Miniature Microscope Manufacturability and Cost Analysis

Degree programme: BSc in Industrial Engineering and Management Science | Specialisation: Industrial Engineering
Thesis advisors: Prof. Dr. Cédric Bessire, Matt Stark

Economies of scale occurs when the production cost of a product unit decrease with an increasing number of produced units. This phenomenon is crucial to lower the price of a product, making it more accessible and affordable. This is important if the targeted customer is financially restricted.

Problem Situation

Most of the medical equipment used in developing countries are unreliable. To mention a few issues, this is due to spare parts being unavailable or being too expensive, a regular disruption of the supply chain, and unreliable electrical power. Several projects intend to provide access to medical devices by making their design open source, for example by supplying the files for the 3D modelling and printing. However, the procurement costs for the components might still be too excessively high for a potential end user. By applying economy of scale principles to the example of a miniature microscope with versatile medical usage, this project proves the reduction of unit cost. This product becomes more affordable for developing countries' researchers, doctors, and students.

OpenFlexure Microscope

The OpenFlexure project aims to facilitate the diagnostic of malaria by creating an open-source microscope with extremely low assembly costs thanks to 3D-printing. The microscope uses flexure properties from 3D-printed plastic to provide high precision mechanical positioning that is crucial for microscopic focusing (see Fig. 1). The compact and light-weight design makes the microscope suitable for transport. A monitor is required to investigate the images, that are sent from the microscope's internal embedded system Raspberry Pi.

Reduction of costs through economy of scale

When manufacturing a single product, the costs of production are set on a single unit. The more units are produced, the lower the fixed costs per produced unit become. For the OpenFlexure Microscope, the original single unit cost could significantly be decreased by increasing the number of produced units from 1 to 10'000. This cost effect is particularly observable in the cost for the components required to fabricate one of the parts of the microscope (see Fig. 2). For example, most distributors have a minimum order quantity per part. When building a single microscope, if only one component is required but the minimum order quantity is five, the costs of the four additional units will fall on the single microscope. Then, when reaching a certain order quantity, the distributor will ship the components for free. Finally, the distributor might offer an order quantity discount. In the end, the cost per Microscope could be reduced by more than 50%.

Samuel Michellod

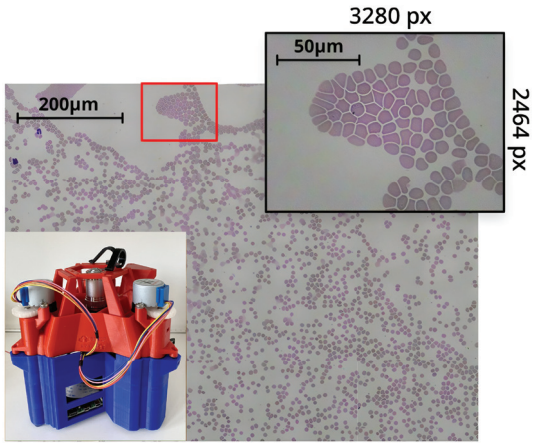

Figure 1 OpenFlexure Microscope with the reflection illumination module imaging Red Blood Cells.

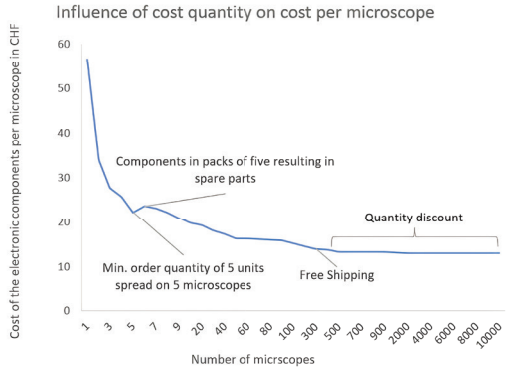

Figure 2 Graph depicting the economics of scale phenomenon through the ordering of electronic components in large