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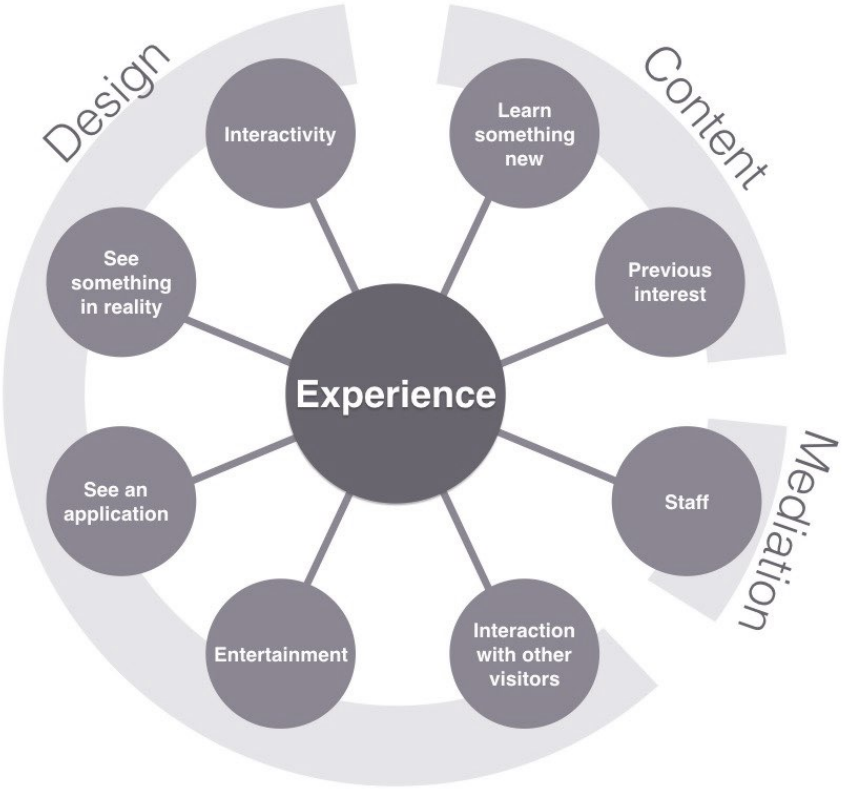

The Success Factors of a Technical Exhibition

A study to investigate the design aspects of an exhibition

Master's thesis in Applied Information Technology

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Cover: Illustration of how different factors are affecting the experience of an exhibition
Photographs included in the thesis by: Johan Bengtsson, Amanda Reinsjö and Sara Eriksson
Illustrations by: Sara Eriksson and Amanda Reinsjö
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Abstract

This study was initiated by *Göteborgs Tekniska College* (Gothenburg's College of Technology [our translation]) in order to obtain an understanding for how an exhibition involving technology should best be designed in order to inspire and inform adolescents. This thesis was performed as a part of a larger project called *Smarta fabriker* (Smart Factories [our translation]), a project with the goal to spread knowledge about the future industry. The result of this study will be used to make a decision about the possibility to establish an exhibition related to the topic at a Science Center in Gothenburg.

The aim of this study was to understand the relevant aspects for the construction of this exhibition. A research question was formulated to help focus the study, where the factors that contribute to how the visitors experience an exhibition are investigated.

Research Question: What factors contribute to if exhibitions involving technology are perceived as interesting by adolescents aged twelve to nineteen years?

The result of this study was obtained through triangulation where interviews, observations and a survey are used. The data was then analyzed with affinity diagrams and a quantitative analysis. The results were also complemented with a conceptual framework which provides a background to the thesis as well as gives an input on research previously conducted in the field.

This study shows that a number of factors are important to take into account when designing an exhibition, of which the most significant one is to make it interactive. Other factors that also have been identified in this thesis as important to some extent for the experience of an exhibition are: to see something in reality, the staff of the exhibition, to learn something new, to see an application, previous interest, entertainment and interaction with other visitors.

Keywords: interactive, exhibit, exhibition design, experiential learning, factors, interest, industry, technology, Science Center, experience

Glossary

This glossary can be used to understand the terms used in this thesis and presents how the following words have been defined in this study.

Fair	Refers to the entire events where the data collection took place
Exhibition	Refers to the part of *Fair 1* organized by *Möjligheternas Värld* and to the upcoming display at a Science Center
Exhibit	Describes a single part of the fairs and exhibitions which regards a certain subject
Station	The different exhibits at *Fair 2* and *Fair 3*
Workshop	The different exhibits at the exhibition in *Fair 1*
Interviewee	The visitors taking part in the interviews in this study
Participant	The visitors taking part of the observations in this study
Respondent	The visitors taking part of the survey in this study
Informant	The general term used to describe both interviewees, participants and respondents

Table of Content

1. Introduction

Exhibitions can be developed for several reasons, one of which is to inspire and to evoke an interest for the subject among the visitor. This study has been conducted in order to understand the design factors important for succeeding with an exhibition of this kind. In the following chapter the aim of the study will be clarified and the research question needed to be answered in order to achieve the aim is presented. Finally, the delimitations of the study will be stated and explained.

1.1 Aim of the study

The aim of this study is to obtain an understanding for how an exhibition involving technology should best be designed in order to inspire and inform adolescents. The aim is further to find a number of factors which are important to consider when constructing an exhibition.

1.2 Research Question

The goal of this study is to answer the following research question:

> What factors contribute to if exhibitions involving technology are perceived as interesting by adolescents aged twelve to nineteen years?

1.3 Delimitations

This study was partly conducted in order to provide data to an upcoming exhibition at a Science Center, see Section 2. This exhibition will have the aim to inspire adolescents to, in a greater extent, choose an industrial or technical oriented secondary school. It also aims to increase a positive attitude towards modern industries and provide a wider understanding of what the industry actually looks like. This study will neither treat the possibly increased interest among the adolescents, nor the choices this may lead to later in life due to the lack of possibilities to examine long-term consequences in a study ongoing for only five months. The focus in this thesis is therefore to investigate what factors that contributed in making these exhibitions to be perceived as interesting directly in relation to the visit.

This study mainly took into account exhibitions that involve technology and technical solutions. This was decided since these subjects are closely related to the main focus of the project which this study is a part of, namely the future industries. The exhibition which this study was intended to provide data for is of technical character and therefore other kinds of exhibitions were excluded from this study.

The fairs that provided the base for the data collection in this study had a target group of twelve to nineteen year olds. The exhibition which this thesis will provide data for will have a larger target group, from preschool age to adults (Göteborgsregionens kommunalförbund, 2014). The factors that are referred to in this

study will only apply to twelve to nineteen year olds, since the analysis mainly was carried out with data from that target group.

The data collection was also carried out only at fairs where the visitors were not able to freely choose which station or workshop they wanted to visit, they were instead guided around in a predetermined order. Hence, this study is limited to only regard factors which concern the actual experience of the exhibit, not factors that could have contributed to attract visitors to the exhibit. The visitors included in this study had neither voluntarily decided to visit the fairs but were there together with their school as a part of their education.

Since the study was conducted on twelve to nineteen year olds and there was no possibility to get parental consent, no sensitive subjects could be treated during the interviews. The subjects that were considered to be sensitive was therefore only treated in the survey which was anonymous.

2. Background

This thesis is part of a project initiated by *Göteborgs Tekniska College* (Gothenburg's College of Technology [our translation]), a company jointly owned by *AB Volvo* and *Volvo Cars Corporation* along with the city of Gothenburg. *Göteborgs Tekniska College* provides secondary education and adult education in the field of industrial technology (Göteborgs Tekniska College, 2016). The project is called *Smarta fabriker* (Smart Factories [our translation]) and the goal with this project is to spread knowledge about the future of the industry and to investigate the possibility to establish an exhibition related to the topic at a Science Center in Gothenburg. The exhibition and the knowledge to be spread will be focused on Industry 4.0, see Section 2.1, and the centre piece of the exhibition is intended to be an updated version of *the Car Factory*, see Section 2.3, which is a part of *Möjligheternas Värld* (World of possibilities [our translation]), further described in Section 2.2. The overall aim for all parties involved in the project is to make the technology and industrial sectors more attractive to young people and thereby secure the competence and the competitiveness of Swedish industry in the future.

2.1 Industry 4.0

At the time for this study, the spring of 2016, the production and the industry is facing a transformation where manufacturing equipment, industrial robots and the products being produced are starting to become connected to the Internet. This makes it possible for all parts of the production process to communicate with each other and by that, the system can become self-directed (Ulfvarson, 2014). It also makes it possible to control and monitor the system remotely, a great change for the industry. This phenomenon is in some contexts referred to as *Industry 4.0*, or *Industrie 4.0*, a german concept for explaining a paradigm shift in the industry where the fourth industrial revolution is about to start. An illustration of the four different industrial revolutions can be seen in Figure 2.1.

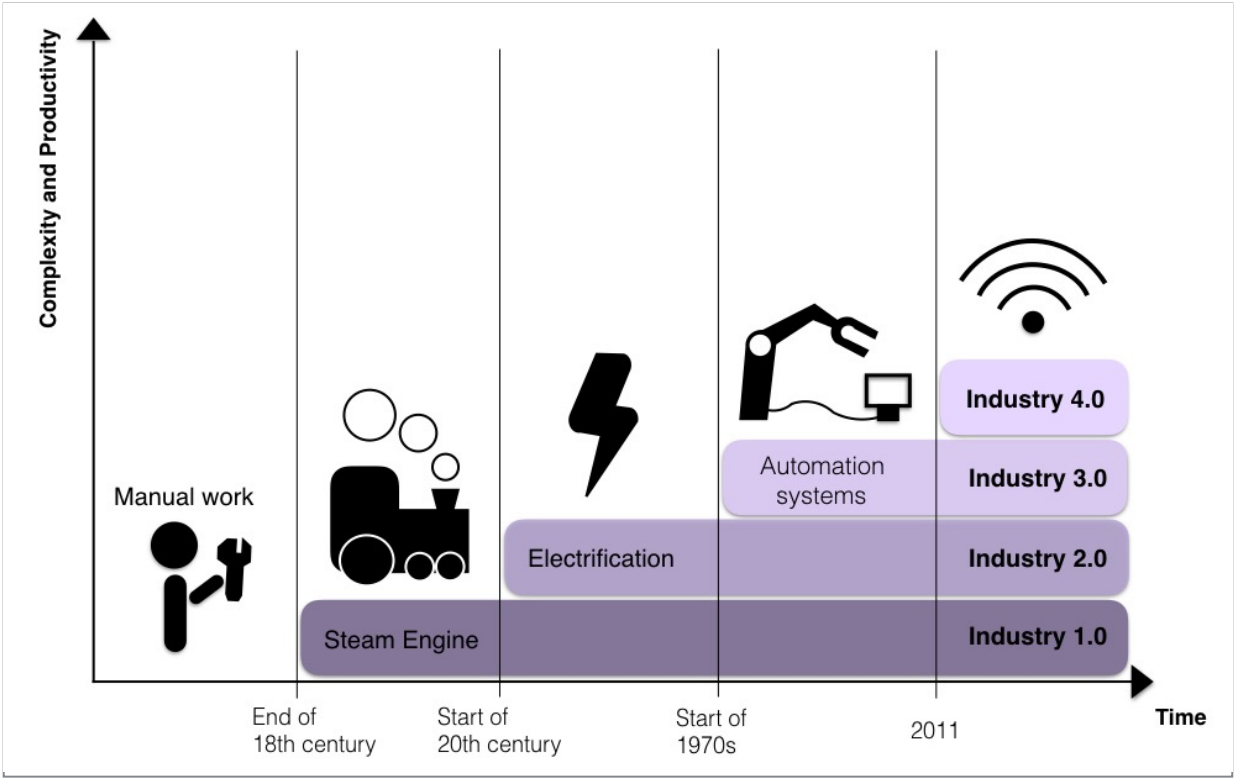


Figure 2.1. Illustration of the four industrial revolutions

The first industrial revolution started in the late 18th century when the steam engine, among many innovations, totally changed the conditions for factories and production (Drath & Horch, 2014). The second industrial revolution started in the beginning of the 20th century and was the result of an extended use of electricity and the increase in productivity thanks to continuous production lines (IndustriAll, 2016). The third industrial revolution occurred around 1970 and involved further electrification and the possibility to program automation systems (Drath & Horch, 2014).

