# 8 SUMMARY

The goal of this thesis was to improve assembly process TPT of one production line using ABB 4Q methodology. The practical part of the thesis consists of four parts. In the first part, problem and target were defined and all necessary data was gathered. In the next part, data was analyzed and causes for problems were investigated. The third part of the practical work focused on solving the problems and improving the assembly process. Last part acted as a summary for the project, where all documents were changed and finalized. Due to TPT data being confidential, all numerical time values were multiplied by unknown factor and units were changed to general "time-unit".

Thesis started with the 8-page theoretical part. This consisted of all theoretical background needed to fully understand the graphs and analysis behind every decision. ABB 4Q methodology was explained as this is the basis of the whole practical work. As 4Q heavily relies on statistical analysis, three most essential tools in this thesis were also thoroughly explained – control chart, capability analysis and cause & effect matrix with Pareto chart.

In the Measure part of the practical work, TPT data for each production step was gathered. All produced products between weeks 1 and 38 of the year 2016 were analyzed. All parts of production were compared to each other, but the other important fact was that on average, 16,6 % $\left(\frac{time\ stepnt\ in\ assembly\ buffer}{assembly\ process\ TPT} * 100\ \%\right)$ of time in assembly process on-one is working on the product. The target of the assembly TPT was decided to be 43 time-units.

The Analyze started with analyzing individual product's assembly TPT. It revealed that big part of the problem is current measurement system, because only 16,9 % of the products may have correct TPT data. During the period between weeks 1 and 38 of the year 2016, the average assembly TPT of these correctly measured products was 100 time-units. Time study was conducted, which showed that actual assembly of one product takes 15 – 19 time-units. Capability analysis was performed which concluded that current capability compared to target values is extremely bad and that current variation is 438 % of the target. Analyze ended with creating C&E matrix with Pareto chart to visualize the most important root causes that need to be fixed.

The last two parts of the practical work of this thesis, called Improve and Control, focus on fixing the most critical root causes, testing new process and finalizing necessary documents. It was decided that incorrect wire sets must be fixed, measurement system must be improved and

assembly process has to be more effective. According to the new assembly process, the product is assembled by two workers at the same time. When the new process was piloted, it showed a $51{,}1\,\% \left(100\,\% - \frac{TPT\ after}{TPT\ before} * 100\,\%\right)$ improvement. However, it was decided that to get a better understanding of the improvements, only actual work hours spent on the assembly of a product should be compared. This data transformation removes a huge amount of noise.

When removing all nights and weekends from TPT data, the average TPT of the old process would be **48 time-units**, target of the project would be **28 time-units** and the average TPT of the piloted new process would be **23 time-units**. Process capability index $P_{pk}$ improved from -0,43 to 0,33 which still leaves a lot to be desired but still is a massive improvement. Overall, the author of the thesis is happy with the results. Many improvements to the assembly process were made and the results were satisfactory. The target of 43 time-units with the nights and weekends included was not achieved during ten pilot assemblies, but when the noise was removed, it was clear that the process was capable of exceeding that target.