Decreasing Costs in the Packaging Industry with Computer Simulations

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M.Sc.Eng. Master Thesis
Title: *An Optimization Framework for Elastomer Machine Tools*

Did you know that practically any structure can be computer-simulated? To find out how the structure responds to loads, heat, vibrations etc.? By doing so, the design can be improved and re-simulated until all design requirements are met and the design is ready for production. It may sound overly complicated, but engineers in all industries have already practised this methodology for decades to save time and large expenses on building physical prototypes.

AR Packaging is one of the larger Swedish packaging companies. They develop, manufacture, and sell machines that produce food packages. Most new customers want their unique package design, which means that the machine must be customized for every new customer. Some of the parts are more difficult to redesign (so they function properly) than others. Furthermore, the overall costs can be decreased if the customization process is accelerated. In this master thesis, a computer simulation methodology is developed to speed up the redesign process of the so-called plunge tool, a cup-formed rubber-like machine tool.

The Finite Element Method (FEM) is probably the most common engineering tool for simulating structures. This project has used it to calculate how stresses and deformations spread through the plunge tool, given its geometry, material, and environment. Using such a tool is risky however, the accuracy of the simulation is unknown until it has been validated with a real-world example. The simulation becomes misleading if it is not accurate enough.

Hundreds of measurements have been made on different plunge tools in this project to get a feel of what makes a great performing plunge tool and to validate the FEM simulation. Since the measurements always contain errors themselves, statistical tools need to be applied. One such very versatile tool is *Design of Experiments* (DoE) which has been used here.

DoE is so versatile that it has been used in two contexts in this thesis. The other case is together with the simulation in a method called *Response Surface Methodology* (RSM) to find the optimal plunge tool design for a customer.

The tools mentioned here have been combined to form a *framework* in this project. The framework has already showed promising results and it is intended to be easily applicable by the company in future projects to save costs and development time.