

# Developing an Interactive Scale Model of a Train to Facilitate Communication and Codesign

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**Introduction** Every company has an interest in keeping the interests of stakeholders in mind when designing a product. Sometimes, important stakeholders are not only found in external clients, but also extend to within the company itself. In the case of a train operator who develops a new train, train drivers, conductors and maintenance staff are important people from within the company to consider during the design process. In the case of the company this thesis was written for, train drivers in particular often feel overlooked during the design process of a new train. They feel like new trains, essentially their new workplaces, are being developed without consideration for them. Besides operational problems, like certain train drivers not being able to reach controls, this has led to a tough climate within the organization. In turn, this had led to friction during the introduction of new trains and, in extreme cases, to an outright refusal to work.

**Assignment** To mitigate this, the train operator has the idea to involve more train drivers into the design process using a physical scale model. This model was developed as a part of this thesis. Both the viability of building such a model and the value it could add were evaluated.

The model was supposed to aid the train operator during two kinds of activities:

- **COMMUNICATION**, by providing an accessible ground for explaining problems the design team has been solving.
- **CODESIGN**, by allowing train drivers to give feedback on design decisions and suggest improvements right on a model.

To find out which exact problems make train drivers feel that they are not heard, research was done. Additionally, design decisions from the development of a new train were studied, which could be featured in the model.

**Results** From these results, a physical scale model (scale 1:10) was developed. This model is able to be reconfigured in several areas. Once a reconfiguration has been done, its consequences are visualized by the model. This allows for members of the design team to explain their choices by showing the progress they went through to arrive at a final decision, and it allows train drivers to reconfigure the train in a way they would like, to submit feedback. Additionally, features that would allow for an independent submission of feedback by train drivers, without a member of the

design team present, were added.

The model was supposed to resemble the final train in great detail. At the same time, it had to be sturdy enough to be used and transported on and to several events. Because of this, 3D printed panels were used to recreate the double curved surfaces on the outside of the train. These panels were supported by a frame made from precision bent sheet metal adding rigidity and keeping stresses away from the 3D printed parts. LEDs were used to add visual fidelity, as well as to visualise certain aspects of the problems that were shown. An exposed Printed Circuit Board was used to act as a “motherboard” for all electrical connections to come together, but also as a part the user mechanically interacted with.

**Evaluation** The model was used during a series of communication events. Here, it worked well in aiding members of the design team to explain a central issue of the design process to train drivers. This issue had been featured in the model, because it was viewed as a very sensitive topic by many employees of the company. After explaining the thoughts that went into the design decisions to resolve the issue using the model, train drivers understood the complications and mostly felt heard. It is expected that this will make for a smoother introduction of the new train, once it arrives.

The features designed to help codesign were well received by members of the design team of the real train, who saw great potential in them and stated that they would like to have a similar model for the development of future trains. However, it was not possible to do user testing with train drivers.

The physical construction of the model generally worked very well. It can however be concluded that an exposed PCB poses a reliability risk, because contact with metals or skin can interrupt electrical signals.

**Conclusions** It can therefore be concluded that the model offered value during communication events and showed potential to add value during codesign activities. It should also be noted that the idea to combine both communication and codesign qualities in a model is not recommended, features that benefit one activity sometimes hurt the other. Additionally, should the model be built outside of the context of a thesis, labor costs are likely to be very high. Labor could be reduced by building a model that does not look as realistic.