This research paper concerns the design and development process of a customized gripper, which can take small and odd shaped products out of the injection moulding machine BOY-22E. The main part of this document starts off with a list of initial conditions, after which the case specification will elaborate on the *problem* that is dealt with in this report: i.e. what is the exact function of a gripper in this specific context.

First a more unconventional method of grabbing is discussed in chapter 5: The Gecko Angle. Here the possibilities of bio mimicking the gecko's setae (and therefore its adhesive qualities) are further explored, by looking into the gecko's climbing capabilities and the current efforts to replicate (parts of) this process. Unfortunately it is currently not possible to use gecko inspired techniques for the gripper discussed in this paper, as the products are too complex in shape and too flexible. Besides the gripper would have to be quite big as it also needs a mechanical mechanism to ensure the release of the products.

Next to the gecko research, further research was done into existing gripping methods. Research into Existing EOAT (End of Arm Tooling), elaborates on servo-electric grippers, vacuum grippers, hydraulic and pneumatic grippers. And it will be discussed why magnetic grippers, as well as Advanced Tool Changers will not be relevant for this project, but potential helpful in the future. The chapter also briefly mentions the potential benefits and necessity of sensors, especially of cameras and load cells. Although, load cells will not be taken into consideration due to their lack of precision and strength with regards to the scale of this project. The conclusion of this chapter is that vacuum grippers have the most advantages, although they might be in need of servo-electric support.

After the research phase the document shows the initial ideation and the concepts that where based on the findings so far. The chapter dedicated to this starts with some ideation on both servo-electric and vacuum based gripping mechanisms, and shows the summary of a brainstorm on the pros and cons of both of these methods. It is explained why from now on the focus will be solely on vacuum as actuating principle, after which the feasibility of the various ideated vacuum designs is considered. This includes looking into: the right size of suction cups, the power of a single vacuum ejector, and the real problems caused by air leakage. The minimum amounts and necessary types of sensors are also briefly discussed. The chapter ends with four possible concepts, each with a different approach to realise optimal placement. With the big question being: what is more important? Quality (precision) or quantity (amount of suction cups)?

In the Revised Requirements the initial conditions are repeated and better quantified, now also including technical requirements. This chapter is meant as an overview to fall back on whilst testing and potentially adjusting or combining the concepts from chapter 7. It also shows some added wishes by the client, which explains the reasoning for some of the design directions and overall recommendations done in chapter 10.

Then follows the prototyping and testing phase where the concepts are translated into prototypes. This chapter shows what was needed to build each prototype, how they were assembled, and which concepts proved to be best. During the assembly process it became clear that the Canvas Concept and the Slots Concept scored very low on user friendliness. Both the Module Concept and the Gliders Concept did show promising test results. It also became clear that though precision is very important, suction cups with a diameter of  less than 2mm do not have enough individual suction force to

withstand any form of deformation, or anything other than *perfect* placement. Since this is not 100% achievable, these cups are removed from consideration.

Modifications and Recommendation (chapter 10) is mainly about proposed adjustments of the chosen final concept. The Gliders Concept showed most promise, though closely followed by the Vacuum Module. The Gliders Concept scores the highest on versatility and user-friendliness, albeit a little less on its error-solving capacity. This chapter show a theoretical and visual overview of the proposed adjustments in order to reduce the flaws of the current design. It then sums up other recommendations and suggestions for further research and development.

Lastly chapter 11 will offer some concluding remarks and a small reflection on the whole process of doing this project.