

## SUMMARY

At the time of writing the summary, the serial production was starting to ramp up. The effects which were revealed and given by the thesis were starting to pay off and the extensive analyse proved the production floor to be ready for the serial demand reaching thousand plus pieces.

The processes viewed in the first paragraph were used skilfully to prototype the product with improved design. Welding which was investigated more in depth was a challenge which was beaten and resourcefully so. The development of the product with changing the production process while maintaining the functionality was succeeded. Live testing at the clients' test lab and also computer simulations prove the changed joint function of the product to be up to the expectations. The destructive sequence proved the product to fail due to material thickness before the welding joint was showing any sign of cycle induced wear or crack. It can be said that the product design optimisation for the strengths and existing solutions and know-how of SMAHT was succeeded. The product costing model for the product was taken to bits and calculated with different machinery options. The most profitable and eco-friendly solution was found, and the processes were defined for serial use. The optimal quantities for production and purchasing were also found to keep the product price as low as possible and with it the holding costs. The process times were measured during the first prototype batch and together with it the plan B machinery picked. For future the product can be produced via different methods and using different machinery. This will also need future experimentation and analyse to find new ways to make the production more stable and efficient. The layout errors were discovered, and corrective actions started to better the flow and efficiency.

Sales price comparison between initial design and after development (same prices removed)

<b>Improved design (automated)</b>	
<b>Process</b>	<b>Cost € (per unit)</b>
Welding	1,62
Grinding	0,43
Purchasing items	5,82
<b>TOTAL</b>	<b>12,24</b>

<b>Clients design</b>	
<b>Process</b>	<b>Cost € (per unit)</b>
Assembly	0,65
Purchasing items	8,31
<b>TOTAL</b>	<b>13,33</b>

The result was a successful development project which converted into serial production and profitable business. The smaller optimisations still await, together with new solutions paired with more autonomous and efficient processes.

## KOKKUVÕTE

Lõputöö kokkuvõtva osa kirjutamise ajal äsja algas seeriakoguste tootmine. Lõputöö viljad hakkasid värskelt võrsuma ja põhjalik analüüs ning arendustegevus lõputöö kestel tagas tootmisüksuse valmisoleku tuhandetesse küündiva nõudluse tagamiseks.

Esimeses peatükis vaadeldud protsessid leidsid kasutust tootedisaini arendamisel ning prototüüpimisel. Keevitus protsess, mida lähemalt tutvustati oli pärjaks väljakutseks, kuid sai lahendatud. Tootearenduse protsess muutmaks etteantud tootmislahendust säilitades toote funktsionaalsus õnnestus. Katselaboris tehtud purustavad ning tsüklilised katsed üheskoos LEM analüüsiga tõestasid, et keevisühendus on vähemalt sama tugev kui eelnev lahendus. Purustavas katses purunes esmalt toode ise enne keevisõmblust, õhukese materjali paksuse tõttu. Katsetuste tagasisidena võib ütelda, et SMAHTi tugevuste, teadmiste ning ekspertiisi kasutamist saatis edu. Tootehinna mudel sai osadeks lahti võetud ning erineva sisendinfo ka seeriahindade tarbeks kalkuleeritud. Hetkeseisuga, kõige kasumlikum ning loodust säästvam lahendus leiti ning ka tootmisprotsessid määrati. Ka optimaalseimad tootmiskogused ning ostutoodete kogused sai välja arvutatud eesmärgiga hoida kulud madalal ning need on ka tänasel päeval kasutuses. Protsessiajad said esimest korda ka realselt prototüüp-partii ajal mõõdetud ning ka varumarsruut tootmiseks leitud. Tulevikuks jääb leida veel tõhusamaid lahendusi tootmiseks, mida hetkel veel tehasel kasutada pole, kuid piisava tasuvustõestusega oleksid investeeringutena päevakorras. Erinevaid tootmismeetodeid on palju ning neid võiks uurida lähemalt tagamaks stabiilsus ning efektiivne tootmine. Esimese katsepartiiga kaasnes ka puudujääkide tuvastamine tehase asetuses ning transpordiviisides. Selle tulemusena algatati parendustegevused, et tagada stabiilne töövoog.

Müügihinna võrdlus kliendi disainile ning arendatud tootele (ühilduvad protsesside hinnad eemaldatud)

Improved design (automated)	
Process	Cost € (per unit)
Welding	1,62
Grinding	0,43
Purchasing items	5,82
<b>TOTAL</b>	<b>12,24</b>

Clients design	
Process	Cost € (per unit)
Assembly	0,65
Purchasing items	8,31
<b>TOTAL</b>	<b>13,33</b>

Lõputöö tulemuseks oli edukas tootearendusprojekt millest sai kasumlik tooteliin. Väiksemad optimeerimised ootavad veel ees koos uute autonoomsemate ning efektiivsemate tootmislahendustega..