Industry 4.0 is a term which was first presented at the industrial fair in Hannover in 2011 and since then the German government has contributed with 100 million euros per year to the industry's investments in online factories (Alestig, 2015). Similar efforts are made in other places around the world, a few examples are *MADE* in Denmark and *the Smart Industry* in the Netherlands. In Sweden, initiatives are also taken to invest in the future industry, here under the name *Produktion2030* and with the goal to keep the Swedish manufacturing industry at the forefront, especially when it comes to sustainable production (Stahre & Warrol, 2015). Alestig (2015) states that the financing from the government is not as extensive in Sweden as in Germany for example, but points out that Sweden still stands up well in the global competition and that *Produktion2030* is the first step towards a coherent action. The Ministry of Enterprise and Innovation (2016) also declares *Industry 4.0* as one of four focus areas in their efforts to strengthen the Swedish competitiveness of enterprises.

The industry is clearly facing a significant change and in addition, the occupations in the production are also expected to be affected. The World Economic Forum (2016) says that certain types of jobs are going to disappear and new ones will be created. They also state that employees will have to learn new and different skills in order to adjust to the altered production. West clarifies this by giving examples of how those changes may appear: "There may be fewer people sorting items in a warehouse because machines can do that better than humans. But jobs analyzing big data, mining information, and managing data sharing networks will be created" (West, 2015, p. 9). In order to ensure that the competence for these jobs is going to be available in the future, *Produktion2030* has as one of its missions to create a united picture of what the industry looks like as well as how it will look in the future (Alestig, 2015). The Ministry of Enterprise and Innovation states that they, among other things, want to focus on: "Meeting new needs of knowledge that comes with the digital revolution" (The Ministry of Enterprise and Innovation, 2016, p. 30 [our translation]). This is also supported by The Boston Consulting Group, which states that the industry must help the education system to adapt to the new technologies. This is suggested to be achieved by "Adapt[ing] school curricula, training, and university programs and strengthen entrepreneurial approaches to increase the IT-related skills and innovation abilities of the workforce" (The Boston Consulting Group, 2015, p. 15).

Industry 4.0 is expected to transform the production as well as the professions related to the industry, in the same way as the previous three industrial revolutions have done. The importance of meeting the need for new competences is identified by different parts of society. A common view about how to deal with this is to create and spread a united picture of the new industry, both within the manufacturing companies but especially in schools and to young people.

2.2 Möjligheternas Värld

Möjligheternas Värld is a project where business and school collaborate to ensure the skill supply in fields of technology and industry (Om projektet, no date). The data collection of this study was carried out at fairs where *Möjligheternas Värld* was present and it was mainly their exhibitions and workshops that provided the basis for the analysis and result of this study. The activities arranged by *Möjligheternas Värld* have students, teachers and student counselors as their target audience, additionally companies and businesses are sometimes involved in order to create a further value to the project (Om projektet, no date).

2.3 The Car Factory

The Car Factory, one of the activities initiated by *Möjligheternas Värld*, is a miniature of a real automated factory, including for instance assembly robots, a business system and energy monitoring (Automationsfabriken, no date). The factory builds toy cars by assembling a car body, two axles and four wheels (Olsson, 2012). After the assembly, it also puts a label on the roof of the car and the visitor can freely choose a name to print on the label. The factory was constructed in order to display modern technology and also give the visitors a unique memory of the exhibition (Automationsfabriken, no date). *The Car Factory* was first used in 2012 and it is the result of the work of students from different universities, vocational educations and secondary schools along with several automation companies, which sponsored with material and specialist competence (Olsson, 2012).

In the bigger project which this thesis is a part of, *the Car Factory* is going to be used in order to effectively spread knowledge about the future industry and smart factories. *The Car Factory* is partly updated to provide an example to some of the new technologies available in the modern factory and as a reference to *Industry 4.0*, the updated factory is called *the Car Factory 4.0*. See Figure 2.2 for photographs of *the Car Factory.*

Figure 2.2. Photographs of the Car Factory at Fair 1

3. Conceptual Framework

A literature review was conducted in order to understand the theory underlying different kinds of exhibitions and their design. When Kylén (2004) describes a literature review, he says that instead of asking people, as one do in interviews, the questions are asked to the texts, pictures and statistics within the literature. The literature is often used to provide the background knowledge needed to understand the results from the interviews and observations (Tjora, 2012).

In this study, the literature review was performed in order to get input on potential factors that could be relevant for the construction of an exhibition meant to be placed in a Science Center as well as provide a context for the study in general. An obvious area to read further about was therefore *Science Centers*. Three areas also identified to be related to Science Centers were *Interactive exhibitions*, *Maker Space* and *Experiential learning*. Science Centers are based on the idea that experience is important to engage visitors, a thought also fundamental in these three areas. Beside these areas, it was also deemed relevant to read more about *Exhibition design*, a subject which concerns the design and construction of exhibitions. The tool used to execute the review was primarily *Summon*, a search engine provided by the library of Chalmers University of Technology, which made it possible to search widely within a number of databases as well as the library's catalog containing books and articles. When searching for specific books, the search engines of libraries at the University of Gothenburg and the city of Gothenburg were also used. When the reviews within the different search areas listed above were perceived as comprehensive enough to provide the background information needed, the result was summarized. In the following sections the relevant aspects, in relation to this thesis, of the different areas are presented in order to give this study a context as well as provide a foundation for the later discussion, presented in Section 6.2.

3.1 Science Centers

The history, the aim and the learning theories of Science Centers are described in the following sections. The larger project which this study is a part of has as one of its goals to examine the possibilities to establish an exhibition at a Science Center in Gothenburg and this thesis is meant to serve as a basis for that exhibition. This makes it relevant for this study to understand Science Centers and their keynotes.

3.1.1 History of Science Centers

Science Centers developed in parallel in both the USA and Europe during the early 1900s (Caulton, 1998). The first step towards modern Science Centers was when regular museums altered some of their exhibitions to be more interactive or added interactive exhibitions in their museum. In 1925 in Europe, the *Deutsches Muséum* in Munich, let the visitors observe the operations of industrial engines and the *Palais de la Decouverte* in Paris were from 1937 staging chemical reactions. In the *Science Museum* in London, which opened 1931, they created a 'technological amusement arcade' with buttons to push and handles to wind. It was originally designed to be an introduction for all visitors of the museum, but ended up being so popular among the younger crowd that it was named the *Children's Gallery* (Caulton, 1998). In 1933 in the USA, the *Chicago Museum of Science and Industry* allowed their visitors to be sent down into a simulated coal mine and in the *Franklin Institute* in Philadelphia, in 1935, the visitors could walk through a two story beating heart (Caulton, 1998). These are a few examples of the earliest Science Centers and their exhibitions.

The first all-interactive Science Center was the *Exploratorium* which opened in California in 1969 and they introduced the new concept *hands-on*, which meant that the visitors could feel, hear and experience the

exhibition (Nisser, 1999). It was formulated as the opposite to *hands-off*, a common sign in regular museums which aimed to prevent the visitors from touching the exhibits. Frank Oppenheimer, the founder of *Exploratorium*, was given the assignment by the government of the USA, who felt technically inferior since Russia managed to put Sputnik up in an orbit around Earth in 1957. The mission of *Exploratorium* was therefore to give children and adolescents an understanding of the basics of technology and encourage them to proceed to study these subjects (Nisser, 1999). When creating the *Exploratorium*, Oppenheimer was inspired by the *Children's Gallery* and the *Deutsches Muséum*. The *Exploratorium* created about 200 'recipes' for interactive exhibits, which through this 'cookbook' made it possible for other Science Centers to start with already existing concepts of exhibitions (Caulton, 1998). New Science Centers therefore occurred successively, first in the USA and then all over the world (Nisser, 1999).

The early Science Centers mainly focused on technology and science. In the second generation of Science Centers biology and human focus entered with the increased interest of living conditions and life cycles. The third generation of Science Centers entailed a cooperation and involvement of the schools (Nisser, 1999). An example of this is that Science Centers of 2016 were considered to help spread a positive attitude to science and *Skolverket*, the Swedish National Agency for Education, even recommended Science Centers to be a complement to the theoretical education in schools (Skolverket, 2015). Science Centers have also entered their fourth generation, which was made possible by the computer technology. The visitor were now able to control the exhibitions through computers and enter virtual worlds (Nisser, 1999).

3.1.2 Aim of Science Centers

The aim of Science Centers is the same today as it was for the *Exploratorium* in 1969; to increase the interest for technology and science among children and adolescents as well as encourage them to proceed studying these subjects. They also aim to increase the understanding of the importance of technology and science to the society (Nisser, 1999).

In a study carried out in 1998 on what impact the *California Science Center* had on the public science understanding, attitudes, and behaviors, 85% of the adults who had visited a Science Center with their children reported that the visit had increased their children's understanding of science or technology. This indicated that Science Centers had fulfilled their purposes (Falk & Needham, 2011).

3.1.3 Learning theories in Science Centers

"Much of the educational philosophy upon which interactive exhibitions are based originates from the work of Jean Piaget and other developmental psychologists such as Froebel and Vygotskij." (Caulton, 1998, p. 18)

To better understand the theories behind Science Centers, the basic theories formulated by Lev Vygotskij, John Dewey and Jean Piaget are presented in this following section since they where perceived to be the most prominent within the literature regarding Science Centers.

According to Piaget (1896-1980) a child goes through a number of 'development stages'. The development stages refer to the child's current cognitive ability, and a child can only learn and grasp concepts that fit within its current development stage (Phillips & Soltis, 2014). The learning of the child occurs through the child's manipulation of objects and the discovery of the relations between them. It is when the child is in physical contact with the outside world that it makes discoveries about how the world works (Säljö, 2000). This was one of the key concepts that emerged with Science Centers. At the new kind of exhibitions, the visitors were able to interact and influence in contrast to the old museums where the visitors were only able to watch the exhibits (Caulton, 1998). This was also closely connected to the theories of Dewey (1859-1952), who formulated that it was "[…] under no circumstances effective to just explain a new idea - the student

may learn the idea by heart but gains no understanding of the concept. Neither does the student realize its relevance and connects it with other ideas" (Phillips & Soltis, 2014, p. 89 [Our translation]). Dewey emphasizes instead that learning is achieved through activities with a clear purpose where the cooperation and communication with others is the key to learning.

In contrast to Piaget, Vygotskij (1896-1934) did not believe in the greater importance of the current 'development stage' of a child. He referred to Piaget's stages as a relatively 'static' indication of the intellectual tasks a child can perform on its own. Aware that learning always takes place in a certain social context, Vygotskij formulated *the learning potential* of a child (Phillips & Soltis, 2014). To describe this potential, Vygotskij introduced the term *the zone of proximal development*, see Figure 3.1. The zone of proximal development represents the difference between what tasks a child can solve by itself within the cognitive field and the tasks it can solve with the assistance of an adult (Bråten, 1996). In Science Centers, this theory by Vygotskij is used to widen the thoughts expressed by Piaget and to view the visitors' ability to learn new things in a more dynamic way.

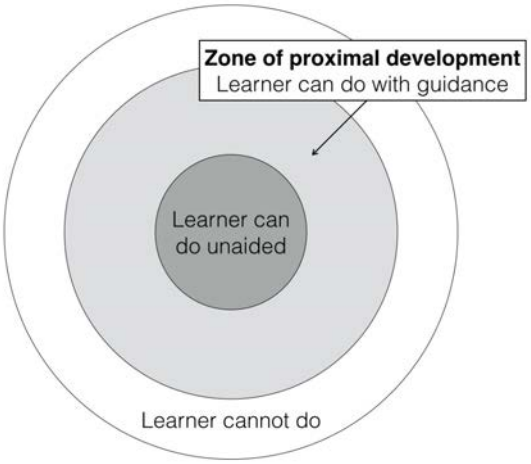


Figure 3.1. Illustration of Vygotskij's zone of proximal development (CC0 1.0)

3.2 Interactive exhibitions

Since the exhibition this study provides a basis for is supposed to be placed at a Science Center, it is considered likely that some form of interactive elements would be part of it. To get a further idea of what this really means, the area of interactive exhibits was therefore included in the conceptual framework of this study.

