

DISSECTION OF A CAR: AN INTERESTING AND INSTRUCTIVE EXPERIENCE FOR INDUSTRIAL DESIGN STUDENTS

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ABSTRACT

Dissection of a car has been an annual project for the 3rd year students enrolled to the Industrial Design study program at Department of Product Design, NTNU. The aim of the dissection has been to increase the students understanding of structure and function of different parts of a complex product. During one week the students completely disassemble an old car bought for the purpose. The project starts with a brief introductory lecture about how a car functions, general principles and general description of major components before the students start the dismantling. During the dissembling the class of approximately 20 students is divided into five groups, and each group dismantles its part of the car as far as time permits.

At the end of the week each group presents its part of the car to the other fellow students and explains the behaviour of the components that the group dismantled. Each group documents its part using video, photos and sketches. Sustainable product design is to some extent also in focus with respect to the use of materials, dismantling friendliness and recycling opportunity.

A web-based survey among the classes who have participated in the dissection project and two classes that will participate in the future are the basis for this work. The students find the exercise very fun, and that it provides a good hands-on intro to a complex product. The paper will include a description of the dissection laboratory work, the experience and results from the survey with suggestions for improvements.

Keywords: Dissection, students, industrial design, best practices in design education

1 INTRODUCTION

For 10 years, dissecting a car has been an annual project for the 3rd year students enrolled to the Industrial Design study program at Department of Product Design, NTNU. The project was initially carried out as a part of the third year subject *Product Design 6 – Products and Systems*. In recent years, the project has also been an integrated part of the subjects *Sustainable Product Design* and *Applied Modelling*, studying the use of materials and ease of dismantle and recycling, and documenting the dissection using audio visual equipment.

The aim of the project has been to increase the students' knowledge and understanding of a complex product, by dismantling and studying the structure and the function of the different parts of a car. From subjects like *Mechanics* and *Machine Elements*, the students have acquired theoretical knowledge of different structures and components. However, experience shows that students often have not seen these structures and components in real life or in interplay with other mechanical and structural elements and systems. The exercise of dissecting a car should thus give hands-on experience supplementing this knowledge.

Before dismantling the car, a brief introductory lecture is given on how a car functions, general principles and general description of the major components like the engine etc. This should give the students a brief overview and create a basis for the actual dissection.

2 DISSECTION

The dissection is completed during one week, where the students completely disassemble an old car bought for the purpose. The class of 20 students is divided into five groups, and each group is

responsible for dismantling its respective part of the car, working on one of the following five key areas:

1. Interior, environment and safety equipment for the driver and passengers
2. Steering, suspension and braking system
3. Frame structure and the electrical system
4. Engine
5. Drive train, gear and transmission

Starting up Monday morning, each group dismantles its part of the car, using all time available in three out of four subjects. The process of dissecting the car is continuously documented using video, photos and sketches. At the end of the week each group present its part of the car to the other students, using the documentation and the disassembled parts. The parts are either arranged in exploded views or presented in cutaway views. The students present the components that the group dismantled, and should be able to explain the behaviour of components such as four-stroke engine, differential and vacuum booster brakes to their fellow students.

Sustainable product design is also in focus with respect to the use of materials, dismantling friendliness and recycling opportunity. In addition to the oral presentation, the students produce a 1-2 page report, analysing and discussing sustainability issues, and a 3-4 minutes long video documenting the work.

After the final presentation, tools and workshop are cleaned and car wreck is prepared for removal.



Figure 1. Dismantling the car is quickly done having five groups working on individual parts of the car (2005)

3 SURVEY

A web-based survey among the former and future students was carried out in order to evaluate and improve the project. The survey had two versions, and classes who previously had participated in the dissection project got 21 questions addressing the following topics:

- year and gender
- task description, expectations, work load, motivation, effort
- organisation and interaction between the three subjects
- the tutors
- benefits and output
- group formation and distribution of tasks
- suggestions for improvements

- should the project continue

Classes that would participate in the future got 9 questions addressing the following topics:

- year and gender
- motivation and knowledge
- benefits
- group formation and distribution of tasks
- expectations
- should the project continue

4 ANALYSIS

The results from the survey show that the motivation among the students is high, doing such a practical exercise. Most students express a strong desire to continue the car dissection in the years to come. Doing the project as a part of the 3rd year seems to be adequate in relation to the academic progress. The following will discuss the accomplishment of the car dissection and propose suggestions for improvements.

4.1 Group formation and task distribution

A random formation of the groups and task distribution do not take into account preferences and interests among the students with regard to group composition and key area on the car. After the initial group formation, there has to some extent been possible to switch between groups. It is likely to believe that the distribution of male and female students should have influenced the group formation. However, experience shows that gender does not have significant impact on the outcome. Instead, what makes the group formation a challenge is factors like previous knowledge and experience. Should students already having experience with a car engine dismantle the engine, in order to get a good and educational final presentation towards the other students, or is the learning outcome higher when students without any engine experience work on the engine?

Students having already participated in the project are positive regarding a random group formation, while future students would rather like to be able to influence the formation.



Figure 2. Students presenting engine and gearbox with eagerness (2005 and 2006)

4.2 Choosing car

Fully intact scrap vehicles have been objects for the dissection, in order to be able to accomplish the project financially. From a design and sustainability perspective, it would have been desirable to use a newer car. Newer cars illustrate the use of new materials, processes and assembly methods, and are often better designed for recycling, giving a more up to date and realistic picture. On the other hand,

and from an educational perspective, the advantage of using older cars is the use of more transparent and tangible technology which is easier to understand and explain.

