CHAPTER VII

Conclusions and Recommendations

7.1 Conclusions

This thesis has an objective to improve the organic rice operational process by using FMEA technique in order to reduce the amount of broken rice in the studied factory. The studied factory produces coated organic rice. The description of the production process is explained in Chapter 3.1. The current problems in the studied factory are evaluated in Chapter 3.2. As found by Pareto analysis (Appendix I), rice coating and drying processes are the main causes of the broken rice problem. These two processes account for 20.7% of broken rice in year 2006. Therefore FMEA is implemented to define, identify, and eliminate the problems occurred in the coating and drying process in the studied factory in order to reduce the percentage of broken rice and also the process time for coating and drying.

FMEA (Failure mode and effect analysis) is an engineering tool was used in the problem identification and analysis as mentioned in Chapter 4. This technique requires a teamwork, therefore, FMEA team which consists of multifunctional members was established first. Then brainstorm among the members was then carried out. The results of analysis are shown in Appendix II. The analysis has indicated that there are 26 risks that have RPN score over 100 (Table 4.4). These risks can be summarized as follows:

(1) Rice coating process

- Contaminates in rice
- Variation of paste viscosity
- Improper conveyor and brush speed
- Inconsistent quality of rice
- Uncleanness of paste mixing tanks and coating brushes
- Solidification of paste
- Uncontrolled moisture in the air
- Inhomogeneous paste in mixing tanks
- Wrong weighing of raw materials

- Inaccurate temperature during coating

(2) Drying process

- Improper drying temperature and drying time make the drying time longer than required
- Poor distribution of coated rice on belt
- Non-suitable temperature in drying rooms
- Deposits on drying belt

The FMEA team has discussed and suggested the actions for solving these problems. All of recommendation actions are reported in Appendix II and summarized as follows:

- Contaminates in rice at coating process is improved by set up work instruction
- Viscosity of paste varies batch by batch at coating process is improved by set up work instruction
- Long drying time at drying process is improved by set up preventive maintenance plan
- Improper conveyor speed at coating process is improved by update work instruction
- Inconsistent quality of rice at coating process is improved by set up work instruction
- Improper brush speed at coating process is improved by update work instruction
- Uncleanness of paste mixing tank at coating process is improved by modify equipment to match with cleaning
- Solidification of paste at coating process is improved by build insulation and set up work instruction
- Poor distribution of coated rice on belt at drying process is improved by set up preventive maintenance plan
- Improper brush speed at coating process is improved by training operators
- Improper conveyor speed at coating process is improved by training operators
- Uncleanness of coating brush is improved by modify coating brush system
- Nonsuitable temperature in drying room is improved by design insulation and update work instruction

- Uncontrolled moisture in air at coating process is improved by develop system that can control moisture in air
- Deposits on drying belt is improved by set up schedule for cleaning
- Uncleanness of paste mixing tank is improved by set up work instruction
- Nonsuitable temperature in drying rooms is improved by set up preventive maintenance plan and training to operators
- Wrong weighing of raw materials at coating process is improved by training to operators
- Inhomogeneous paste in mixing tank at coating process is improved by revise work instruction
- Inaccurate temperature during coating is improved by set up work instruction

The FMEA project for rice coating and drying processes has begun from July 2007 to October 2007 as mentioned in Chapter 6.2. After implementation, the results have indicated that there are improvement in amount of broken rice and process time for rice coating and drying processes. As can be seen from Table 6.2, the percentage of broken rice was reduced from 20.7% to 17.9%, which is equivalent to 13.8% reduction of the amount of broken rice. Similarly the process time for coating and drying processes after implementation was reduced from 172 to 141 minutes, which is equivalent to 17.8% reduction. This process time is calculated based on the processing time at coating and drying processes only since some failures after improvement (i.e. raw material preparation or paste preparation) acquire more time than before FMEA implementation. But this time is not taken into consideration when the researcher calculated the process time after FMEA implementation. The process of preparing raw material or paste is separated from the drying and coating process. For example, raw materials after contaminate removal will be stocked before the order is placed to carry on the drying and coating processes.

Although the objective of this thesis has been achieved, there are still some issues that can be developed in the future in order to improve the process further. These issues are discussed in the following section.

7.2 Limitation

There are limitations found in this research. Firstly the FMEA technique used in this research covers only rice coating and drying process. The FMEA technique can be used further in other processes such as organic rice loading and dust collection process and packing process. The time period used to evaluate the result after FMEA implementation is only 4 months (July 2007 to October 2007) which might not be enough yet to absolutely confirm the result. However due to the time limitation of this study, the researcher cannot further investigate the result in long-term.

The other difficulty the researcher has confronted is that it is not easy to work with other people. Since FMEA technique requires teamwork, it is inevitably to have arguments with other people sometimes. Particularly the researcher is female and has to cooperate with some operators and workers in order to get data necessary for this research.

7.3 Extension

7.3.1 Continue Improvement and Keep Updating

By definition of the FMEA which is an engineering tool to eliminate and/or reduce known or potential problem, it is necessary to keep updating new coming problems. After the FMEA starts, it becomes a living document and never really complete. This is the dynamic tool for continuous improvement and requires continuous updating. At the present, there are still 3 failures (having RPN score over 100) on which there is no action to take (Table 6.1). It is, therefore, suggested for FMEA team to try to solve these failures in the future. In addition, the criteria for pursuing FMEA technique, the RPN score, should be reduced from 100 to 50 (increasing the %confidences from 90% to 95%). This will lead to a reduction in the potential problems and a continuous improvement in the rice operational process in the studied factory.

7.3.2 Extension The FMEA Technique to Upstream and Downstream Processes

It is likely that broken rice can be caused by other processes apart from rice coating and drying processes. Overall process time of the whole production also depends on other processes such as dust collecting process, packaging process, metal detection process, etc. Since this study is limited to only rice coating and drying processes, it is certain that FMEA analysis can be extend to other processes in the studied factory. This will ensure the quality of raw material and final products and reduce the process time for some degree.

7.3.3 Determining Suitable FMEA Team Members

This research has focused on technical analysis while other perspectives such as purchasing, financial, accounting, stock controlling are ignored. Therefore some recommendations might not be the right solution in terms of cost, particularly because the financial staff is not included in the FMEA team members. It is suggested to include the staff from accounting and purchasing to join the team. In addition, if the FMEA analysis is intended to extend to upstream and downstream processes, staff whose work involving with these processes need to be included.

7.3.4 Continue Provision of Training Programs

Human error is one of the failure modes occurred in the studied factory. Operators do not follow the work instruction strictly and sometimes do not understand the work instruction clearly. Some works also require skilled operators. Therefore training is the most important factor to overcome this problem. Training should be carried out in several aspects. As suggested, general training should be provided to all staff of the factory. Then particular trainings that suitable for staff in each process should be specifically designed and provided for each process staff. For example, staff who work in coating process need particular training in the field of paste preparation, and coating technique.