CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Right from the olden days, man had been consuming several beverages. Tea is one of the widely consumed beverages by man (Alkan et al., 2009; Liu et al., 2010). Tea is largely used as a sign of hospitality. Nearly two third of the world’s population drink tea and it is next only to water in its consumption. Tea is also an important antioxidant agent which is believed to prevent a wide range of ailments like cancer and heart diseases (Sinija et al., 2007; Chen et al., 2009; Ravichandran, 2004). Tea is predominantly manufactured in countries like India, China, Sri Lanka and Kenya. There has been a stiff competition among these countries to conquer the international tea market. One of the strategies adopted by these countries to face the competition is the infusing of high degree of quality in the tea produced by them.

Besides aiding to face competition, quality of the tea influences the prices (Ravichandran, 2004). Hence, food technocrats and agronomists have been striving to identify solutions for improving the quality of tea. Though it appears as though only the food technocrats can contribute towards the improvement of quality of tea, it is a fact that engineers have a significant role to play in the manufacturing of tea (Temple et al., 2000). This is due to the reason that, the manufacturing processes of tea are developed through the design, production and operations of equipment which fall under the purview of various disciplines of engineering.
These manufacturing processes influence the quality of tea to a great extent. The failure to manufacture tea with high quality results in losing of sales too. While food technocrats have been studying the various chemical compositions of the raw material and their implications on the quality of tea, it is felt that engineers can contribute significantly in the manufacturing and engineering aspects of tea to enhance its quality. Though the tea industry has realised the importance of infusing high degree of quality to face the ever increasing competition, there has been a lack of knowledge about the Total Quality Management (TQM) concepts which have been used in other industries worldwide to produce high quality products and services. The need of the hour is that, this research and practice gap needs to be filled by applying the techniques adopted in TQM field in the manufacturing of tea.

TQM addresses the concept of ‘continuous quality improvement’. Continuous quality improvement results in improved productivity by eliminating defects, non-value adding activities and rework. Improving quality continuously also leads to the reduction of cycle time and machine time (Waddell and Stewart, 2008). It is felt that TQM concepts if implemented in tea industry will eliminate failures and thereby produce high quality tea which will fetch higher prices in the international market. Under these circumstances, failure analysis concepts need to be implemented to prevent the manufacturing of low quality tea.

The field of TQM has largely employed failure mode and effects analysis (FMEA) technique to carry out failure analysis in several fields (Tay and Lim, 2006). Meanwhile, some researchers have advocated the deployment of advanced versions of FMEA (Pillay and Wang, 2003). Therefore, it becomes important to explore the implementation of FMEA and its advanced versions in the tea industry. On realising this need, the doctoral work reported in this thesis has been carried out.
During the first phase of the doctoral work reported in this thesis, the literature was surveyed to identify the advanced and extended models of FMEA. After surveying the characteristics of these models, a model called Total Failure Mode and Effects Analysis (TFMEA) was found to be a suitable model for carrying out failure analysis in the tea industry. In the tea industry, two types of tea namely green tea and black tea are manufactured. Black tea is largely consumed throughout the world. During the second phase of this doctoral work, TFMEA was applied in two companies manufacturing black tea. The experiences of implementing TFMEA in these companies were used to investigate the practicality and benefits of applying TFMEA in tea industry. The details of these practice oriented research investigations are presented in the following parts of this thesis.

1.2 PROBLEM DEFINITION

A large number of companies worldwide are using TQM concepts to achieve continuous quality improvement (Waddell and Stewart, 2008). However, TQM techniques are not being used in tea industry. This is despite the fact that, today tea manufacturers are striving to produce high quality tea by making changes in the manufacturing processes and agronomic practices followed. Particularly, it is concerning to note that no failure analysis technique is applied today in the tea industry. In the TQM field, FMEA technique is widely used to analyze and prevent the failures (Devadasan et al., 2003; Sharma and Sharma, 2010). Yet FMEA technique is encapsulated with complex ranking procedure to assess severity, detection and occurrence aspects of failures. Furthermore, the application of FMEA is required to be complemented by complex Risk Priority Number (RPN) calculations (Tay and Lim, 2006; Sharma and Sharma, 2010). These complexities tend to make the application of FMEA in the tea industry an unrealistic phenomenon. Hence, a simple but effective failure analysis and prevention technique needs to be adopted for analyzing and preventing the failures in the manufacturing of tea. Such practice is missing in both research and practice arenas surmounting the tea industry.
1.3 OBJECTIVES OF THE RESEARCH WORK

After identifying and defining the problem of research, the literature was surveyed to identify a simple but effective failure analysis and prevention technique. This search ended in the identification of TFMEA technique. Followed by this identification, the objectives of this doctoral work were set. The primary objective of this doctoral work was to investigate the practicality and compatibility of TFMEA in attaining continuous quality improvement in the tea industry. This primary objective was achieved through the attainment of the following secondary objectives.

