprises and society as a whole can be recognized. Many researchers and practitioners have highlighted the total losses due to TPM omission or ineffectiveness like decline in the productivity equipment reliability, high cost of manufacturing; decline in the overall plant efficiency, and

increased work-related accidents (Al- Najjar, 1996; Vineyard *et al.*, 2000 and Holmberg *et al.*, 2005). All of these led to an increase in the rate of the TPM acceptance, as a result of practitioners' thirst to improve the overall production effectiveness as much as possible (Alsyouf, 2007).

Pramod (2007) is of the opinion that in some countries TPM implementation is not yet comprehensive enough to increase the productivity and reduce the losses and thus, benefit the organization as a whole. Most important reasons cited by researchers regarding partial implementation of TPM program in such countries is the lack of safety regulations, which encourages machine operators to take on maintenance work on their own as well as a lack of top management's ability to provide conducive environment for proper implementation of the TPM program (Admin, 2010; Ahuja and Khamba, 2008b).

Presumably, for the above causes, introducing many new techniques and approaches to TPM program in a manner makes them more suitable to overcome the obstacles that companies or plants are likely to encounter during implementation, and to some extent leads to improve the level of effectiveness of overall production through reducing production costs and increase production with appropriate quality (Bamber *et al.* 2008). The aim of the introduction of these techniques and methods is for enhancing the effectiveness of TPM (Kaur *et al.*, 2012). Singh *et.al.*, (2013) and Kennedy and Mazza (2010) have observed that to overcome most of the obstacles faced by many companies in the implementation of the TPM program, there has to be a tool or technique to ensure the successful implementation of TPM in companies and plants that face the difficulty of implementation of this program correctly. Bamber *et al.*, (1999); Ahuja and Khamba (2008b) and Arashpour *et al.*, (2009) opine that the 5S method can mostly be used as an effective tool to overcome obstacles in the implementation of the TPM program.

Researchers have highlighted that 5S principles namely, Seiri (sort, organization), Seiton (set in order), Seiso (shine, cleaning), Seiketsu (standardize the

cleaning), and Shitsuke (sustain, discipline) if applied at the workplace can help with the correct implementation of TPM (Bicheno and Holweg, 2008; Todorovic and Djapan, 2013), which, in turn, lead to improve the work safety, quality and efficiency, and reduce stops and production costs; then increase in the level of productivity and improved it in terms of quality and quantity are necessary to get a competitive advantage which has a big role in improving the current situation for many industrial organizations (Bicheno, 2008; Prabowo, 2010; Urban and Mazurek, 2011; Singh *et al.*, 2013). However, there are several industrial organizations that face many obstacles and challenges during the implementation of 5S and TPM in their productive processes, including organizational, cultural, technological, and others. The most important of them is the weak support by the top management in the implementation of these contemporary techniques (5S and TPM), particularly in the first phases of their implementation (Ahuja and Khamba, 2008b). Furthermore, some organizations partially implement these techniques in hope of obtaining the full benefit of them (Ahuja and Khamba, 2008b; Graisa and Al-Habaibeh, 2011).

In addition, there are other factors that affect the successful implementation of many contemporary techniques such as 5S, Kaizen, Six Sigma and TPM. These techniques if implemented successfully can improve production effectiveness to meet the needs of the market in terms of quality, quantity and price, which can help build the competitive advantage for the industrial organizations to improve their current situation (Wagel, 1990; Gapp *et al.*, 2008). The factors that can hinder the successful implementation of these modern techniques are related to human resources and represent ethical and psychological aspects (Robinson and Ginder, 1995). Ethical factors, such as the dilemma of the relationship between the manager and the subordinate, poor awareness and follow up in the ethical training programs and following the unethical instructions and commands, and psychological factors, such as the lack of desire and motivation to improve the current situation, anxiety and fear of loss of job or specialization due to technological improvements and poor awareness and sense of responsibility towards implementation of modern techniques, are all important contributors towards the lack of success of contemporary techniques initiatives as required (Wagel, 1990; Nachiappan and Anantharaman, 2006; Nelson Raja *et al.*, 2010).

