Introduction

UNeedle is a high-tech start-up based in Enschede, the Netherlands. The activities of UNeedle are research, development and manufacturing of microneedles used for intradermal injections. The cannulas in these microneedles are made out of silicon through the use of a process called photolithography, an etching method involving extreme ultraviolet light. As part of its strategy, UNeedle is ramping up the production output by automating the assembly process. An advantage of this transition is the increase in assembly process-related data.

In essence, UNeedle wants to utilize this data to get more insight and make data-driven design choices on what assembly process-related challenges to tackle first. It was chosen by the management to do this according to the Overall Equipment Effectiveness metric or OEE. The OEE is a concept from the Total Productive Maintenance system developed by Seiichi Nakajima. Three main metrics describe how successful an assembly line is compared to the maximum output. These metrics are; availability, performance and quality.

Approach

In order to sufficiently define the OEE and develop the dashboard, a systematic literature review was carried out to find an applicable definition of the OEE onto UNeedle's assembly line and to understand and prepare production data (Wirth and Hipp, 2000) so it could be of use in a final dashboard. Besides the literature review, multiple interviews were conducted with stakeholders in and outside the company to understand UNeedle's background, objectives and way of working. Numerous visits to the cleanroom have been undertaken to get a comprehension of the assembly line to be monitored. All this research resulted in a draft dashboard that was iteratively improved with an engineer's and manager's feedback to get to a final design.

OEE

During the research, two different definitions of the OEE have been developed as a result of the theoretical research conducted and the experience gained during the practical application. One had a more academic approach and assumed that everything was measurable. The other had a more practical definition which could have been implemented with available data. A definition in which the OEE can be displayed according to UNeedle’s needs was made. In this application, the leading production equipment was used to calculate the OEE and identify errors and processes, whereas the manual processes were only measured for their performance metric. Multiple key performance indicators were defined that would later be used in the dashboard.

The IT behind the dashboard

The technology implemented to facilitate data retrieval, storage, manipulation and display came down to a combination of Google Apps Script, Google Sheets and Google data studio. Because all tools operated in Google workspace, seamless and fast integration was possible. This aided the goals of fast, semi-automated information transfer and manipulation at zero costs.

The Dashboard

A dashboard has been designed that meets UNeedle’s requirements. It displays equipment effectiveness according to a tailor-made OEE definition, splitting up into availability, performance

and quality dashboards, all with different timeframes. It also includes two extra dashboard pages with process and error Pareto charts to aid data-driven assembly line improvement.