Interactive exhibitions can be defined in a number of ways, and the definition of *interactive*, relative to hands-on and/or participative varies widely. The Oxford English Dictionary defines the word *interactive* in the following way: "Reciprocally active; acting upon or influencing each other." (Oxford University Press, 2016). Adams and Moussouri (2002) define *interactive* as the cluster of terms that contains different levels of engagement by the visitors, for example hands-on, participatory and immersive, meaning that more than one of the senses of the visitor are stimulated. The term *interactive* is therefore "used to refer to this family of experiences, which actively involve the visitor physically, intellectually, emotionally, and/or socially." (Adams & Moussouri, 2002, p. 2). Roussou (2004) further restricts the use of the term. The definition of interactive, as for the visitor to have an active role, would also include turning the exhibit on and off. Roussou argues that in an exhibit, to be considered interactive, there has to be a reciprocal action from the environment. This can be compared to a video tape. The video tape could with Adams and Moussouri's definition be seen as interactive since there is an ability to pause, rewind and fast forward it. These actions do not, however, in any way affect the outcome of the content and there is only one dimension, time, to influence. The video tape is therefore, according to Roussou's definition, not considered interactive (Talin, 1994).

To further define the term *interactive* and its variations, a comparison with computer games can be used. How interactive a game is, is determined by the number of degrees of freedom in the game. For example, a game that has a given output, a given goal, can still be interactive, but in a lower degree than a game where

different scenarios are possible, and a specific goal is not predetermined. Still, a game with a given goal can have different levels of interactivity, depending on how many ways it is possible to reach that goal (Talin, 1994).

In this study the definition formulated in the Oxford English Dictionary will be used with the assumption that it refers to the same rather strict meaning also presented by Roussou (2004). In this study *interactive* will be used to describe an exhibit where the visitors actively do something and where the exhibit answers to this action with a reciprocal counteraction. The exhibits which are not interactive according to this definition but fits into the definition presented by Adams and Moussouri (2002) will in this study be called *active*. This is the exhibits where the visitors actively do something but the exhibit does not answer in any way to that action. The interactive exhibits will also be defined according to the computer game analogy presented above. This means that the exhibits with a defined outcome and only one way to achieve it has a low degree of interactivity. An exhibit with several different ways to achieve the same outcome is medium interactive and the exhibit with several different outcomes depending on the visitors' action has a high degree of interactivity.

Adams and Moussouri describe five themes to form a framework of an interactive space: multi-sensory dialogue, cultural connections, empowerment, uniqueness and construction of meaning, see Table 3.1 for an explanation of these (Adams & Moussouri, 2002).

Theme (defined by Adams & Moussouri, 2002, p. 11)	Explanation
1. Multi-sensory dialogue	The exhibitions needs to engage the visitor on a variety of levels. It should also offer real problem-solving and foster creativity. The visitor needs to feel a social pay-off for the effort put in the exhibition.
2. Cultural Connections	A successful interactive exhibit can broaden the visitors understanding of how they fit in the culture, which is important since visitors like to place themselves in context.
3. Empowerment	An exhibit that encourage the visitors to bring their personal knowledge will make them create their own experience at the museum. Therefore it is important to have an understanding of the visitor's prior experiences.
4. Uniqueness	The visitors need to feel that they are experiencing something new. Although it is important that the exhibits are not totally unknown to visitors, in which case they can perceive the exhibits to be too difficult.
5. Construction of meaning	A successful interactive experience is one that makes the visitor a part of a social group. The interactive exhibits should therefore aim to get people to communicate and collaborate with each other.

Table 3.1. Themes to form a framework for en interactive space

As described earlier in Section 3.1.3, the main advantage of an interactive exhibit is the learning through doing. Amthor (1992) supports this by arguing that people retain about 20% of what they hear; 40% of what they see and hear and 75% of what they see, hear, and do. This supports the idea of interactive exhibits as a learning platform. This is also confirmed by Edwin Schlossberg, who designed exhibitions for the Brooklyn Children's Museum in New York. Before doing so, he talked to Piaget, who is mentioned in Section 3.1.3, and read sociologist Goffman's *The Presentation of Self in Everyday Life*. He also consulted an educational computer scientist and an artificial-intelligence pioneer and in an interview with the magazine *Nature*, he

stated that most of the experts he had talked to think that learning by doing is better than just looking or hearing (Hoffman, 2009).

Schlossberg designs what he calls *meaningful activities*, and he defines meaningful as a participation in which the outcome depends on the participant's actions and decisions (Ellsworth, 2005). To compare this with the computer game analogy, Schlossberg's definition of meaningful activities is the ones with a high degrees of freedom and no clear goal. Schlossberg also strives for people to talk to each other and work together to make his exhibits work (Ellsworth, 2005).

3.3 Experiential learning

As mentioned in the sections above, the experience and the active involvement of the visitors is the main thought behind Science Centers. Since this study aims to understand which factors that are relevant for how a visitor experiences an exhibition it was considered important to also understand how experiences affects learning. The subject reviewed in order to understand this was experiential learning which is further described in this section.

The definition of experiential learning varies considerably depending on who is to define it. Kolb, one of the educational psychologists who formulated ideas about experience as essential to learning, says that "A common usage of the term 'Experiential learning' defines it as a particular form of learning from life experience; often contrasted with lecture and classroom learning" (Kolb, 1984, p. xviii). Kolb himself chooses to defines the expression in a wider way: "My intention in using the term 'experiential' was to describe a theoretical perspective on the individual learning process that applied in all situations and arenas of life, a holistic process [...]" (Kolb, 1984, p. xx). Apart from being seen as a distinctive learning from life, as the common definition states, or as a holistic term for learnings applicable in all situations, Kolb's own definition, experiential learning can also be seen as a connection between the learner and the surrounding. Beard and Wilson give an example of this when they use the definition "Experiential learning is the sense-making process of active engagement between the inner world of the person and the outer world of the environment" (Beard & Wilson, 2006, p. 19). Another educational psychologist with a great influence on the concept of experiential learning is Dewey, briefly mentioned in Section 3.1.3, who promotes an active learning where the individual engages in meaningful activities with applications in the real world (Dewey, 2004). He justifies this by stating that previous empiricism shows that physical activity allows the children's innate impulses to come to use and this, in turns, means that education becomes fun and learning becomes easier (Dewey, 1985).

Beard and Wilson (2006) present a model to describe experiential learning in the form of a *learning combination lock* with six different parameters which together create the foundation of the learning experience, see Figure 3.2. These parameters are the environment, the activities, the senses, the emotions, the intelligence stimulated and the change resulting from learning. Each parameter must be thought through in relation to the other parameters in order to create the optimal learning experience according to Beard and Wilson (2006).

Not every experience is going to transform into learning however. Every day we are subjected to an overwhelming number of impressions and experiences which makes it impossible to take everything in. For us to learn from experience, these experiences must be cognitive appealing to us and as said by Beard and Wilson: "Thus, perception and interaction are insufficient in themselves, and we must interact in a meaningful way with external stimulants if we are to learn. Experience is a meaningful engagement with the environment in which we use our previous knowledge (itself built from experience) to bring new meanings to an interaction" (Beard & Wilson, 2006, p. 21). Dewey is also careful to point out that experience is not

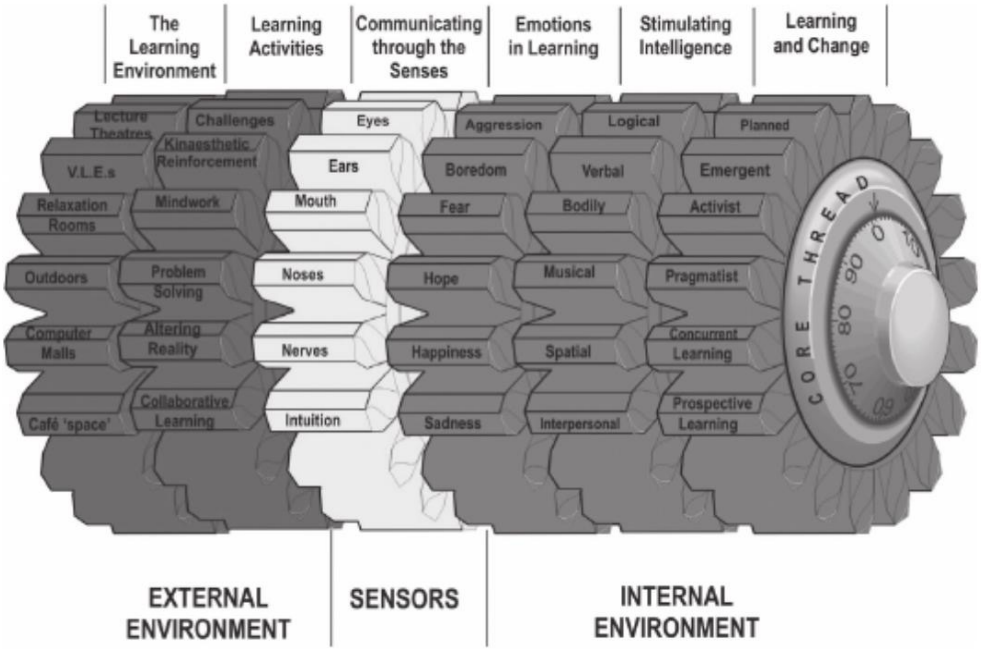


Figure 3.2. The learning combination lock developed by Beard and Wilson (2006), used with permission

directly equate with learning, "The belief that all genuine education comes about through experience does not mean that all experiences are genuinely or equally educative" (Dewey, 1938, p. 13). Kolb (1984) chooses to describe the implementation of experiential learning as a four mode cycle where the learner should experience, reflect, abstract and act, see Figure 3.3. Experience is in this case complemented with reflecting on the experience, abstracting the concept of the experience and finally acting on what you have learned from the experience. This, according to Kolb, will create experiential learning.

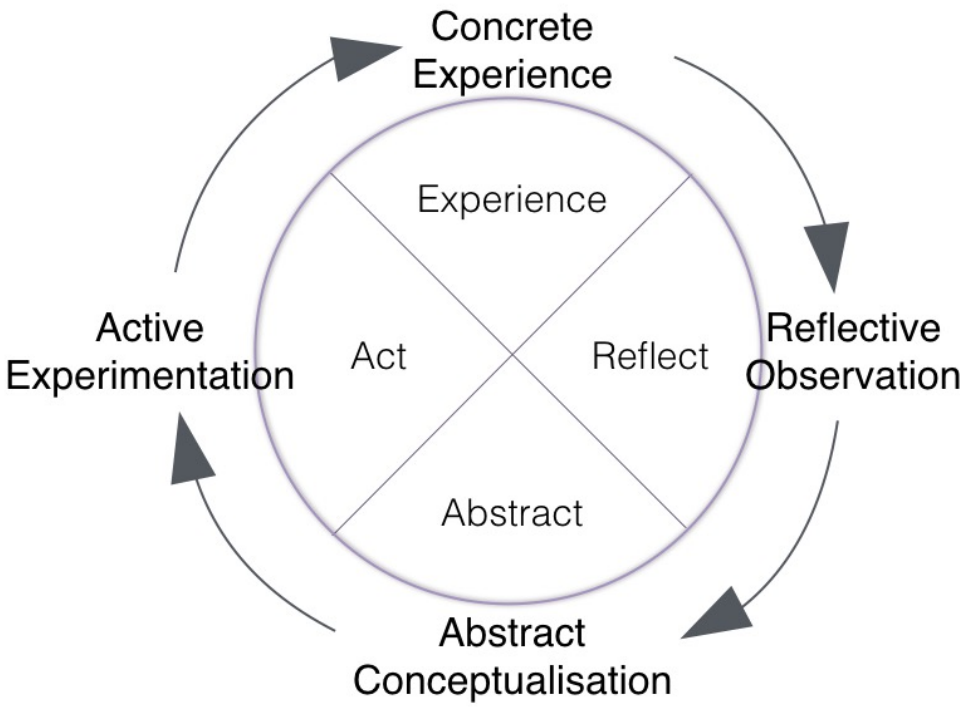


Figure 3.3. Kolb's four mode cycle for experiential learning (CC BY 3.0)

Beard and Wilson (2006) also mention a number of factors that will affect how one perceives the experience, see Table 3.2. These factors work as a filter through which all experiences will be affected. Apart from these, Dewey (1938) developed the idea that experiences must exist in a relevant context and with a clear purpose, otherwise it do not matter how exciting and interesting the experience is since it will not create a meaningful learning.