On the basis of the above discussion, the researcher believed that, most of the companies and factories that are struggling to improve their financial position and achieve a competitive advantage must work to strengthen the implementation of 5S techniques and TPM pillars, by focusing on the role of ethical and psychological factors towards the proper implementation of 5S and TPM. Thus, the present study investigated to understand the real role that ethical and psychological factors can play in the implementation of 5S and TPM. In addition, this study attempted to evaluate the state of implementation of 5S and TPM, and diagnose the obstacles that lead to either partial implementation or unsuccessful implementation of 5S and TPM; as well as, it attempted to determine the cumulative impact of implementation of these techniques (5S and TPM) on the effectiveness of production lines, which would help in diagnosing the challenges (Big Losses) that prevent the cumulative positive effect of implementation of 5S and TPM on the effectiveness of production lines.

### **1.3 Problem Statement**

5S and Total Productive Maintenance (TPM) are recognized as key concepts in Lean and World Class Manufacturing models. Nevertheless, few organizations understand the benefits that can accrue from their simultaneous implementation (Kennedy and Mazza, 2010). According to Gapp *et al.*, (2008), many firms and factories have implemented either of these two techniques, without realizing that the 5S method is tantamount to foundation stone toward the implementation of the TPM program. Furthermore, researchers highlight that simultaneous implementation of these two techniques (5S and TPM) is not impossible, and their implementation together in a single system can bring many benefits to the industrial organizations, including a large improvement the safety at the work environment, asset performance, quality, productivity and most importantly financial performance. All these in turn will help these organizations to improve the current situation and to strengthen its competitive position by improving the production effectiveness and meeting the needs of customers and consumers as required (Graisa and Al-Habaibeh, 2011; Gajdzik, 2009; Hegde *et al.*, 2009; Arashpour *et al.*, 2009).

However, many researchers like Ahuja and Khamba (2008b), Hedge *et al.*, (2009), Arashpour *et al.*, (2009), Graisa and Al-Habaibeh (2011), Moradi *et al.*, (2011), Haddad and Jaaron (2012), and Singh *et al.*, (2013) have confirmed through studies that they conducted on many industrial organizations which implementing these techniques (5S and TPM) that, there are still companies and factories around the world suffer from several of the obstacles, including organizational, cultural, technological and operational within their productive processes during the implementation of these techniques. In spite of what referred to by above researchers, but the real problem is that all of these researchers have focused in their studies about implementation of 5S and TPM, and their impact on the overall effectiveness of the productive equipment individually only, rather than focusing on the overall effectiveness for production lines during the implementation of 5S and TPM in the organization as a whole; this is by studying the obstacles and challenges that prevent improve the state of implementation of 5S and TPM and leave a positive impact for these techniques (5S and TPM) on the overall effectiveness of production lines. This is mainly due to lack of efficient methods, which can be relied upon to assess the state of implementation of 5S and TPM and measure their cumulative impact on the overall production lines effectiveness (Nachiappan and Anantharaman, 2006).

Confirming the aforementioned argument, Jain *et al.*, (2014) and Gajdzik (2009) stated that with increased competition worldwide and with the markets becoming more aware of the price and quality, it is necessary for industrial organizations, especially those seeking to obtain a lasting competitive advantage make every effort to implement various techniques and programs that would improve their productivity and competitiveness. Therefore, companies and factories should not only seek to improve the effectiveness of individual equipment to obtain the required competitive advantage, but rather they should seek to improve the level of the overall production lines effectiveness in the organization as a whole. By successfully implementing 5S and TPM, they can obtain the required competitive advantage (Nachiappan and Anantharaman, 2006 and Nelson Raja *et al.*, 2010).

Nevertheless, the successful implementation of 5S and TPM depends not only on the diagnosis of the obstacles and challenges that hinder the implementation of these techniques (5S and TPM) to improve the overall production lines effectiveness and attain competitive advantage, but it also depends on the capacities of human resources (employees) that affect the successful implementation of 5S and TPM in the organization (Wagle, 1990). Thus, the other problem shows in terms of that the employee is a considered the main and decisive component for successful implementation of 5S and TPM and achieving the desired competitive advantage for organizations, this according to what confirmed by researchers (Kennedy and Mazza, 2010; Kumar *et al.*, 2014). Therefore, it should be highlighted on this component through a set of ethical and psychological factors and their role in the implementation of the tasks of 5S and TPM.

