Summary

The purpose of this thesis is to identify the top quality problems in ABB electrical machine factory's large stator core manufacturing and diesel generator's stator to frame welding departments, and to provide solutions to solving those, thus increasing the products' quality. In the result of the thesis different type of problems, affecting the quality of the stator core and welded stator in frame have been identified, analyzed, and actions for improvement described.

Competition for orders for new generators between different generator manufacturers is very high, since the market demand for generators comes from a limited number of customers. ABB is recognized for its high quality and integrity, therefore no cut backs in quality are allowed. It is vital for ABB's success to remain the quality leader status among competitors, since high reputation is a main weapon in competition. Therefore, the thesis hopes to contribute to the ABB's strive towards continuous improvement in quality.

Following to the short introduction about quality, the second chapter gives an overview of the ABB motors and generators history in Estonia, which did not start from manufacturing generators, but actually from manufacturing switch boards in Keila. From the beginning of the business activities of ABB in Estonia in 1992, the business has expanded into all the five ABB's business divisions, which are actively represented here, in ABB Jüri One Campus. Although it must be noted that the subject of this thesis, the diesel generator, is a product quite new to ABB's Jüri motors and generators factory. The production was ramped up to produce diesel generators in Estonia for the first time in 2012. This chapter also provides an overview of the diesel generator production and shortly describes the main components and processes.

In this thesis, the quality improvement theory has been purposely described in very short, since it has been widely covered by numerous literature, and was not needed to go too deep into the theory. It also would not add in originality or additional practicality to the thesis.

The fourth chapter, the case study, is the core of this thesis. The case study chapter was structured similarly to Six Sigma DMAIC model. The chapter starts with data collection, where the data

sample size consists of production quality notifications registered into the enterprise resource planning (ERP) software SAP from the beginning of 2013 till the end of 2014. The data required a lot of attention and corrections because of poor quality problems reporting level in the ABB factory. It was immediately clear that the data collection efficiency needs attention. The collected data was stratified by defect types, stakeholders, etc.

The problems of collecting data about quality problems in production and poor quality costs from SAP are outlined in the analysis chapter. The costs incurred by defects are the metrics to decide and prioritize quality problems. Therefore, the problems with quality cost reporting were analyzed, and a AS-IS process model of the current situation in quality cost reporting was formed. Further, the non-conformances were analyzed from three perspectives: 1) supplier quality problems (input to ABB), 2) quality problems during process, and 3) quality problems discovered in the next production phases (somehow unnoticed defects). With Pareto analysis, the top four problematic supplier materials regarding incurred costs (accounting for 80% for the non-conformances) were identified: 1) fingerplates, 2) end frames, 3) shell plates, and 4) bond beams. Each material problem was briefly described and conclusions made. A Pareto analysis of quality problems during process outlined the most expensive defects by type. Top problems discovered during production process in the large stator core manufacturing and diesel generator's stator to frame welding are 1) mechanical damages, 2) component position failure, and 3) dimension failure, and 4) defective materials from ABB suppliers. Problems were described. The third perspective in quality notification analysis looked at what type of defects go through the quality inspection and are only discovered in the later phases of production, or in worst case by the customer. In comparison to the previous two overviews, problems discovered in later production phases were less critical by defect nature, which derives from much lower incurred costs. The top problems were: 1) weld imperfections, and 2) cleaning after welding not done.

The improvement chapter focuses on solving three key problems: 1) how to improve reporting quality costs to SAP, 2) define quality notification minimum requirements, and 3) how to guarantee uniform air-gap between exciter stator and rotor. A TO-BE model for quality cost reporting was designed and the requirements for quality notification registering were defined. Approximate benefit from these improvements together with supplier quality improvements are

8408,5 € per year. Third improvement was designing a jig that helps to assembly the exciter stator inside the frame's end shield in the correct position, resulting in uniform air-gap between exciter stator and rotor. Calculating the savings from the new jig is a potential topic for a masters or doctoral thesis. Though, from the literature on the air-gap fault, this improvement will eliminate possibilities of static eccentricity of the exciter rotor. The negative effects of the eccentric air-gap are: 1) unbalanced magnetic pull, 2) deviations of the output voltage and current, 3) oscillations in the power of the machine, 4) unequal distribution of the load (causes local hot spots and wearing of coil insulation), 5) excessive mechanical vibrations, and 6) faster wearing of bearings.

Under the chapter called sustain, new materials were added to the incoming material inspection list together with inspection characteristics in order to prevent the same problems in the future. Also the use of the new jig was integrated into diesel generator's stator to frame welding inspection protocol. Economical calculations were formulated in the last chapter.