ASSEMBLY PROCESS OPTIMIZATION FOR CHARGEBOXES

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Designing a comprehensive system that optimizes the assembly process of hexagonal-shaped ChargeBoxes for efficient handling, storage, rotation, and transport.

The design research presented in this thesis was conducted for ChargeHyve, a start-up company specializing in fireproof locker systems for charging electric bike batteries. These lockers provide safety and prevent potential fire outbreaks. However, the company's current assembly process contains multiple inefficiencies that affect productivity, ergonomics, and safety. This thesis aims to address these challenges by answering the research question:

"How can the assembly process of hexagonal-shaped ChargeBoxes (CBs) be optimized through the design of a comprehensive system for efficient handling, storage, rotation, and transport?"

The research follows a structured approach, beginning with an in-depth analysis phase. Observations, interviews with the assembly team, and ergonomic evaluations revealed critical issues, including awkward lifting postures, unstable handling, and inefficient storage practices. These challenges not only slow down assembly but also increase the risk of injuries and errors. Further stakeholder and target group analysis identified user needs and properties. Product specification research examined weight, dimensions, and fragile components of the CBs. Based on these findings, a requirement list was developed to guide the design phase.

The design phase addressed two main objectives: optimizing storage and improving handling mechanisms during the final assembly steps:

1. Storage Optimization:
   A Vmax shelving system with custom storage compartments (figure 1) was developed to create a more space-efficient and organized workplace. The compartments are provided with protective materials to prevent damage to the CBs and facilitate easy sliding and retrieval. This solution improves workflow and ensures a cleaner, safer work environment.

2. Mobile height-adjustable cart with a tilting framework:
   A mobile height-adjustable cart with an integrated tilting framework (figure 2) was designed to handle the CBs during the final stages

Figure 1, Storage Optimization

of assembly. Inspired by bike storage mechanisms, the tilting framework allows for smooth 90-degree rotation, enabling easier access to all sides of the ChargeBox. This solution reduces physical strain on workers, improves ergonomics, and minimizes the risk of damage to fragile elements.

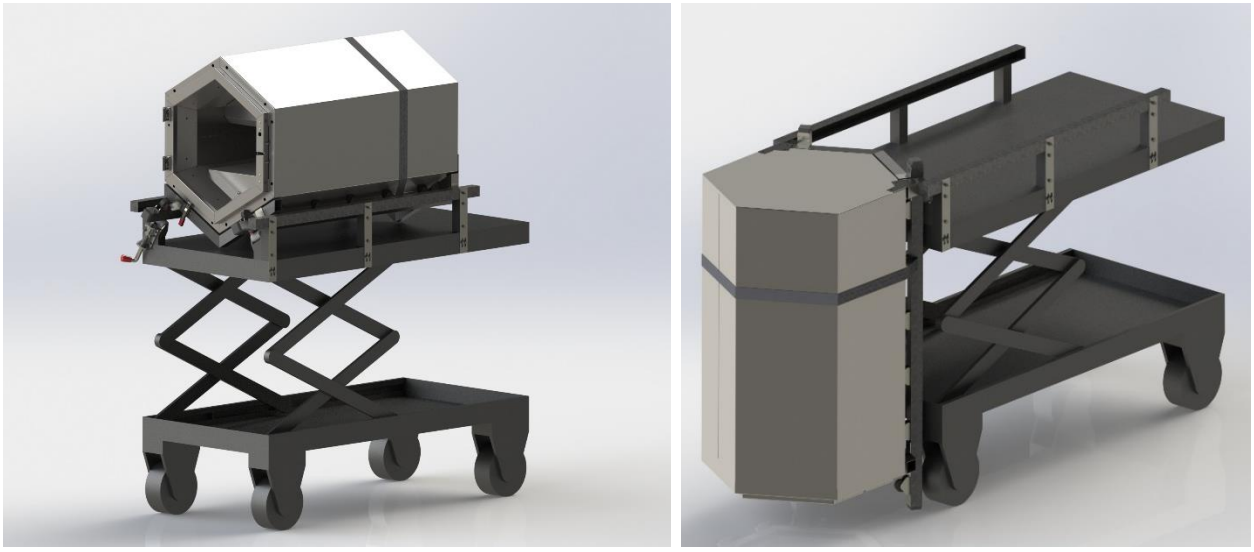

Figure 2, Mobile height-adjustable cart with a tilting framework

The final system (figure 3) addresses the identified challenges, enhancing safety, ergonomics, and operational efficiency. The combination of Vmax shelving and the tilting cart forms a robust foundation for improving the assembly process while providing scalability for future operational growth.

In addition to the design itself, this research highlights areas for continued improvement. Recommendations include prototyping and user testing to validate the design, cost-benefit analysis to ensure feasibility, and further ergonomic studies to refine worker comfort and safety.

This project demonstrates how thoughtful design can transform workplace efficiency while prioritizing safety and user well-being, aligning with ChargeHyve's vision for innovation and quality in their assembly process.

Figure 3, Final system