Thus, confirmation of the above statement, Wagle (1990) and Robinson and Ginder (1995) indicated that the industrial organizations rely heavily on their workforce to attain the desired levels of performance either in production or in financial. This reliance is largely based on the workforce (employees) capacities, which can be affected by a set of factors. This is because the quality of services provided by industrial organizations is mortgaged to the extent of their employees' adherence to set of ethical factors, such as: i) Manager–subordinate relationship (Autonomy/empowerment); ii) Ethical training programs; iii) The ethical instructions and commands. The other factor, which considered important is the psychological factors, include: i) Motivation and morale; ii) Job security and work load; iii) Awareness and sense of responsibility (Wagel, 1990; Robinson and Ginder, 1995; Ireland and Dale, 2001; Ramayah *et al.*, 2002; Brah and Chong, 2004; Seth and Tripathi, 2005; Gapp *et al.*, 2008; Ahuja and Khamba, 2008b; Haroun, and Duffuaa, 2009; Panneerselvam, 2012; Rolfsen and Langeland, 2012; Aspinwall and Elgharib, 2013; Kumar *et al.*, 2014).

Ethical factors like autonomy, ethical training, and ethical instructions and commands, are all important for the successful implementation of modern techniques (Wagel, 1990). It has been highlighted by research that employees who have been

given adequate training and commensurate rewards for successful implementation, along with their adherence to the instructions and standardized procedures literally and ethically. All of this has a big role in the successful implementation of contemporary techniques, such as 5S, Kaizen, six sigma, and TPM, and then reap the desired results by the organizations (Wagel, 1990; Robinson and Ginder, 1995; Panneerselvam, 2012; Ahuja and Khamba, 2008b; Aspinwall and Elgharib, 2013). Furthermore, research points out that for successful performance of modern techniques like 5S and TPM, it is necessary that employees are empowered (Ahuja and Khamba, 2008b; Haroun, and Duffuaa, 2009; Rolfsen and Langeland, 2012). Unfortunately, many organizations follow rigid organizational structures and managers are hesitant in giving autonomy to their sub-ordinates and thus suffer from improper or unsuccessful implementation of these modern techniques like 5S, TPM, TQM etc. (Robinson and Ginder, 1995; Ahuja and Khamba, 2008b).

Researchers have highlighted the significance of psychological factors or the factors internal to individuals that influence either positively or negatively the behaviour and performance of the employees. These are intangible factors, but can be felt through the reflexes and behaviours which are depicted by the employees (Sashkin and Sashkin, 2003; Shajahan, 2004). These factors such as employee motivation and morale; job security and workload and awareness and sense of responsibility, all contribute to the successful implementation of modern techniques. Researchers are of the view that employees can be motivated through awareness and training programs for successful implementation of modern techniques like 5S, Kaizen, six sigma and TPM (Brah and Chong, 2004; Seth; Tripathi, 2005). These awareness campaigns and training programs can guide the employees to benefits of the implementation of these techniques and raise their morale and sense of responsibility (Gapp *et al.*, 2008; Ahuja and Khamba, 2008b). Moreover, the successful performance for the necessary techniques to improve the work environment and the level of productivity requires employees feel secure in their jobs after performance, and they will not lose their jobs (Eswaramoorthi *et al.*, 2011) nor additional burden would be placed on them (Ahuja and Khamba, 2008b).



Based on the critical issues (obstacles and challenges) the above mentioned toward implementing 5S and TPM. There are many researchers like Allurentis (2013) and Fattah (2010) have been indicated that the Iraqi industrial organizations as an integral part of the global industrial community are also face many of these critical issues represented by organizational, technological, behavioral and others during the implementation of modern techniques like (5S and TPM) that are used to bring out the best productivity. This, in turn, left the destructive traces the development of industrial activity in Iraq generally (Hamoudi, 2011). All this mainly due to the wrong policies practiced by the top management of those organizations, and the most important is the lack of provide the necessary support to the employees financially and morally toward the proper implementation of these techniques and then get the desired results of them as required (Al Moussawi and Al Jubouri, 2012).

