Summary

KROHNE develops and produces high quality, reliable and innovative measurement systems for industries worldwide. The research conducted here relates to the manufacturing facility KROHNE Altometer based in Dordrecht. At Dordrecht, 315 employees develop, manufacture and repair flowmeters for customers around the world. These flowmeters are based on two measuring principles. One principle uses the difference of potential generated by a flow of liquid through the tube, these are the Electromagnetic Flowmeters (EMF) flowmeters. The other principle uses ultrasonic sound measurements and are called Ultrasonic Flowmeters (UFM). Each type of flowmeters is produced in separate buildings. The ultrasonic flowmeters of the UFM3030 type, however, are produced in AK Altosonic segment but depend on the production facilities in the production of electromagnetic flowmeters in segment K1 Aquaflux for the paint spraying and the calibration process. The resulting transportation from one building to another is undesirable and has a negative effect on the on-time-delivery for both EMF and UFM.

KROHNE Altometer wants to conduct as many processing steps for one type of flowmeters within a single building as possible. In practice, the production steps of the UFM3030 are not much different from the electromagnetic flowmeters. This reports investigates the following main question:

"Investigate the feasibility of integrating the UFM3030 production in the production of electromagnetic flowmeters.".

The feasibility is investigated based on the goals and policies of KROHNE and an analysis of the current situation. The analysis of the current situation focuses on the assembly of the flowmeters, because here the problems are encountered with the shared machine capabilities. KROHNE wants independent production lines, with a flow oriented production, achieving an on-time-delivery of 95%. The average on-time-delivery in the second half of 2010 was 42%. KROHNE wants to use *Lean management* by aiming for low inventories by using the one-piece flow principle, a balanced assembly according to the takt time and a visual control of processes.

Based on the analysis, a number of constraints and design requirements have been established for a new situation in order to meet the desired policy requirements. This can be summarized in two points, reducing the variation and increasing the throughput in the process. The on-time-delivery should be improved by reducing variation in the assembly. The poor on-time-delivery is caused by absence of employees, shortages in materials, failures in PST6, rush orders in the assembly and processing the UFM3030 from AK with painting and the final assembly. Integrating UFM3030 in EMF production does reduce variation in the assembly, but this measure is not sufficient enough to improve the on-time-delivery to 95%. That would also require an increase in the throughput potential of assembly in K1.

The detailed design requirements result in an integration of the UFM3030 production processes, an increase in the potential throughput and preventing waste in the assembly in K1 caused by unnecessary transportation and work in progress (WIP). The detailed design requirements can be divided into:

- Materials and equipment should be added to be able to integrate the UFM3030 in the production of K1. In the assembly, a signal test is required for UFM3030 after assembling the sensors. Furthermore, the necessary tools have been identified in the task diagrams UFM3030.
- Based on the required takt times, additional work stations have been assigned to the processes and guidelines are given for balancing unbounded mixed-model production lines. One such product line, multiple variants of a product are assembled with a position WIP between each processing step.
- The control is relocated to a lower level of control in the form of team leaders who can quickly respond to disturbances in the process. Unnecessary transportation and WIP are prevented by defining inventories of WIP in advance, a controlled order intake and a better supply of materials to the workplace.

The basic solutions have been worked out in more detail in a physical design of the assembly. This design is used to explain how the new workplaces could be divided and how potential wastage in production can be avoided. The design can be used as a future state. In detail, the actual design is likely to be different, because each step towards the new situation creates other variables to be take into account. The implementation of the recommended situation is a long road. The most important of the entire implementation is the discipline which is necessary to hold a productive meeting every week so that small steps in the right direction can be made. A possible route may consist of introducing a skill-matrix and training of all the employees involved, the transfer of the required materials, transferring the tools, the actual transfer of production, structurally reducing the amount of WIP in the production so that problems are identified and the implementation of Kaizen for continuous identification and resolving of problems.

The implementation of the recommendations cannot be performed in one go. Any changes in production will gradually be implemented by defining plans, setting up test facilities and assessing results. In a cost-benefit analysis the necessary costs are compared against the potential benefits. The required costs of around € 250,000 may be recovered in less than three years through improvements in the efficiency of the work.