Dutch legislation in the working conditions decree (Arbeidsomstandighedenbesluit version February 2004). This decree requires a health and safety plan to be made for the construction of a bridge, and the design engineers, contractors and customers are held responsible for different parts of the health and safety plan. During the design phase, a design health and safety coordinator has to list and evaluate all risks. There are more substantial rules for working conditions but the design team did not know the exact content of these rules. They believed that compliance with these substantial rules was part of the responsibilities of the contractor, because the contractor is the employer at the building site. In fact, compliance to the rules is the responsibility of the employer and the employee in the working conditions decree. Thus there is a regulative framework for working conditions but this regulative framework was not used during the design process because the design engineers did not consider it part of their responsibility to address working condition issues arising during construction in any substantive way. The engineers only made the required list of risks during construction.

3.3 Lightweight Car

The DutchEVO, a very light, sustainable family city car was designed at Delft University of Technology. The empty weight of the car was set at a maximum of 400 kg. At present European family cars usually weigh about 1200 kg; even the two seater Smart has an empty mass of 720 kg. The design requirement to produce a sustainable car with an empty mass of less than 400 kg led to a radical design process. It was not certain whether the normal configuration for a car could be used; this was something that had to be decided on during the design process. Eventually, a standard engine was chosen but the floor structure, the side panels and the doors were very different from those of regular cars.

Ethical issues related to safety and sustainability were encountered by the design engineers. First, the light car will always have higher acceleration in a crash with a heavier car and is, therefore, less safe than the heavier car for people inside the car. Second, it is not possible to incorporate all usual active and passive safety systems in a car of 400 kg. With regard to car safety the tests performed by EuroNCAP[7] are an important element of the regulative framework concerning cars in the EU. However, it was not possible to design a light car and still aim at very good results on the EuroNCAP crash tests. After an analysis of these crash tests, the design team decided that these crash tests lead to heavy cars that make people feel safe in their car. Cars performing well in EuroNCAP tests do not necessarily protect people well in all kinds of crashes, for example in crashes into trees or lampposts. Therefore the design team rejected the EuroNCAP crash tests. Third, the design team based part of their ideas about sustainability on the Brundtland definition of sustainable

[7] EuroNCAP is a cooperative of different European consumer and governmental organizations.

development, i.e., "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, 43). However, it is unclear whether cars can be considered to be sustainable under this definition. The Brundtland definition is usually interpreted as referring to basic needs only, and the question is whether personal transportation is a basic need of people. Fourth, sustainability was operationalized mainly as using less energy by making the car lightweight but other operationalizations can also be defended, for example, that a sustainable car is a recyclable car. Fifth, the design team also wanted the car to be "emotionally sustainable". By this they meant that people should get more satisfaction from the car than merely being able to use it to go from A to B. The team wanted to stimulate a caring relationship between car and owner, to promote long-term ownership rather than people 'throwing away' their car after a few years, and they wanted the car to be fun to drive. This can be at odds with the other part of sustainability because if people really like to drive a car, then they might use the car for distances that they would normally walk or cycle. This would increase energy use no matter how light the car is.

Decisions about safety and sustainability were made based on internal design team norms. These norms were developed during the design process. An example of an internal design norm was that when choosing between different options the lighter option should be chosen. Another internal design team norm was that for making driving in traffic safe, the driver of the car should feel a little vulnerable. These internal design team norms were based on the education of the engineers in the design team, their previous design experience[8] and their personal experience. The norm that the car should make the driver feel a little vulnerable was based on the personal experience of design team members that they tended to take more risks in modern cars than for example in a Citroën 2Cheveux.

3.4 Trailer

The second radical design case study was a preliminary design and feasibility study for a light composite trailer with a new loading/unloading system. This was a radical design process: the normal configuration and operational principle were changed because a new loading/unloading system was included in the design and a composite material was used to meet the demand for a light trailer.

An important ethical issue in trailer design is safety. In this case, a safe trailer was operationalized by the design engineers as a structurally reliable trailer: this means a trailer that will not fail during use. When designing a "normal" trailer there is a regulative framework that can be used that incorporates rules on maximum

[8] Most of the design team members were bachelor, master and graduate students therefore their design experience was very limited. The project leader was an experienced car designer and two other more experienced designers worked for the project.