Filters that affect our experience (Beard & Wilson 2006)	Clarification
Previous knowledge	What we know about the experience from before
Previous experience	What similar experiences we have had
Emotions	What emotions we come with and what emotions the experience raises
Concept of self	How one experience oneself
Choice	How self-chosen the experience is
'Loudness' of stimulus	How attentions-grabbing the experience is
Location	In what kind of environment is the experience taking place
Personal needs/want	How willing one is to absorb the experience

Table 3.2. Filters which affect an experience

3.4 Maker Space

Since the learning ideas of Maker Space in many ways are reminiscent of the ones of Science Centers, this was considered to be a relevant area for this study. In the following section, the history and the learning ideas of Maker Space will be presented.

The Maker Movement is a movement which involves all forms of *DIY* (Do It Yourself) and *DIWO* (Do It With Others) and is defined by the desire to practically understand how things work. The main thing that distinguishes the Maker Movement is not the curiosity itself, but that there are social communities and the physical places to meet likeminded people to share knowledge with. These places are called Maker Spaces (or sometimes Hackerspaces or Fab Labs) (Malmegård, 2012).

3.4.1 The history of Maker Space

The Maker Movement had considered approximate date of birth in 2005, with the launch of the magazine Make, published by O'Reilly Media. The roots of the movement could also be traced to the state university *MIT* (Massachusetts Institute of Technology) who coined the alternative Maker Space concept Fab Lab (Malmegård, 2012). There have always been hobby inventors, electronic enthusiasts and craftsmen, but before the launch of Make, they were just individuals. The new magazine gave them the common name *makers*. The slogan of the magazine was “If you can’t open it, you don’t own it” which was a stance against consumption and meant that even if there was an almost limitless range of electronic products on the market, the consumers were lacking the understanding and ability to adapt them to their needs. The digitalization of society was one of the prerequisites for the Maker Movement. There was no longer a need to access a studio and materials to the same extent, and instead of having to apply for a patent with all the paperwork that accompanies, there was now the ability to simply create something and launch it over the Internet (Andersson, 2013). Today there are almost a thousand Maker Spaces, and the number increases. The American government has recognized the strength of the movement and in the early 2012, they launched the project of creating Maker Spaces in a thousand American schools. This was very similar to the old-time mechanic school, only updated to fit the digital age. Instead of creating low-paid factory workers, the aim was to create a generation of system designers and product developers (Andersson, 2013).

3.4.2 Learning ideas of Maker Space

The Maker Movement can be described as a fusion of new technologies and traditional craftsmanship. The combination of these two worlds, which in the modern society (and education) often exists apart, resulted in the movement giving birth to a number of interesting hybrid phenomenon. The theories in this borderland often have an educational bonus, one example is that the exploration of something practical as origami can become theoretical mathematics (Malmegård, 2012). The Maker Movement offers a new way to learn about mathematics and technology, therefore it appeals to educators who are concerned about students that does not engage in these subjects in the formal educational settings (Sharples et al., 2013). The Maker Movement also draws great emphasis on the importance of a growth mindset. A growth mindset is the belief that personal qualities are developed from efforts. The opposite is the fixed mindset, where qualities are considered innate properties, which can not be significantly altered (Dweck, 2012). Unlike the formal education, where there traditionally have been right and wrong answers, the Maker Movement is not looking for a solution, but encourage the exploration itself instead (Makerspace Team, 2013).

Maker Space is based on the idea of experimental play, that you learn by playing and by experimenting. By taking apart electronic devices, not only can a better understanding for how they work be gained, but it may also increase the overall interest in technology and possibly lead to ideas about improvements and new applications which the manufacturer did not think of (Makerspace Team, 2013). Another of the Maker

Space's basic ideas is the one of the constantly changing society. The children growing up in the early 2000's has no idea what the labor market will look like when they are adults. Therefore it is crucial to develop skills that can help them adapt to that, skills as creativity, curiosity and the ability to learn. Those are all skills which the Maker Space aims to develop (Makerspace Team, 2013).

3.5 Exhibition design

Beside the areas related to Science Centers and other experience oriented fields, it was also of interest for this study to understand the design and construction of exhibitions in general. In order to collect information about this, the area of Exhibition design was reviewed. The following section will describe the main thoughts included in Exhibition design and provides a wider understanding for the relevant factors to consider when developing a new exhibition.

Exhibition design is a term describing the process of planning and designing both the content and the layout of an exhibition. This is a relatively new area in which not many specialists are educated even though both exhibitions and design as separate areas have been well known for a long time (Tang & Mayrand, 2002). Since there has not been an established profession called exhibition designer, people with various backgrounds have in different ways been a part of the exhibition design. Lake-Hammond and Waite (2010) provide a number of examples of the professional areas related to exhibition design: artistry, graphic design, industrial design, interior design and architecture.

The opinions on what the sole purpose of exhibition design is differ slightly. Dernie (2006) says that the most important thing to consider is how the exhibition objectives and the environment they exist in cooperate to communicate with the visitors. Lake-Hammond and Waite (2010) agree that the design should promote the connection between the visitors and the content of the exhibition but emphasize the significance of creating an holistic experience through choice of presentation method as well as how the information is organized and adopted to the audience. The latter description is more applicable in the cases when it is difficult to make radical changes to the surrounding space which the exhibition takes place in since it is more focused on what way the content is communicated.

The subject of exhibition design involves a number of different disciplines and several aspects to consider but in this text only those relevant to an exhibition in a Science Center will be exemplified. In recent years, exhibition design has developed to be more audience-focused and experiential museums have become more common (Dernie, 2006). Lake-Hammond and Waite (2010) also state that the development of exhibitions have shifted focus over time. Before, the design was formed after the exhibition objectives available while today, it usually starts with a distinct conceptual plan about what is to be mediated.

When it comes to choosing the content to be displayed, it is important to make a selection. The information should cover the subject but not be so extensive that it is overwhelming. It should also be presented in a way that both satisfies the average visitor as well as the amateur enthusiast and it should suit the needs of the visitors but still honor the importance of the content (McKenna-Cress & Kamien, 2013). Coates and Ellison emphasize that experiential exhibitions are an effective way to reach out to the visitors: "The element of choice is very important, as it allows the user to have a personalized experience. Many of us learn by doing, not by watching or listening. The experience of interacting means the user will learn and retain the information in a memorable way." (Coates & Ellison, 2014, p. 174).

The information must also be exposed in a way that reaches out to the audience. Two main factors to consider are visibility and context, where lighting, scale of the material presented and the platforms used to communicate all affects how well the exhibition is perceived by its audience (Coates & Ellison, 2014).

However, it is important to remember that the visitors are individuals, they will always be affected of what they have seen and experienced before entering the exhibition. McKenna-Cress and Kamien (2013) argue that previous interests, misconceptions and emotions concerning the subject will have a strong influence of the experience and based on this, it is important for exhibition designers to find out what the target group think about the subject and what they wish to know more about.

Exhibition design also addresses the importance of connecting the different parts within the exhibition to create a complete meaning. This is called narrative structure and refers to making the objects meaningful in relation to each other as well as the context they are placed in (Lake-Hammond & Waite, 2010). Apart from the factors described above, a summary of seven factors was also suggested by Borun et al. (1998) to be the base for a successful family exhibit, these are presented in Table 3.3. Since this specifically applies to families, it should be looked at with caution in relation to the target group of this study but the factors there claimed to be important for an exhibit might have similarities with those specific for the target group in this thesis as well.

Factors for a successful family exhibit (Defined by Borun et al., 1998, p. 23)	Explanation (Also by Borun et al., 1998, p. 23)
Multi-sided	Family can cluster around exhibit
Multiuser	Interaction allows for several sets of hands (or bodies)
Accessible	Comfortably used by children and adults
Multi-outcome	Observation and interaction sufficiently complex to foster group discussion
Multimodal	Appeals to different learning styles and levels of knowledge
Readable	Text is arranged in easily understood segments
Relevant	Provides cognitive links to visitors' existing knowledge and experience

Table 3.3. Factors for a successful family exhibit

4. Study Approach

In this section, the study approach is presented. First, the context of the data collection will be described in order to picture the situation where this study have been conducted. Then, the methodology of this study is explained and how it was used to execute the different steps of the data collection. Finally, the methods used to perform the methodology are presented. The methods are divided into methods for data collection and methods for data analysis.

4.1 Context of the data collection

In the following section, the context of the data collection is described. The different fairs where data was collected are presented with a short description of the fairs, who the visitors were and illustrations of the layout of the exhibitions. A summary of the different stations or workshops for each fair is also given in order to provide a picture of what the main subjects were and how they were arranged.

4.1.1 Fair 1

The first fair visited during this study was a trade fair for the operation and maintenance of manufacturing industry (Svenska Mässan, 2016). *Möjligheternas Värld* exhibited *The Car Factory* during this fair, together with eight workshops. The workshops were numbered in this study to facilitate more structured observations and easier transcriptions, see Figure 4.1 for an illustration of the exhibition area. The visitors who were studied at this fair were mainly secondary school students who attend a program focusing on technology or industry. The workshops were also mainly staffed with secondary school students whose task were to inform about the different subjects at the workshops. Beside the secondary school students, the staff also consisted of teachers, university students and representatives from businesses. The visitors at this fair were divided in smaller groups and were then assigned to start with visiting a certain workshop. They then rotated so that all visitors got to visit all workshops.

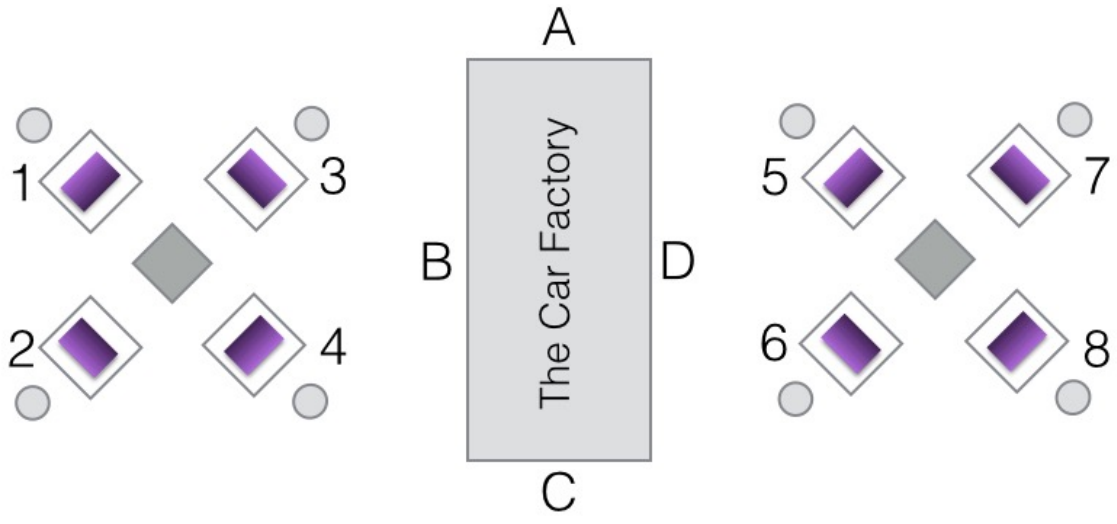


Figure 4.1. An overview of Fair 1

Below follows a short description of the different workshops to provide a background for the upcoming result and analysis.