Thus, according to the above discussion, the problem statement of the present study is embodied in two important aspects: First aspect, the successful implementation of 5S and TPM, and achieving the desired results of them in terms of improved largely (the safety at the work environment, asset performance, quality, productivity) depends not only on the diagnosis and treatment of the factors (obstacles), such as organizational, cultural, behavioral and others. Implementation of 5S and TPM also depends on understanding the real role that could be played by the other factors, such as ethical and psychological factors, which are directly related to the employees' performance in the implementation of 5S and TPM successfully, and then achieving the desired results. Second aspect, the most previous studies have focused only on improving the overall effectiveness of the productive equipment individually during the implementation of 5S and TPM, rather than working on improving the production lines effectiveness in the organization as a whole; this through diagnosis and address largely the obstacles and challenges (Big Production Losses), which prevent the improvement of the state of implementation of 5S and TPM, and then leave the positive impact of these techniques (5S and TPM) on the overall effectiveness of production lines.

## 1.4 Research Objectives

The key aim of this research work was to help better understand the role of ethical and psychological factors in the implementation of 5S and TPM and their cumulative impact (5S and TPM) on the overall production lines effectiveness. The objectives of the study are:

1. To explore the role of the ethical and psychological factors in the implementation of 5S and TPM and the difference in their levels of implementation
2. To evaluate the state of implementation of 5S and TPM and detect obstacles that hinder this implementation, along with identifying areas (5S techniques and TPM pillars) that need to be improved
3. To study why does the state of implementation of 5S and TPM differ (if any) in the factories under study
4. To study the cumulative impact of the implementation of 5S and TPM as one system on the overall production lines effectiveness, and to diagnose the key challenges (Big Losses) that suffer them the production lines in their processes during the implementation of 5S and TPM.
5. To compare among production lines of the selected factories in terms of the cumulative effect of the implementation of 5S and TPM on the overall effectiveness of these lines.

## 1.5 Research Questions

To address the aforementioned research objectives and research problem, the following research questions guided the study:

**RQ1:** Do ethical and psychological factors play a role in the implementation of 5S and TPM and difference in the levels of their implementation?

**RQ2:** What is the state of implementation of 5S and TPM and the obstacles that hinder their implementation in the factories under study?

**RQ3:** What are the areas (5S techniques and TPM pillars) that need to be improved?

**RQ4:** Why does the state of implementation of 5S and TPM differ (if any) in the factories under study?

**RQ5:** What is the cumulative impact of implementation of 5S and TPM as one system on the overall production lines effectiveness? And the key challenges (Big Losses) that are faced by the production lines during the implementation of 5S and TPM?

**RQ6:** Which of production lines of the selected factories is the best in terms of the overall line effectiveness (OLE) during the implementation of 5S and TPM? And why?

## **1.6 Significance of Study**

The current study provides a new findings about the role that could be played the employees in implementation of 5S and TPM through a set of ethical and psychological factors that have a direct impact on the performance of these employees, as well as about the importance of 5S implementation in TPM projects, and also about the state of implementation of 5S and TPM and their impact on the overall production lines effectiveness in industrial organizations. The findings can:

- 1) Provide a deeper understanding about the crucial role that ethical and psychological factors play for employees in the implementation of 5S and TPM and difference in the levels of their implementation, as well as about how exploit this role positively towards achieving more success in the implementation of 5S and TPM, and then improve the production effectiveness to the fullest extent in industrial organizations.
- 2) Provide a clear vision about the paramount importance of implementation of 5S techniques within TPM projects, this is in terms of the ability of these 5S techniques to make the working environment more organized, cleaner and

more pronounced in terms of the problems for successful implementation of the TPM program (Sahu *et al.*, 2012).

- 3) Help the organizations management, including the study sample organizations to improve the state of implementation of 5S and TPM in their productive processes as much as possible. This is achieved by identifying the nature of obstacles and problems which would hinder the implementation of 5S tasks and TPM, and also weakening the implementation of the areas (techniques and pillars) of 5S and TPM; hence, taking the correct steps to eliminate or reduce these obstacles and problems, this by relying largely on the recommendations that have been mentioned in chapter 5 of this study.
- 4) Help the decision makers in industry organizations, including organizations involved in this study to provide objective and accurate information on the nature of the challenges (Big losses) which would lead to the lack of leaving a cumulative positive effect of implementation of 5S and TPM on the overall effectiveness of production lines in the organization as a whole; thus, taking the necessary proceedings to eliminate these challenges or reducing their gravity.