- To study the effectiveness of the TFMEA in preventing failure as a means to attain continuous quality improvement.
- To design a procedure theoretically for applying the TFMEA in tea industry.
- To identify two manufacturing companies for investigating the practicality of the TFMEA using the theoretically designed procedure.
- To implement the TFMEA in the identified two tea manufacturing companies.
- To provide guidelines for successfully implementing the TFMEA for analyzing and preventing the failure in the manufacturing of tea.
- To analyze the results of implementing the TFMEA in the two tea manufacturing companies.
- To make necessary modifications in the procedure based on the implementation experiences and the results of the analysis.
- To develop a broad roadmap and also evolve appropriate change management strategies for successfully implementing the TFMEA in tea industry.

The above objectives were attained during the doctoral work reported in this thesis by following the research methodology described in the next section.

1.4 RESEARCH METHODOLOGY

The doctoral work reported in this thesis was begun by surveying the literature dealing with the tea industry and failure analysis in TQM field. The results of this survey revealed that, no research on applying failure analysis techniques like
FMEA in the tea industry has so far been reported in literature arena. Tea industry is labor intensive and most of the laborers involved are not knowledgeable to scientifically analyze and point out the causes of quality failures in the manufacturing of tea. The results of the literature survey revealed that, TFMEA is a simple, effective and holistic technique and hence, it can be easily implemented in the tea industry to achieve continuous quality improvement (Devadasan et al. 2003). These findings favored the adoption of the TFMEA technique for investigating the practicality and compatibility of failure analysis and prevention in tea industry.

To begin with, a procedure consisting of 13 distinct steps was theoretically designed to implement TFMEA in tea manufacturing companies. By following this procedure, the TFMEA was subjected to implementation studies in two tea manufacturing companies. The experiences gained through the conduct of these implementation studies revealed that TFMEA is a practically compatible technique for achieving continuous quality improvement through failure prevention in tea industry. However, certain stages of TFMEA could not be completely investigated during the conduct of these implementation studies. The hurdles faced to implement these stages of TFMEA technique have been discussed in this thesis. This discussion will help the future theorists and practitioners to implement completely the TFMEA technique in tea manufacturing companies.

1.5 CHAPTER ORGANIZATION

This thesis has been organized in seven chapters. The organization of these chapters is shown in Figure 1.1. After this introduction chapter, the literature surveyed during this doctoral work is presented in chapter 2. While this chapter narrates the contributions of researchers working in the fields of tea, TQM, and FMEA, it pinpoints the absence of any research contributing a technique to achieve continuous quality and reliability improvement in the tea industry. In chapter 3, the TFMEA technique is introduced. The rationale behind the working of TFMEA technique is explained in this chapter. The hallmark of this chapter is the
enumeration of 13 steps for implementing TFMEA technique in a hypothetical tea manufacturing company.

Figure 1.1. Chapter Organization

In chapters 4 and 5, the efforts made to implement TFMEA technique in two companies by name ‘Pandian tea industry’ and ‘Swamy and Swamy tea plantations factory, Highfield’, are explained. ‘Swamy and Swamy tea plantations factory, Highfield’ is hereafter referred to as Highfield tea industry. These investigations were carried out in Pandian tea industry and Highfield tea industry by following 13 steps of TFMEA implementation which are enumerated in chapter 3. In chapter 6, the results of implementing TFMEA technique in Pandian tea industry and Highfield tea industry are analyzed and discussed. In this chapter, the hurdles that were faced during the implementation of TFMEA technique in Pandian tea industry and Highfield tea industry are narrated. The thesis is concluded in chapter 7. In this chapter the work carried out in the doctoral work is summarized. The limitations of this work are also indicated in this chapter. The avenues for carrying
out future research to effectively enhance continuous quality improvement of tea are appraised in this chapter.

1.6 CONCLUSION

Tea industry is one of the major sources of employment generation and export earnings in some of the developing countries (Alkan et al. 2009). Because of its potential in generating wealth, markets selling tea have been experiencing stiff competition. As a result, countries producing tea have been competing with each other to capture the global tea marketing domains. In this endeavor, quality of the tea manufactured and the price of the tea influence the share of each country in the global tea market (Chen et al. 2006). In this context, sustained efforts are being taken by the major tea manufacturers to improve the quality of tea and also to bring down the cost of manufacturing tea. It has been acknowledged by all the stakeholders that, quality is the major factor which determines the price of tea in the international market (Ravichandran 2004). Since tea manufacturing industry involves core engineering activities, it is envisaged that internationally accepted ‘continuous quality improvement’ approaches like TQM need to be applied in the tea industry for improving the quality of tea.

During the doctoral work reported in this thesis, the significance of applying one of the widely applied techniques in the TQM field namely FMEA, in improving the quality of tea was explored. Further the application of one of the improved versions of FMEA called TFMEA in improving the quality of tea was investigated. A literature survey conducted in this direction has indicated that, tea industry is yet to use a failure analysis technique for improving quality of its production and cutting down the processing cost. In realizing this research and practice gap, this research work has been undertaken. This gap has been filled in the doctoral work reported in this thesis by contributing a procedure for implementing TFMEA in tea manufacturing companies. The details of the efforts exerted to achieve this goal are presented in the following chapters of this thesis.