4.3 Workshop and EHS (Environment, Health and Safety)

Doing a car dissection in a model workshop implies challenges regarding space, available tools and EHS, having 20 students working on one car.

In practice, the work is spread throughout the week, creating a quite even distribution of the work load in the workshop. This is due to the natural order of disassembly; the engine needs to be removed before the group responsible for drive train, gear and transmission can start dismantling the gearbox.

The workshop staff is involved during the car dissection in order to assist the disassembly and to ensure sufficient EHS. Oil, gas and other chemicals must be treated in a safe manner, and special pads are used to suck up oil spills. It is very important that safety is ensured, when several students are working on top, inside, under and around the car at the same time. EHS instructions must be provided to all students and included in the task description and initial introduction.



Figure 3. Safety is a challenge when several students are working under and inside the car at the same time (2005)

4.4 Reviews and presentations

Today there is no intermediate presentations or formal gatherings prior to the final presentation, where the different groups can exchange experience and present their ongoing work. The students would have liked to know what the other groups are working with.

One possibility is to have daily gatherings with plenary discussions. It can however be difficult to gather all the students every day. Of practical reasons it might be better to have short intermediate presentations and discussions at the end of day one and three. Main parts and large components are still intact at day one, and it would be relevant to have a review at this point. The dismantling is well under way on day three, and focus can now be moved from general functions to use of materials and methods of joining.

At the final presentation every group present its part of the car to the other students. In the cases of insufficient presentations, supplementary information and demonstration of individual components are prepared and held by the tutors. In order to get an even better exchange of knowledge and experience between the groups, future presentations should possibly be a bit more formalized. Setting aside more time for presentations and discussions, ensuring that every student gains insight into the different groups and key areas, might prevent any dissatisfaction with group composition and task distribution.

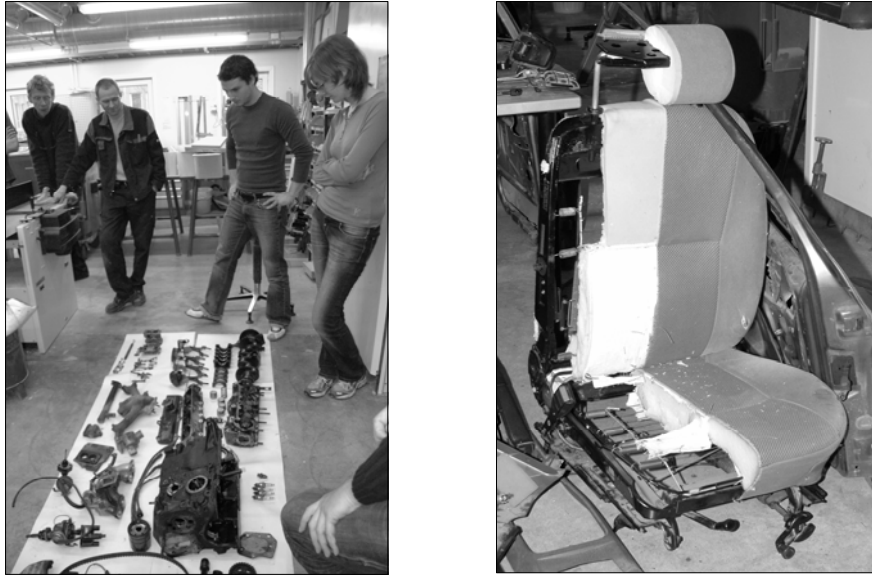


Figure 4. Dismantled parts are presented to the other groups in exploded and cutaway views.
 Engine and seat are prepared for presentation (2006 and 2005)

4.5 One project, three subjects

One of the challenges doing the dissection is the integration of three different subjects in one project. To some extent the students find it confusing, and there is clearly room for improvements. A more precise and exhaustive task description and greater involvement from all tutors in the initial phase and throughout the project is desirable.

5 CONCLUSION

The results from the survey do not reveal any need for major changes to the car dissection project. The students find the exercise very fun and instructive. It provides a good hands-on intro to a complex product in a quick, easy and feasible way. Many students would like to dismantle several more products during the study program, and those who have not had the exercise state that dissection of a car is one of the tasks they are looking forward to.

The input from the students and evaluation of previous car dissections points out some challenges and potential for improvement. The following section will give an outline of future car dissections.

5.1 Future car dissection

Prior to the car dissection, an introductory lecture is given, describing the general structure of a car and what specific parts and areas that are most interesting for the different subjects; *Product Design 6 – Products and Systems* and *Sustainable Product Design*. Relevant literature and Internet resources must be available along with principal drawings of the structure and functions of a car and its components. Forming the groups this day will give the groups an opportunity to plan the work in advance.

Based on the lecture, day one should start with a review of the car and its main components, pointing out the specific areas and components the groups are going to work on.

At the end of day one and three there should be held short presentations of the work done so far, constantly keeping the students informed about the other groups. In this way the students will be able to better follow the disassembly of the different parts, creating a better basis for understanding the individual dismantled parts presented at the final presentation. Table 1 suggests a weekly program.

Table 1. Outline of car dissection

Day	Time	Activity
Friday	2 h	Lecture on principal structure and functions of a car EHS instructions Task distribution and group formation
Monday	09:00 10:00 15:00	Review of the car and its main components prior to disassembly Independent work guided by tutors and workshop staff Short presentation and discussion of the work so far
Tuesday		Independent work guided by tutors and workshop staff
Wednesday	15:00	Independent work guided by tutor and workshop staff Short presentation and discussion of the work so far
Thursday		Independent work guided by tutors and workshop staff
Friday	12:00 15:00	Preparation of presentation Final oral presentation, demonstration and discussion Tidying the workshop and preparing the car for removal