In addition, the current study provided comprehensive and basic theoretical base for researchers in the future regarding the concepts of 5S and TPM and the benefits that can be achieved by their implementation. Included among these were the phases of their implementation and the impact of their implementation as one system on production effectiveness in industry organizations. This beside providing the theoretical concepts regarding the metrics like (OLE) which would used in measuring and analysing the cumulative effect of implementing 5S and TPM as one system on production lines effectiveness in scenario of contemporary manufacturing.

## **1.7 Research Scope**

The Kurdistan region of Iraq as well as the rest of the country has been under a long period of stagnation due to economic sanctions since the early 1990s that has

lasted for over a decade and later on due to war in 2003, resulting in destruction of industrial infrastructure (Sunbul and Al-Kubaisi, 2010). After the collapse of the previous regime, the Iraqi government as well as the regional government of Kurdistan has embarked upon broad based developmental programs that require large quantities of construction materials, especially cement (Hamoudi, 2011; Al Moussawi and Al Jubouri, 2012; French group Lafarge, 2012; Edwards, 2013). According to an estimate, the cement demand in Iraq is rising by 10 percent annually (French group Lafarge, 2012) to cater for the development works in the field construction and infrastructure building destroyed during the war (Al-Moussawi and Al-Jubouri, 2012; Hamoudi, 2011; Fattah, 2010). However, despite the rise in cement demand as well as the increase in the number of cement factories, there is a significant shortfall in the supply of cement for the development purposes (Allurentis, 2013). This is mainly attributed to the low level of effectiveness of the production processes and higher maintenance cost of the equipment for these plants that result in higher production costs of the cement product (Kareem, 2007; Al-Moussawi and Al Jubouri, 2012).

For the reasons stated above, the researcher chose the cement industry in the Kurdistan Region of Iraq to conduct the study. The focus of the study was three cement plants (Tasluja, Mass, and Bazian). For more details about these factories, see Appendix (F). The specific focus of the study was the implementation of 5S and TPM in these cement plants. For this purpose, the researcher focused primarily on two major departments (production and maintenance), mainly due to their direct involvement in the implementation of 5S and TPM. The researcher also focused on the human resources department to achieve a clearer understanding about the state of implementation of 5S and TPM in the factories under study. These departments were highlighted during the preliminary interviews conducted by the researcher in the three cement factories. The purpose of these interviews has been explained in Appendix (E).

## 1.8 Basic Issues for Current Research

The main issue that drove researcher to choose 5S and TPM and conduct the study upon them, is that the 5S and the TPM together have become more popular especially in the area of manufacturing industries throughout the world. However, there are only a few industrial organizations that are able to reap the benefits of successful implementation of these techniques because the majority of the organizations face problems and difficulties during implementation. Therefore, the firms and factories, especially those that are always seeking to improve the financial situation and competitiveness, find a way to overcome the obstacles and difficulties faced during the implementation of these techniques (Tourki, 2010).

As well as, among the other basic issues that led to choosing 5S and TPM and conducting the current study on them were: Firstly, very few studies deal with 5S and TPM together, specifically within the cement industry sector, despite their popularity in the Asian context. Secondly, the absence of adequate literature about "what are the problems and difficulties which are faced by many organizations productivity 'especially in the Middle East' during the implementation of 5S and TPM, which prevent improving the level of production effectiveness as required". Thirdly, lack of literature on "How to measure the cumulative effect of implementing the 5S and the TPM on the overall production lines effectiveness by using OLE metrics".

The other big issue in the implementation of 5S and TPM represented in, the lack of studies which seek to detect the role of each of the ethical and psychological factors in the implementation of 5S and TPM and difference of the levels of their implementation. The successful implementation of several new techniques such as 5S and TPM depend entirely on the performance of the human element (employee), which in turn is influenced by several factors. The most important of these factors are the ethical and psychological factors. These factors are the foremost and the trendsetter for other factors for successful implementation of 5S and TPM and can affect the performance of the human element. These factors can have either a

positive or negative impact towards the implementation of these techniques (Wagle, 1990; Haroun and Duffuaa, 2009; Panneerselvam, 2012; Kumar *et al.*, 2014). Thus, the researcher intended to study the role of these factors in the implementation process of 5S and TPM, and also the role they can play in the level of implementation and its difference.

