Summary for the application for “Olle Jonson-priset” 2023

At Volvo Powertrain in Skövde the combustion engine cylinder heads are cast in foundry 2. The production of cylinder heads is fully automated except for the Volvo Penta D6 and D4 cylinder head, in which prior to casting, the sand cores are assembled manually. Since the sand cores are difficult for a robot to assemble and because they are produced in a lower quantity compared to other cylinder heads. At the current workstation the manual assembly creates a bottleneck in the production of the D6 and D4. This is due to a lower production rate and a high error rate when compared to the rest of the cylinder heads produced at foundry 2. Most of the production errors are gluing errors. This is a problem because it lowers the production rate at foundry 2 and because the high error rates result in a high quantity of discarded moulds. Another problem is the ergonomics of the workstation, which can lead to fatigue and physical damage to the operators. The goal is to decrease the strain on the operators.

With the problems and their consequences as stated above, Volvo Powertrain wants to investigate if there is a possibility of implementing collaborative robots for the gluing of the sand cores in the assembly of the D6 cylinder head.

The use of both industrial and collaborative robots is well known in the world today. At Volvo Powertrain in Skövde the manufacturing in dominated by industrial robots, industrial robots are used in both foundry 1 and 2. Whereas the company's knowledge of industrial robots is substantial, the company's knowledge of collaborative robots is limited. This includes the different standards that are used, the risk assessment and general information for collaborative robots.

Several methods were used to broaden the knowledge of the uses of collaborative robots. A requirement specification was created where desirables and requirements were established. With the use of idea generation methods as well as decision matrices a suitable concept was established. A simplified risk assessment was performed along with data acquisition of the time it takes for the operators to perform their tasks at the current workstation. The data was then statistically evaluated with the three-point method. With this information the visualisation of the new workstation could be performed. Lastly an ergonomic and economic analysis of the new workstation was conducted.

In the requirement specification 2 main measurement values where defined. The production rate and the error rate. They are especially important because they tell if the implementation of the collaborative robots at foundry 2 is possible and if it is economically justifiable. The workflow of the thesis is closely related to these 2 measurement values.

In the thesis relevant information that is needed to implement collaborative robots is presented. Summarised information of different standards, rules and regulations that can be applied to collaborative robots can be found. A python script for calculating the collaborative robots speed according to ISO 15066´s force and power limiting can be found in attachment 2. The risk assessment presented in the thesis is simplified but can be used as a background or a starting point for a full risk assessment of the new workstation.

The value provided by this thesis is that it shows that collaborative robots are suitable for application at the D6 working station. This thesis also provides value in that it expands the edge of knowledge meaning that Volvo can use this knowledge in their production at other places than the D6 working station. The implementation of collaborative robots at the D6 working station will have a payback time of 0,6 years and will increase production rate with 44%, as well as lowering the gluing related error rate. This thesis will be of interest for engineers and supervisors seeking to implement collaborative robots in a production flow.

This thesis has shown what is possible to achieve with collaborative robots within the scope of the D6 working station. To implement this a full risk assessment must be made, a new economic analysis must be made, the equipment must be purchased, and a detailed construction of the station must be made. After the working station has been implemented the production rate and error rate calculated in this thesis can be validated by measuring the error and production rate after the collaborative robots has been implemented. The error rate will be lowered, and the production rate will be increased as shown in this thesis.