Summary Bachelor Assignment

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This bachelor assignment consists of a thorough analysis of waste management and waste removal from the trains of the railroad company NS in the Netherlands. The aim of the assignment was to create a long term plan on how waste bins on the trains can be improved. The analyses brought different issues to the surface. Through discussions and ideations, multiple design iterations for improvement of the waste removal were conceptualized. A significant amount of this assignment entails the analysis of waste removal on the NS trains. The analyses were split into multiple parts.

Firstly research into the waste status of 2022 in the NS trains was extensively performed. The research into the current waste status showed many different findings. The main takeaways from these analyses were:

- Sorting analyses prove that the main waste found on trains is residual and plastic waste.
- NS has Green Deal sustainability goals, aiming towards waste free stations in 2040. These goals require adjusted implementations of waste management by the NS.
- Interviews with one of the primary users of the waste bins, i.e. the cleaning employees, showed that the work is incredible straining, time consuming and the cleaning company suffers a staff shortage. This results in only gathering waste in one flow: residual.

The information from the analyses suggests that the composition of waste generated on trains is influenced by broader societal factors such as consumer behavior, product packaging practices, and the availability of recycling options.

Secondly, the analysis phase of this assignment provided a deeper understanding of the stakeholders. With a survey NS customers were questioned on their experience with the current waste status in the NS trains. It was evident that the primary stakeholders interacting with waste on trains and the ones involved in waste removal processes are NS customers and the cleaning employees.

Subsequently, the ideation phase of this assignment focused on enhancing waste management practices within NS trains. In order to improve the waste removal out of the NS trains, the waste flows would have to be adjusted into different categories. This preliminary ideation was eventually abandoned once it became clear that adjusted waste flows could not be determined for the future yet. Policymakers at different departments of the NS preferred unidentified waste flows and more research into optimizing the current bins.

The design direction was then adjusted to improving the bins for the cleaning employees. Improving the method of removal for the cleaning employees could result in a better work environment, cleaner trains and more waste sorted on the NS trains. Ideation with the revised focus was divided into two objectives: adding parts to or adjusting the current bin.

After ideation and discussion sessions with the NS, a few ideas were conceptualized. Requirements for the concepts were organized using the MoSCoW-method. The main focus was to ensure the

removal of waste out of the bins on the trains more efficient. With increased efficiency of the bins the sustainability goals of the NS could be more easily met.
The first design direction parts were added to the current bin. This resulted in a concept of a waste bag holder underneath the bin. The new and empty waste bags would be stored under the bins. Through a roll up system, they could be installed quickly after the removal of a full waste bag.

With the other design direction, the current bin was adjusted, which resulted in two different concepts. One with the top of the bin to flip open, the other with the bottom part of the bin to flip forward. One provided more stability and rigidness to make the process of waste removal less flimsy. The other concept provided more flexible changes, with a bigger bottom part to flip open to remove the waste bags.

In future designs, the concepts could be combined to counter their weaker points. For both concepts, the addition of the bag holder can improve the speed in which waste is removed.

Moving forward, the waste collection in the NS trains needs to work towards proper separation. These concepts can provide ideas for adjustments that helps cleaning employees with effective waste removal. As all designs are conceptual, more research needs to be performed.

This bachelor assignment showed great contrast between the expectation of proper waste collection and the functionality of the waste bins itself. To ensure a more hygienic and sustainable environment for customers of the NS, the practical problems that arise when collecting and removing waste first need to be addressed. Design iterations have been suggested to improve the inner workings of the bins to chip away some of the struggles. The designs could improve the effectiveness of source separation. In conclusion, **to work towards more sustainable waste removal on the NS trains in the future, the current waste collection and removal methods first have to be optimized.**