1. **Environmentally Friendly Production**
   This workshop described a number of ways to reduce the environmental effects of production. The workshop contained a presentation of the subject which was carried out by one or two instructors. Computer screens were used to support the presentation, see Figure 4.2. In the end, the visitors had the opportunity to ask questions on the subject.

Figure 4.2. Photograph showing the workshop Environmentally Friendly Production

2. **Additive Manufacturing**
   This workshop showed how 3D printing can be used in production and described the underlying technique. The instructors presented the subject and used a real 3D printer to show the visitors how it works, see Figure 4.3. They also had a number of 3D models in various sizes for the visitors to see and feel during the presentation.

Figure 4.3. Photograph showing the workshop Additive Manufacturing with a 3D printer

3. **Smart Ways to Work**
   This workshop described how QR codes (Quick Response codes) can be used to provide instructions to operators in the production in order to increase the efficiency when training new staff or when diagnosing errors in the production, see Figure 4.4 for an example of a QR-code. The instructors presented the subject and used *the Car Factory* to provide an example. There were several QR codes on the factory and when scanning these a short instruction video occurred. One of these videos was also shown as a part of the presentation at the workshop.

Figure 4.4. Example of a QR-code.

4. **The Attractive Work**
   This workshop explained the importance of good working conditions in relation to a company's competitiveness and attractiveness, see Figure 4.5 for a photograph of the workshop. This was exemplified by a wristband which measured the stress level of the employee through the skin's moisture and the pulse. One of the instructors wore the wristband and after a presentation of the subject the instructor jumped in order to show how this affected the stress level. This was demonstrated to the visitors through two diagrams on a computer screen which were connected to the wrist band.

Figure 4.5. Photograph showing the workshop The Attractive Work

Figure 4.6. Photograph showing the workshop Networked Society

5. **Networked Society**
   This workshop exemplified how the networked society and modern communication technologies provide new opportunities in the industry, such as real-time monitoring of key performance indicators and remote monitoring. The instructors described the advantages of this and exemplified how this can be used by showing a screen placed on *the Car Factory* containing a monitoring system, see Figure 4.6.

6. **Internet of Things**
   This workshop described how all different parts of a factory can be connected to the Internet which makes it possible to remotely diagnose robots and monitor the conditions of the production. This was explained by the instructors and they were using a computer screen to illustrate how it might work, see Figure 4.7.

Figure 4.7. Photograph showing the workshop Internet of Things

7. **Digital Twins**
   This workshop showed how virtual simulations can be used in the industry. This was done by using a scanned model of a part of a factory in order to carry out flow simulations and test the process in a virtual environment before it is tested in the real world. The instructors explained the concept of digital twins and showed the scanned model on a computer screen for the visitors to understand how it can be used to facilitate the work in the industries, see Figure 4.8.

Figure 4.8. Photograph showing the station Digital Twins

8. Augmented Reality

This workshop aimed to show the visitors the applications of augmented reality in the modern industry where it can be used for real-time support through a video link. There were two different positions at this workshop where one of the visitors acted as support for another visitor who was to perform a task, which was to build a specific construction with Lego. One of the visitor wore a pair of VR (virtual reality) glasses along with a headset through which the two visitors could communicate, see Figure 4.10. The other visitor had a camera placed above the workspace, this camera view was what was seen in the VR glasses, see Figure 4.9. The visitor with the camera also had instructions on a tablet by the side of the workspace and his/her task was to show the visitor with the glasses how to build the construction. The visitor with the glasses had as his/her task to build a similar construction as was shown through the camera view in the glasses. The instructors at this workshop explained how the technique works and how it can be used in the industry.

Figure 4.9. Photograph showing the position that gives instructions at the station Augmented Reality.

Figure 4.10. Photograph showing the position with the VR glasses at the station Augmented Reality

A. Order a car

At this side of *the Car Factory* there was a screen where the order was made and the finished car was also delivered here. There was always one or two instructors who was in charge of ordering the cars stationed here. The visitors talked to these instructors, specified which color they wanted on the car body and the wheels along with what name they wanted printed on the top of the car.

B. QR-codes and overview of the wheels

This long side of the factory provided a good overview of the process. Near the corner to A was a number of QR-codes, used in workshop 3, which described tasks such as how to change the label roll for the name signs. At this side there was also small openings in the safety cage to enable refills of the car bodies. Near the corner to C was a screen showing a camera view of the wheels position on a conveyor. This camera view was used to illustrate how the robot was able to find the right wheel to pick up.

C. Overview of robot and wheels
At this side, the visitors had a good overview of the robot and the wheels. Here it was possible to see when the robot switched tools and how it picked up both wheels and car body, then placed them for assembly.

D. Monitoring systems
At this side, just as at the other long side B, the visitors had good overview of the Car Factory which allowed them to follow the process from start to finish. There was also a screen reporting errors and key performance indicators for the system, used in workshop 5.

4.1.2 Fair 2

The second fair visited in this study was organized to give eighth graders knowledge about the industry and a wider picture of the educational and occupational opportunities in the industry. There were seven different stations at this exhibit of which five were staffed by secondary school students, one by students from a university, the station *Computer Game Development*, and one by staff from Science Centers, the station *And what about me?*. The fair started with a introduction for all visitors which contained information about the schedule of the day and a show performed by the representatives of the Science Center. After that, the visitors were divided into seven groups and all groups started at different stations. They then rotated so that all groups got to visit all the stations. See Figure 4.11 for an illustrated overview of the exhibition hall.

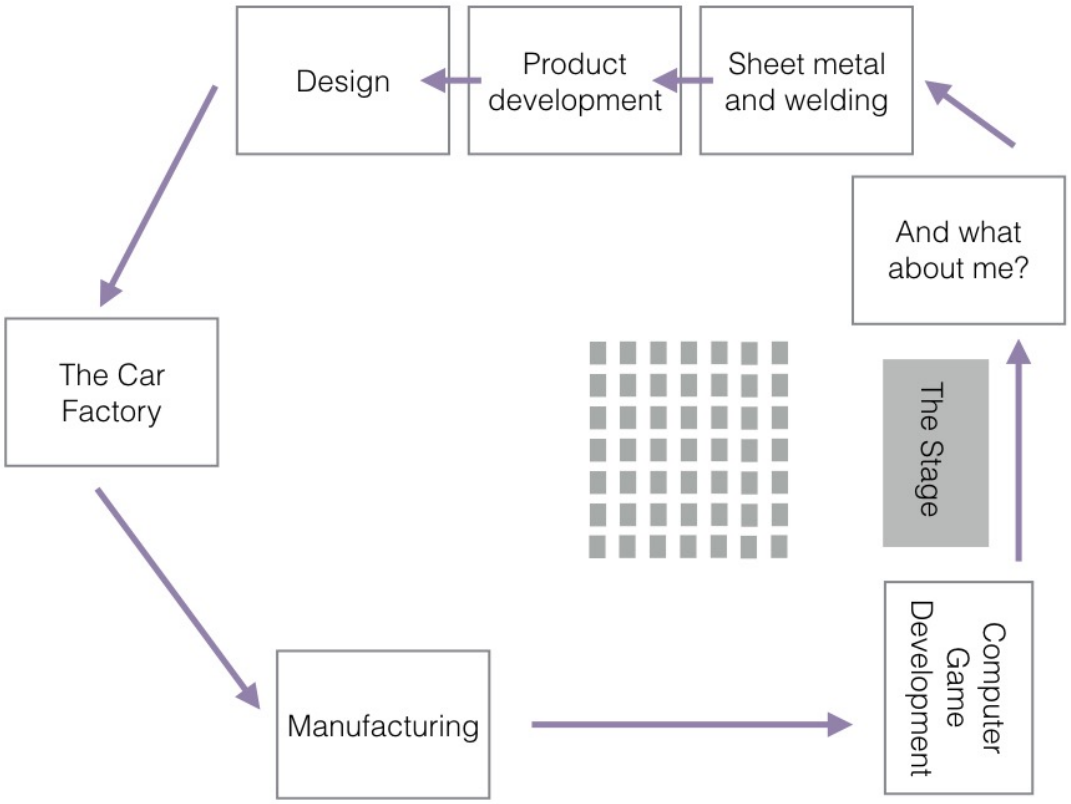


Figure 4.11. An overview of Fair 2. The Stage is where the introduction was held

Below follows a description of the stations and their layout in order to give an understanding for the later analysis.

1. **Computer Game Development**
   This station was arranged by a university with educations within the field of game development. The visitors were divided into two groups, where one group tested a computer game developed by the instructors who attended the university and the other group listened to an instructor who talked about the different educations in game development available at the university. The two different parts are shown in Figure 4.12 and Figure 4.13. After half the time the two groups switched places.

Figure 4.12. Photograph of the presentation at Computer Game Development

Figure 4.13. Photograph of a visitor playing the computer game

2. **And what about me?**
   This station was organized by Science Centers and the instructors here were employees from Science Centers. All visitors received a paper and pen each, and were asked to draw a pig. Thereafter, they were asked to stand in a circle and hold up their drawings, which can be seen in Figure 4.14. The staff then told them what their drawings said about their personal traits. For example long/short tail and pig looking to the right/left were characteristics of the drawing that was claimed to tell something about the visitors as persons.

Figure 4.14. Photograph of the station And what about me?

3. **Sheet Metal and Welding**
   At this station the visitors were divided into three groups where the first one got to test a welding simulator, the second group tried to weld and the last group listened to students talking about what a welder does. The groups then rotated so that the visitors got to try all three activities at this station. Photographs of the simulator and the welding can be seen in Figure 4.15 and Figure 4.16.

Figure 4.15. Photograph of the welding simulator

Figure 4.16. Photograph showing when one of the visitors tried welding

4. **Product Development**
   Here, the visitors were divided into four groups that all got to see the same movie showing a truck being digitally sketched, but on different computers. They were then showed how to 3D sketch in a CAD (Computer-aided Design) program and also got to see and touch objects that had been 3D printed. Two 3D printers were continuously printing new models during the presentations as well. See Figure 4.17 and Figure 4.18 for photographs from the station.

Figure 4.17. Photograph the demonstration of a CAD program

Figure 4.18. Photograph of an instructor showing the 3D printer to a group of visitors

5. **Design**

The visitors attended a quiz walk with two to three visitors in each group. The quiz was about determining the age of a number of products and there were miniatures and models in front of the questions as well as pictures related to the quiz, see Figure 4.19. The visitors also got to guess what a particular residue (composed of three materials) was used for in furniture manufacturing. Finally, they were supposed to come up with suggestions for products that can be manufactured by other residual items, see Figure 4.20.

Figure 4.19. Photograph showing one of the questions in the quiz walk

Figure 4.20. Photograph showing two visitors trying to find an application for the residual items

6. **The Car Factory**

The visitors were divided into four groups that each followed a instructor around the factory, and listened to how the production of the toy cars works while they got to see it happening in real time, see Figure 4.21. In one of these groups, all the visitors were allowed to order one car each and the visitors in this group was selected based on if they had younger siblings to give it to.

