# KOKKUVÕTE

Töö eesmärgiks oli luua kliendi nõuetele vastav elektriliselt avatava laadimisluugi süsteem MiCa bussi jaoks. Esmalt tutvustati ettevõtet AuVe Tech ja selle poolt loodud isesõitvat sõidukit MiCa.

Selleks, et saavutada eesmärk oli vaja kaardistada eelnevalt loodud MiCa bussidel kasutatavad laadimisluugi lahendused ja neid analüüsides tuvastada vajalikud omadused. Toodi välja eelnevate lahenduste kitsaskohad ja head küljed mida lahendusse kaasata. Seejärel kaardistati turul leiduvaid lahendusi suurte autotöötjate tooteportfellide hulgast ja analüüsiti nende omadusi. Koostati tabel koondamaks kliendi vajadusi, mida süsteem peab täitma. Võrreldi turul olemas olevaid lahendusi kasutades lahenduste hindamismaatriksit Tabel 2.3, eesmärgiga saada ülevaade millised omadused on tehtava lahenduse jaoks kõige olulisemad. Samuti oli vaja tekitada pingerida, et valida parim lahendus MiCa bussi jaoks ning selle lahendusega minna edasi kontseptsioonide loomise etappi. Parimate omadustega lahenduse – Küljele pöörav luuk – põhjal loodi kolm kontseptsiooni, mis oleksid üksteisest piisavalt erinevad. Kontseptsioone hinnati kasutades kontseptsioonide hindamismaatriksit Tabel , leidmaks parim kontseptsioon. Valiti parim lahendus – Vertikaalse fikseeritud võlliga. Peamisteks põhjusteks, miks antud lahendus oli süsteemi arendamiseks parim, on selle kompaktsus ja üleüldine keerukus võrreldes teiste kontseptsioonidega. Antud olukorras pakkus see kompaktsuse osas suurimat kindlust, süsteemi ära mahtumisse antud ruumalale.

Selle kontseptsiooniga mindi edasi projekteerimise faasi, kus valiti süsteemi arendamiseks sobivad komponendid. Süsteemi arendamisel oli vajalik arvestada bussi osadega, mis on liikumatud. Sellisteks osadeks olid ülemine raam, sisemine ja välimine komposiitplaat ja laadimispistik. Loodi laadimisluugi süsteemist virtuaalne mudel ja selgitati lahti selle olulisimad sõlmed ja nende toimimine.

Teostati insenertehnilised arvutused. Tehti tugevuskontroll võllile olukorras, kus luugi vastu toetub 100 kg kaaluv inimene. Selle käigus saadi teada, et kasutatav materjal POM ei ole antud kasutuses piisavate tugevuslike omadustega tagamaks võlli tugevust. Seejärel võeti kasutusele AW6060 T6 materjal võlli jaoks. Arvutades selgus, et ka seda materjali kasutades ei saavutata võllil piisavat tugevust. Seejärel tehti arvutused ja leiti, et on vajalik suurendada võlli läbimõõtu 10,5 mm pealt 13,5 mm peale. Selliste parameetritega oli tagatud võlli tugevus olukorras kus selle keskele toetub 1 kN koormus.

Töö väljundiks on virtuaalne prototüüp, mis hõlmab kõiki laadimisluugi süsteemi osasid ja pakub võimalust visualiseerida luugi avanemise geomeetriat. Prototüüp vastab ettevõtte poolt seatud vajadustele ja pakub ettevõttele võimalust testida laadimisluugi süsteemi ning seda jooksvalt edasi arendada ilma vajaduseta seda toodetava sõiduki küljes teha.

# SUMMARY

The goal of this paper was to create an electrically opening charging port system for the MiCa autonomous shuttle, that meets the customer's requirements. First, the company AuVe Tech and its self-driving vehicle MiCa were introduced.

In order to achieve the goal, it was necessary to map the charging port solutions used on previously created MiCa buses and to identify the necessary features by analyzing them. The bottlenecks of the previous solutions and also the good sides were pointed out in order to avoid or use them in the new solution. Then, the solutions available on the market were mapped from the product portfolios of major car manufacturers and their characteristics were analysed. A table was prepared to summarize the customer's needs, which the system must fulfil. The solutions available on the market were compared using the solution evaluation matrix Table 2.3, with the aim of getting an overview of which features are the most important for the solution to be made. It was also necessary to generate a ranking in order to choose the best solution for the MiCa bus and to proceed with the best solution to the concept creation stage. Three concepts were created based on the solution with the best features – the side-turning hatch – that would be sufficiently different from each other. Concepts were evaluated using the concept evaluation matrix Table 3.1 to find the best concept. The best solution that was chosen - with a vertical fixed shaft. The main reasons why this solution was the best for system development are its compactness and overall lack of complexity compared to other concepts. In the given situation, it offered the greatest certainty in terms of compactness, that the system could fit into the given space.

This concept was moved on to the development phase, where the components suitable for system development were selected. When developing the system, it was necessary to consider the parts of the bus that are immovable. Such parts included the upper frame profiles, the inner and outer composite plate, and the charging plug. A virtual model of the loading hatch system was created, and its most important nodes and their operations were explained.

Engineering technical calculations were performed. A strength calculation was performed on the shaft in a situation where a person weighing 100 kg leans against the hatch. In the process, it was found out that the material POM used does not have sufficient strength properties to ensure the strength of the shaft. AW6060 T6 material was then introduced for the shaft. When calculating, it turned out that even using this material does not achieve sufficient strength on the shaft. Then the calculations were

made, and it was found that it is necessary to increase the diameter of the shaft from 10.5 mm to 13.5 mm. With such parameters, the strength of the shaft was guaranteed in a situation where a load of 1 kN rests on its centre.

The output of the work is a virtual prototype that includes all parts of the loading hatch system and offers the possibility to visualize the geometry of the hatch opening. The prototype meets the needs set by the company and offers the company the opportunity to test the loading hatch system and develop it on an ongoing basis without the need to do it on a production vehicle.