## 1.9 Definitions of Important Terms

In the current study, the important terms had been defined as follows:

- i) 5S is an idea generated from the Japanese housekeeping and stands for the Japanese words seiri (sort), seiton (set in order), seiso (shine and cleaning), seiketsu (standardize), and shitsuke (sustain). 5S has been termed as a useful tool for the lean manufacturing process that helps to simplify the workplace and make it more organized and cleaner and safety, this is by eliminating non value added processes and reducing waste and human errors.
- ii) TPM (Total Productive Maintenance) is an innovative program not only to maintain and improve the effectiveness of production equipment, but also to maintain and improve the overall production lines effectiveness, which through it the organizations be able to provide quality products and on-time deliveries. TPM has eight pillars which are as: Autonomous Maintenance; Focused Improvement; Planned Maintenance; Quality Maintenance; Training and Education; Development Management/Early Management; Safety, Health and Environment; and Office TPM.
- iii) OEE (Overall Equipment Effectiveness) is the quantitative tool designed by Nakajima in 1988 to measure the total performance of individual equipment in terms of the availability and performance of the equipment and the quality of the output produced. Thus, the OEE creates an awareness of how effectively the equipment is utilized and operated. OEE was also proposed as a metric for evaluating the progress of the TPM program. Therefore, OEE is considered a strong force that helps implementation of the TPM program throughout an organization.

- iv) OLE (Overall Line Effectiveness) is the last metric from OEE metrics based on the continuous manufacturing system. It has been developed by Nachiappan and Anantharaman (2006) as an index to evaluate the efficiency of a continuous product flow manufacturing system. One of the major goals of OLE is a diagnosis and treatment of what are called “Six Big Losses” which, in turn, are considered of the most common challenges that inhibit improve production effectiveness during the implementation of many programs and techniques, such as 5S, Kaizen, Six Sigma and TPM the used to bring out the production in industrial organizations. The OLE value can be found by considering the impact of the six big losses on the production line system in the factory.
- v) Six Big Losses are the losses that are considered of the most common causes of lost productivity in industrial organizations. These big losses include (Equipment failure/Breakdown, Setup and adjustment, Idling and Minor stoppage, Reduced speed, Defect and Rework, and Reduced yield).

### **1.10 Organization of the Study**

The study is divided into five chapters, each devoted to major aspect of the study designed to investigate the phenomenon of implementation of 5S and TPM and the factors affecting their successful implementation.

The first three chapters provide the theoretical and practical foundations of the thesis. Chapter One frames the study by comprehensively discussing the research topic in terms of the background, problem, objectives, questions, significance and scope of the research. The second chapter summarizes the relevant literature related to the 5S and TPM techniques and their implementation. Discussion is also presented on the literature concepts of OEE, OLE and Six Big Losses, in addition to the discussion the implementation of 5S and TPM as one system. Furthermore, the chapter also discusses important factors (ethical and psychological) and their role in successful implementation of 5S and TPM. The chapter also provides a theoretical



foundation before developing the model and hypotheses for the study. Chapter Three describes the methodology employed with particular attention paid for the methods (Instruments) and techniques used for data collection and analysed, as well as the issues concerning reliability and validity.

The last two chapters report on the results of the empirical field study undertaken to test the model. The analysis results appear in Chapter Four. Both of quantitative and qualitative results are presented and analyzed using inferential statistics and technical analysis methods for quantitative results, in addition to content analysis for qualitative data. Chapter Five provides the discussion on results, contributions of the study, limitations of the study, recommendations of the study, and suggestions for the future research.

## **1.11 Summary**

This chapter presented the background of the study that led to the formulation of the problem statement for the current research. The main issue is concerning the disclosure on the roles which can be played by the ethical and psychological factors in implementation of 5S and TPM; as well as, studying the state of implementation of 5S and TPM and their cumulative impact on the overall production lines effectiveness which, in turn, helps largely to diagnosis the obstacles and challenges faced by the industrial organizations in their production processes during the implementation of 5S and TPM, thereby to overcome them as much as possible. In this chapter, the research objectives and research questions that guide the study were also presented. The scope of the research and the choice of topic, along with the important terms were also briefly discussed. The proceeding chapters would highlight the previous literature, methodology adopted and the results generated through data collected using mixed methods, and also discussion and contribution of the study before recommendations of the study, future research directions and conclusion are provided.

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