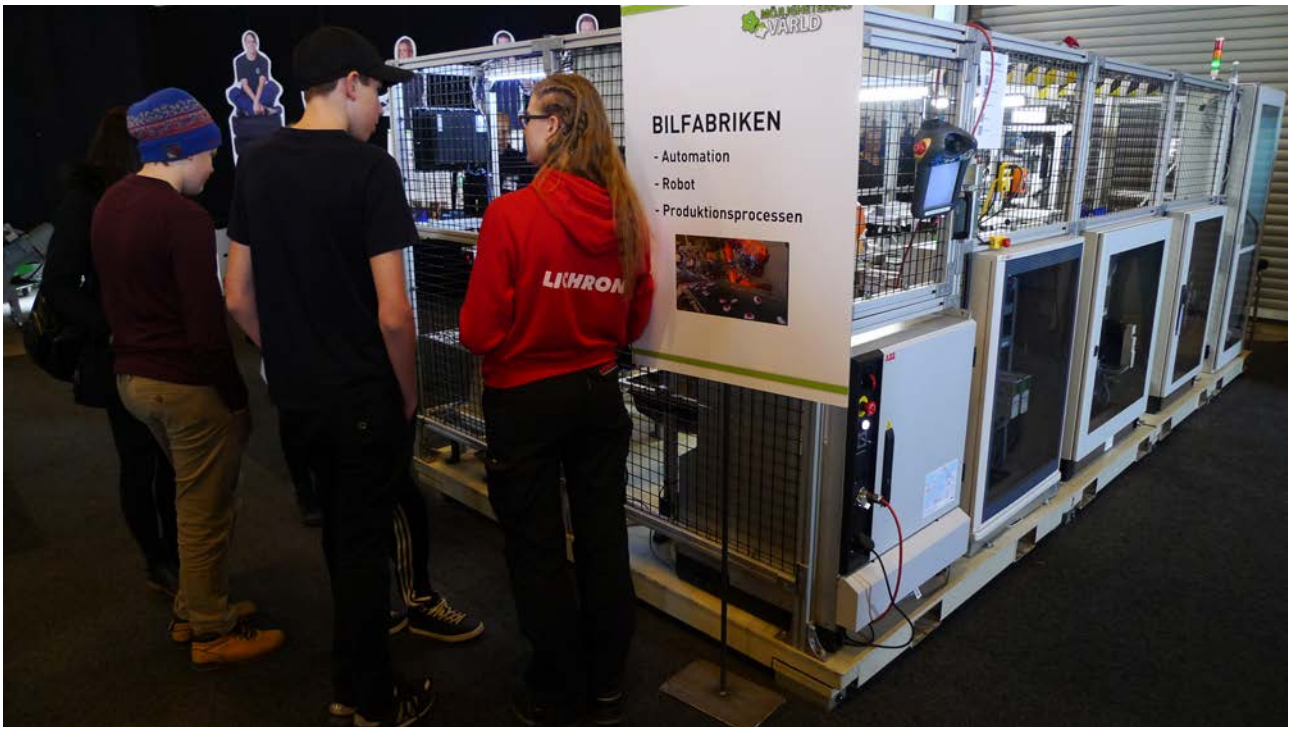


Figure 4.21. Photograph of an instructor showing The Car Factory for a group of visitors

7. **Manufacturing**
   Here, the visitors listened to the instructors talking about the two machines that were in place, a lathe and a milling machine. Some of the visitors also got to start the machines and remove the finished article using tools. See Figure 4.22 for a photograph from the station.

Figure 4.22. Photograph of the station Manufacturing and the lathe

4.1.3 Fair 3

The third fair began with a presentation of the company organizing this fair, and their latest innovations. The visitors were then divided into four groups and got to follow guides to the different stations. The guides at this fair was young employees at the company and they followed the groups around the fair. At every station there were additional experts within each field who told the visitors about the different parts of each station. In Figure 4.23, an illustrated overview of the fair is provided where the path of the visitors is presented and how the stations were situated in relation to each other.

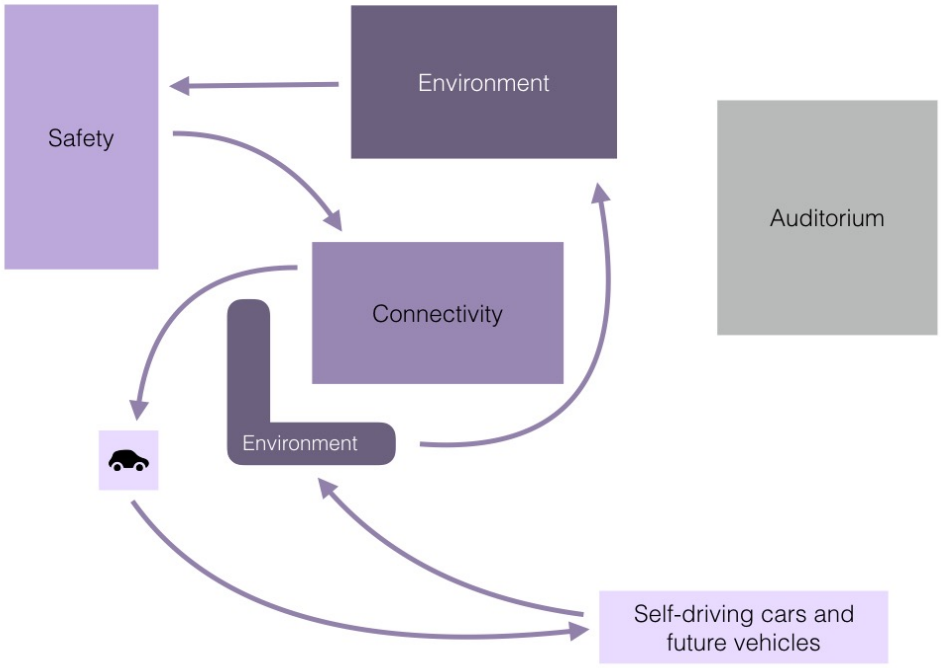


Figure 4.23. An overview of Fair 3. The arrows illustrates how the visitors moved through the fair. The icon of a car represent the autonomous miniature car. The Auditorium is where the introductory presentation was held.

Below, the stations and their layout are described in order to give an understanding for the later analysis.

1. **Self-driving cars and Future vehicles**
   In the first part of the station, the visitors got to see an autonomous miniature car that was a school project by students in secondary school, see Figure 4.24. The car drove around in a fenced area and used different functions, such as sensors and laser beams, to avoid colliding with the walls of the enclosure. Then the visitors were led out into the foyer, where they were shown a film about the

Figure 4.24. Photograph of the autonomous miniature car

future of self-driving cars and got to talk to an expert in that area, see Figure 4.25. Finally, in the last part of the station the visitors got to watch a truck and they also got to sit in the driver seat to get an idea of a truck driver's various blind spots.

Figure 4.25. Photograph of an expert talking about self-driving cars and the truck used in the same station can be seen in the background

2. Environment

The visitors first got to listen to a presentation about how much materials that will be used in a number of years if the consumption continues in the same pace as now and how many globes that corresponds to. They were also shown how much the engines have been streamlined the past thirty years in order to reduce emissions. This part is shown in Figure 4.26. Thereafter they were led to a parked hybrid car where the staff talked about in what ways the company is currently working with the environmental aspects. They were also shown a film about how an electric engine works in a car today and got to discuss the different fuels that can be used in a car. In the last part of this station they were shown a gasoline engine and an electric engine that were placed next to the car, see Figure 4.27.

Figure 4.26. Photograph of the globes and the engines used as examples in the station Environment

Figure 4.27. Photograph of an electric engine

3. Safety

The visitors got to see an uncluttered body of a car. Here the visitors could see that the body was built with several different materials, which was illustrated with different colors for each material in the car, see Figure 4.28. An expert at the station explained why they have chosen to have different

stern metals in different parts of the car and the effects this have in a collision. The visitors were also shown films on how the company crash test their cars, and got to see one of the cars that had been involved in such a test. They also got to see and touch crash tests dummies and it was explained to them how they function and which factors that are measured in a crash test. At the last part of this station, they got to sit in a simulator of an overturning truck and feel how much impact the safety belt has in such a scenario, see Figure 4.29. Here they also got to see a film where one crash test dummy is strapped with a belt and one is loose in an overturning truck.

Figure 4.28. An uncluttered body of a car where the left side is color coded for different stern metals

Figure 4.29. Simulator of an overturning truck

4. Connectivity

The visitors got a quick rundown by experts working in the field of how a connected car can be used and got to see a film about the features that are available in the connected cars today and the ones which will be included in the future. The visitors were then seated in a car and got to test some of these different functions. Last at the station, all visitors were asked to write wishes on pieces of paper, about what qualities they would like to see in a connected, and maybe self-driving, car in the future. A photograph from the station is shown in Figure 4.30.

Figure 4.30. Photograph of the station Connectivity

4.2 Methodology

During this study, three different fairs were visited, these are described above in Section 4.1. The main data collection took place at those fairs and the analysis of the data was continuously carried out in between the visits. In Figure 4.31, an illustration of the working approach for the data collection in this study is presented. The research approach in this study was to start with a wide perspective and observe everything that could be of interest. This wide perspective was kept during the first and second fair, although the collection methods were slightly modified during the study depending on the results acquired from the previous collected data. For the third fair, most of the data from the first two fairs had been analyzed and the third fair was used to strengthen a theory generated from this analysis. The methodology of this study includes triangulation and is inspired by Grounded Theory, two terms which are described further in the sections below. Finally, the research sample will be presented.

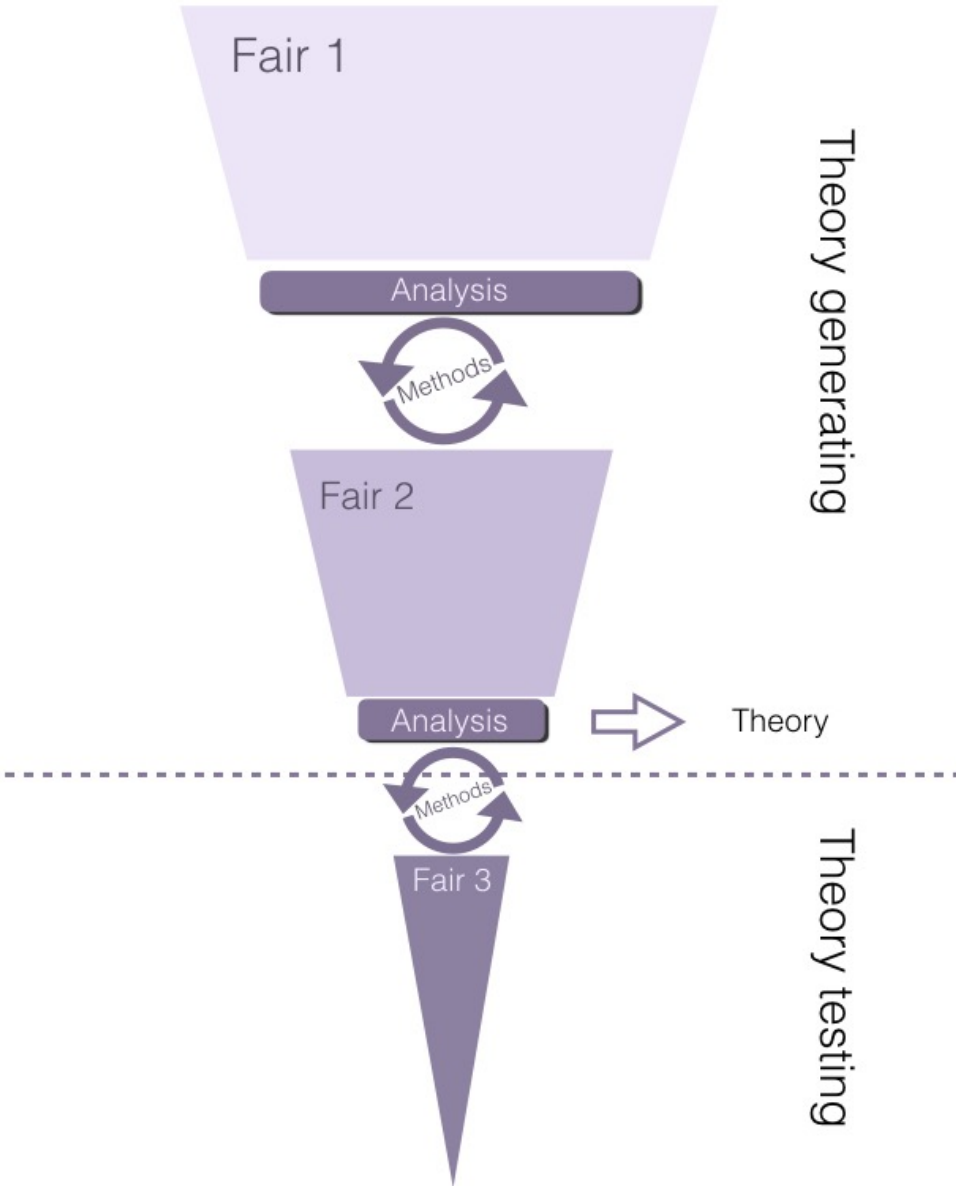


Figure 4.31. Illustration of the study approach

4.2.1 Triangulation

Triangulation is a term describing the use of more than one research method (Wilson, 2014). Denzin (2006) defines four different types of triangulation: data, investigator, theory and methodological triangulation. The methodological triangulation can be further divided into within-method and between-method triangulation. Within-method triangulation is when a variation of one method is used, for example, to use different types of interviews. Between-method would be to use a variation of different methods, for example to complement the interviews with observations (Denzin, 2006).

When using triangulation, the results can be either convergent, complementary or contradictory. If given only convergent results, the use of triangulation can be considered redundant, and the same results would probably have been given using only one of the methods. When using triangulation complementary or initially contradictory results are desired in order for the method to be effective (Flick, 2009).

Triangulation in this study

In this study, methodological between-method triangulation has been used to formulate a theory, see Figure 4.32. Both interviews, observations and a survey have been used to provide data to this thesis, these are further described in Section 4.3. Triangulation was used in this study in order to ensure comprehensive data where the different methods for data collection were meant to complement each other.

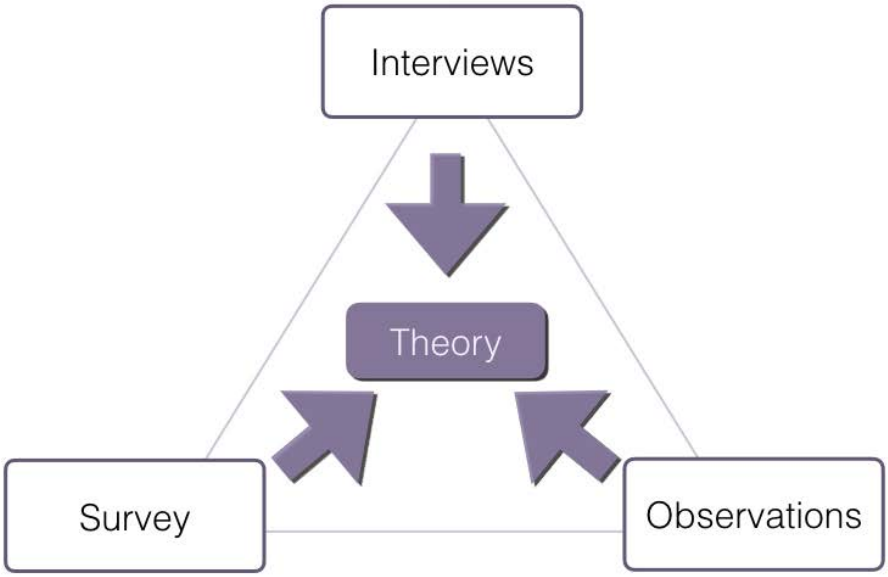


Figure 4.32. Illustration of how triangulation was used in this study

4.2.2 Grounded Theory

Grounded theory was first outlined by Glaser and Strauss (1967) and is defined as a general methodology where data is collected and analyzed. A theory is then developed as a result of that analysis (Flick, 2009). The methods used in grounded theory projects are the same as in other research approaches. Interviews and observations are often used and qualitative methods can be mixed with quantitative ones (Strauss & Corbin, 1994). The main difference is that instead of the data collection being based on an existing theory, the gathered data is used to generate the theory (Strauss & Corbin, 1994). The grounded theory researcher starts with the empirical work unprejudiced. The research question is formulated openly and is assumed to change during the process. Data collection and theory generation are performed in parallel, and the material is then used to generate the final theory (Patel & Davidson, 2011).

Grounded Theory in this study

As can be read in the book by Glaser and Strauss (1967), grounded theory can only be developed and fully understood by trained sociologists, but even laymen can apply this theory to their work. This study can therefore not be deemed to have used grounded theory as a whole, but the work in this thesis has in many ways been inspired by grounded theory. In this study, there was no predetermined theory, but it started out with an extensive data collection from which a theory was obtained. The data collection and the analysis were performed in parallel throughout the project, which can be considered to be inspired from the grounded theory (Patel & Davidsson, 2011).

4.2.3 Research sample

In a study with a large target group it is impossible to collect data from all individuals within the population. Therefore, a sample is chosen to represent the population which makes it possible to draw general conclusions (Patel & Davidson, 2011). In this study, a combination between convenience sample and opportunity sample was used. Both are non-probability samples which means that the probability for individuals in the target group to be part of the sample is not equal. Convenience sample is defined by Colman (2016a) as “A non-probability sample of research participants or subjects selected not for their representativeness but for their accessibility or handiness […]”. Opportunity sample is defined as “A non-probability sample comprising a pre-existing serviceable group […]” (Colman, 2016b). During the data collection, only a small part of the entire target group was available, namely the ones invited to the fairs, which limited the sample to an opportunity sample. Within this group, a convenience sample was made with respect to who was available and in place for the time of the data collection. To have a non-probability sample means that it is difficult to generalize the result, especially in a statistical way (Statistics Sweden, 2008). The sample selection was carefully considered and since probability sampling would not be practically feasible in this study, non-probability sampling was selected with the knowledge that the results would not be possible to generalize directly to the entire population.

4.3 Methods for data collection

Since this study mainly examined individually dependent data, such as the subjective experience of the visitors, the main data collection was carried out with qualitative methods. Qualitative methods are useful when you want to understand the complete picture of an individual’s experience since they are more flexible than quantitative ones and enables one to ask open-ended questions as well as follow-up questions (Mack et al., 2005). Observations and interviews were mainly used for collecting data in this study. Quantitative methods were used to some extent, in the form of a survey, but the main purpose with the survey was to validate the results given by the qualitative methods. The result from the survey was also used in those cases where interviews and observations could not be used since the subjects were regarded to be sensitive, this is described earlier in Section 1.3.

In the sections below, the methods will first be described from a general perspective according to the literature and after that follows a segment where the method’s application in this study is presented.

4.3.1 Observations

Observations are characterized by *naturalism*, the idea that the social world ought to be studied in context. By selecting observations as a data collection method, the researcher will access the social situation in which the events occur. Observations show what people *do* while interviews show what people *say that they do* (Tjora, 2012).

Observations can be divided into two categories: Observations testing theories and observations creating theories (Chiriac & Einarsson, 2013). In the first type the aim of the observation is to either confirm or discard an existing theory. This method is hypothetical deductive, the hypotheses is derived from theories and then tested against empirical data. The theory generating observation is based on empirical data. The researcher has no predetermined hypothesis, but works inductively to get an idea, and possibly a theory, of the phenomenon studied (Chiriac & Einarsson, 2013).

The observations can be further divided into high and low structured observations. In a high structure observation, the researcher has preselected what should be included in the observation. In a low structured observation, which are mainly used in exploratory purposes, the researcher collects as much information as possible within a certain area (Chiriac & Einarsson, 2013). A coordinate system which can be used to categorize observations according to if they are theory testing or generative as well as if they have low or high structure can be seen in Figure 4.33.

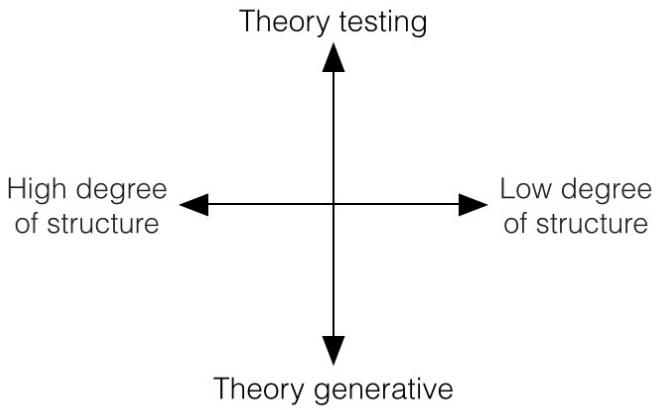


Figure 4.33. Illustration of a coordinate system in which observations can be categorized

A hidden observation is in general ethically questionable in research. The persons involved have no way of knowing that they are a part of a research study and have no possibility to withdraw from the project. However, it is accepted to carry out hidden observations, given that it takes place in public spaces, without the need of the researcher to inform all involved (Tjora, 2012). “Informed consent is not necessary as long as the researcher has no contact with the informants, the information is not sensitive, and research has greater utility than the damage suffered by those being researched.”, this exception does not apply if photo, video or tape recording is used (Nesh, 2006, p. 14 [our translation]).

Observations in this study

In this study, the observations were carried out at the three fairs described in Section 4.1. Due to the different designs of the fairs, the observations could not be carried out in the exact same way throughout the project, but had to be modified subsequently. The modifications were not only made with respect to the fair's design though, but also with respect to the data previously obtained. The observations were documented with field notes that were later transcribed and analyzed.

The observations carried out during the first two fairs were theory generating with a varying degree of structure. During *Fair 1* the whole exhibit area of *Möjligheternas Värld* was being observed. The observation template used during these observations can be found in Appendix I. As can be seen in the template, the different workshops around *the Car Factory* were numbered in order to facilitate the field notes. The different sides of *the Car Factory* were also marked, these with letters, to enable notes regarding activity in relation to the factory. The two observers were responsible for observing half of the workshops and two sides

of the car factory each in order to cover the entire exhibit area. At the times when one of the observers was conducting an interview and therefore not able to observe, the other one was responsible for observing all workshops and all sides of *the Car Factory*. These were hidden observations with a low degree of structure and everything that could be of interest was noted. It was considered ethically defensible to perform observations without the consent of the visitors since the subject was not regarded sensitive and they were conducted at a fair. In this study, the fairs have been considered to be public spaces since the visitors were surrounded with a large number of unknown people and it was in most cases possible for anyone to enter the area. This will likely make the visitors act as if they were in a public space.

In the second fair, *Fair 2*, the researchers followed a specific group through the exhibits in order to enable that the group's overall attitude was taken into account as well as its eventual influence on the individuals of the group. These observations were also theory generating, but with a higher degree of structure. The exhibits had been visited by the researchers in advance, and the observations were performed with a number of factors in mind, for example the degree of interaction at the different exhibits and the interplay between the group and the instructor at the exhibit, see Appendix II for the template used during these observations. These observations were open, meaning that the visitors knew that they were being observed and had given their consent. The decision to make these observations open was taken with the knowledge that this might have an influence on the behavior of the visitors but it was considered hard to conduct the observations without the visitors noticing since the researcher followed the group through all seven stations. In order to minimize this eventual influence, the observers aimed to keep a low profile and often stood in the background to not affect how the visitors acted.

Observations were also performed at *Fair 3*. These were, unlike the observations at the previous fairs, only used to understand the context of the fair and to be used as a support for the result from the interviews at this fair. The observations were open and with a relatively low degree of structure, all relevant things concerning the activities at the stations as well as the interactions between instructors and visitors were noted, see Appendix III for the observation template.

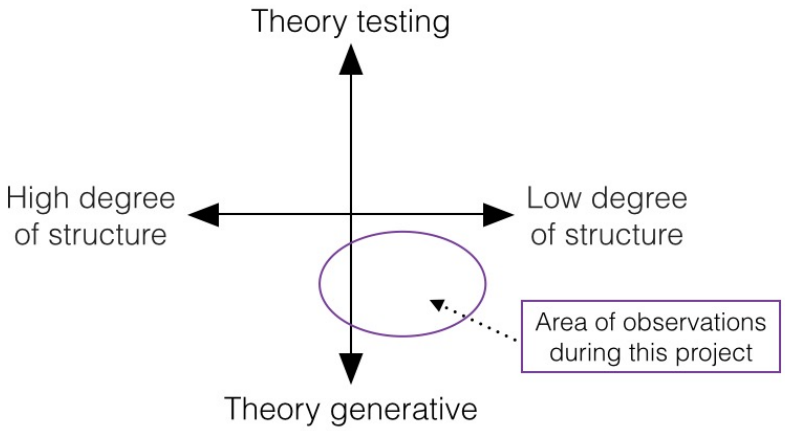


Figure 4.34. Illustration of where the observations in this study can be categorized in the coordinate system

In the first fair, the visitors were of varied age, and the observations therefore focused on the visitors who fitted the target group. Otherwise, the sample was made according to the description in Section 4.2.3. The observations in this study were in the area marked in Figure 4.34. They were theory generative and the structure of the observations varied from rather low to medium, where the first and last observations had a lower degree of structure and the ones at *Fair 2* were more structured.

4.3.2 Interviews

An interview is a meeting with one or several persons with the aim to obtain certain information by getting the interviewee to answer questions (Kylén, 2004). The qualitative interview is a form of non-standardized interview. This means that the interviewer does not know in advance which questions and answers that will become important and significant. This makes the interview explorative and it is important that the interviewer has the ability to adjust and ask follow-up questions on topics that may be of importance for the main purpose of the research (Svensson & Starrin, 1996). The length of an interview can vary from five minutes to an hour depending on the purpose of the interview. For an interview that aims to treat part of a subject or cover a narrowly limited subject, five to ten minutes are considered enough. In a forty to sixty minutes interview, several subjects can be dealt with and a greater depth within those subjects is possible (Kylén, 2004).

When constructing the questions for an interview, one aspect to consider is how free the interviewer is to formulate the questions and deciding the order in which they will be asked. Another aspect is how wide the response space is for the interviewee. This is called standardization and structuring (Patel & Davidson, 2011). The degree of standardization and structure is decided with regard to the aim of the data collection. In a qualitative interview, however, the degree of structure is generally low which means that the interviewee is able to formulate the answers in his/her own words and the variation of answers is not obvious in advance (Patel & Davidson, 2011). The degree of standardization may vary from a few themes which should be treated in a non-specified order to a list of questions that should be asked from top to bottom. In some cases, structure and standardization are not separated and then the term for the strategy used in most qualitative interviews is semi-structured interview. A semi-structured interview has a low degree of structure and a various degree of standardization, described with the terms previously mentioned (Patel & Davidson, 2011).

The interviews can be implemented in a number of different ways, but generally they all undergo three stages: opening, reflection and wind-up, where these three stages all require different degrees of reflection from the interviewee, see Figure 4.35 (Tjora, 2012). Opening questions are simple and concrete with the aim to warm up the interviewee and process the matters that do not require reflection. The reflective part is the core of the interview. This is where the interviewees can immerse themselves in the research question and in this stage the right type of follow-up questions are of importance. The wind-up questions' purpose is to normalize the atmosphere and give the interviewer a chance to inform about how the project will proceed (Tjora, 2012). This pattern is the same for long interviews as well as for short interviews.

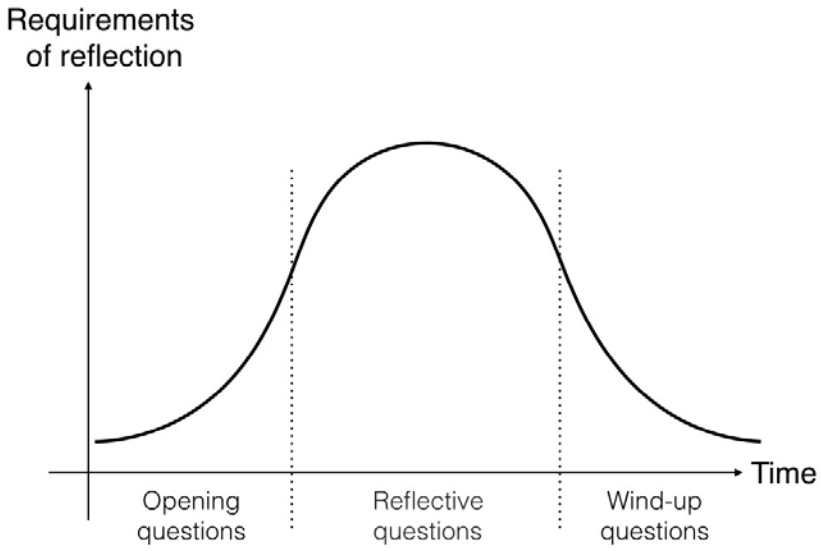


Figure 4.35. Illustration of the three stages which an interview undergoes

Interviews in this study

The interviews used in this study were qualitative, semi-structured and relatively short. The issues dealt with were considered narrow and distinct enough for shorter interviews. Beside that, the interviews did not aim to deal with any sensitive topics, why five to ten minutes were considered enough time for each interview (Kylén, 2004). Since the study had an open research question and all answers within the area were of interest, semi-structured interviews were most suited for the data collection. The degree of standardization was rather high, a list of questions was prepared and the order was thoroughly thought through to follow the three stages shown in Figure 4.35. The interviews were constructed in this manner to eliminate the effect of the individual interviewer's ability and to make the responses comparable between the different interviewees. A certain amount of room was left, however, to ask relevant follow-up questions about things that could be of additional interest in the study or in those cases where the answers were not sufficiently exhaustive.

All interviews started with a short presentation of the purpose of this study and what the data was going to be used for. The interviewee was also asked for permission to be recorded, along with information that this recording only would be used to facilitate the analysis of the study. The opening questions regarded simple matters such as age and education. The reflective questions mainly concerned the interviewee's experience of the exhibition, including relevant follow-up questions. The wind-up questions considered if the interviewee had something additional to add to the previous answers. In conjunction with the last question the interviewer expressed gratitude for the answers given as well as handed over contact information to enable them to take part of the end result of the study. The questions slightly differed depending on the layout and context of the fairs but the overall design of the interviews were kept the same during the data collection at the first two fairs. At *Fair 3*, the interviews were theory testing instead of theory generating which meant that the questions were narrowed down to concern only the subjects regarded in the theory formulated based on the results from *Fair 1* and *Fair 2*. For the detailed interview templates for the different fairs, see Appendix IV, Appendix V and Appendix VI.

The interviews were audio recorded to enable transcription later on in the study. This method was chosen in order to allow the interviewer to focus on the interviewee and asking the right follow-up questions since that is of great importance in qualitative interview (Svensson & Starrin, 1996). The selection of informants in the interviews was made according to the research sample, see Section 4.2.3. A total of twenty-five persons were interviewed**,** a summary of these can be seen below in Table 4.1. Two of the interviewees, 1:4 and 1:7, were not within the target group defined in Section 1.3. These were still included in the analysis since their answers did not significantly differ from the other answers and also because the target group of the Science Center, which will use the result from this study, includes their age group. Two of the interviewees did not have Swedish as their mother tongue but were considered important to interview in order to obtain a fair representation of the visitors at the fairs.

Interview Number	Interviewee	Age	Fair	Type of interview
1	1:1	18	1	Theory Generating
2	1:2	18	1	Theory Generating
3	1:3	18	1	Theory Generating
4	1:4	28	1	Theory Generating
5	1:5	12	1	Theory Generating
6	1:6	18	1	Theory Generating
7	1:7	29	1	Theory Generating
8	1:8	12	1	Theory Generating
9	1:9	18	1	Theory Generating
10	2:1	15	2	Theory Generating
11	2:2	14	2	Theory Generating
12	2:3	14	2	Theory Generating
13	2:4	18	2	Theory Generating
14	2:5	14	2	Theory Generating
15	2:6	15	2	Theory Generating
16	2:7	14	2	Theory Generating
17	2:8	17	2	Theory Generating
18	3:1	15	3	Theory Testing
19	3:2	14	3	Theory Testing
20	3:3	14	3	Theory Testing
21	3:4	14	3	Theory Testing
22	3:5	14	3	Theory Testing
23	3:6	15	3	Theory Testing
24	3:7	14	3	Theory Testing
25	3:8	14	3	Theory Testing

Table 4.1. A compilation of the interviews conducted in this study

4.3.3 Surveys

A survey can be used for several purposes and can be varied much depending on what you seek to answer. In literature, many advices are given on how to conduct a survey. These are generally concerning time and place, construction and selection of participants. Andersson (1994) describes this when explaining the theme of his book *Som man frågar får man svar* (*You get the answers you ask for* [our translation]) as the answers you get depend on the questions you ask and how you do it.

When it comes to time and place, these are relevant factors to consider in order to get enough answers to the survey as well as getting reliable answers. Kylén (2004) says that if the surveys are collected at the same

time as they are handed out the number of returned surveys will increase but the respondents may not have enough time to thoroughly think through their answers. Another time factor to take into account is the expected time it takes to fill out the survey. It should be long enough to cover the relevant areas for the study but not too long since that can make the respondent tired and hence give carelessly filled out surveys (Eliasson, 2006).

The construction of the survey involves many elements to contemplate. The number and type of questions, the medium used to distribute the survey as well as the layout and formulations are some examples of what might affect the end result. Too many questions lower the probability for respondents to finish the survey but too few can make the result unreliable (Phillips & Stawarski, 2008). There are two main types of questions, open and closed. An open question lets the respondent formulate the answer freely and the closed questions gives the respondent a number of pre-formulated options to choose from (Eliasson, 2006). If the survey contains response options in the form of a scale, one can choose to either have an even or odd number of options, where an odd number provides a neutral alternative in the middle and an even number forces the respondent to state an opinion (Kylén, 2004). The layout should be easy to understand, the formulations should be simple and tailored to the target group and finally, the questions should be organized with the easy questions in the beginning and the more complex ones towards the end (Eliasson, 2006).

Another important aspect to consider when conducting a survey is the non-response rate. This is a number describing how many of the surveys sent out that were not answered. The main issue with non-responses is that it increases the risk for a skewed result since the respondents who answer the survey might not be representative of the entire sample (Japec et al., 2000). In order to reduce the non-response rate it is important to consider the factors mentioned above, such as length of the survey and the timing.

The survey in this study

The survey in this thesis was carried out in conjunction with *Fair 2* and was filled out by people that had participated in the exhibitions, see Appendix VII for an overview of the survey. The survey was designed to provide a large number of data, in order to validate the result given by the observations and interviews. When designing the survey, closed questions were mostly used since it would simplify the latter analysis and make the answers easier to interpret. In a few cases, it was possible for the respondent to answer freely if none of the options fitted his/her perception. The main disadvantage mentioned in the literature is that closed questions can lead to missed answers if the options do not match the thoughts of the respondent (Eliasson 2006). This, however, was compensated with a possibility to fill out a self-formulated answer to the questions that were most relevant for this study and with the interviews where open questions were used. The survey was designed in consultation with the stakeholders of this study to ensure that relevant aspects were considered and also to get feedback on how the layout and the formulations worked in relation to the target group. To ensure well thought through answers and as many answers as possible, the survey was sent out in a digital form to the visitors after their visit. Even though Kylén (2004) states that collecting the survey directly will lead to more answers, in the case of this study it was regarded more likely to receive a larger number of filled out surveys over the Internet. This was due to the fact that the data collection only took place during two out of five days of the fair. It was therefore not manageable to collect as many surveys at the fair compared to the number of surveys obtained over the Internet.

To distribute the survey over the Internet meant that the non-response rate became higher than it would have been if they had been handed out at the fair. Out of the approximately 1000 surveys sent out, 202 were filled in and sent back which leads to a non-response rate of 79,80%. This is a high number and the result might therefore be skewed in relation to the entire sample. As mentioned in Section 4.2.3, this study uses a non-probability sample why the result still can not be generalized to the whole target group. Hence, the answers are more of an indicator of what might be important factors than a statistically reliable result. In this study a higher number of answers were prioritized over a high response rate and therefore the survey was sent out in a digital form.

To reduce the risk for unconsidered answers, the survey was kept relatively short and the questions were mainly closed which made the survey faster to fill out. Most questions were in scale form and the number of options was chosen to be odd, which gave a neutral middle option. The neutral option was considered beneficial in this study because there was a possibility that the respondent could not take a position. The survey was decided to start with the questions about the experience of the fair and end with general questions about the respondent. This order was chosen for the respondent to directly understand the purpose of the survey and for them to focus on the fair rather than the subordinate issues dealt with in the last questions.

4.4 Methods for data analysis

When the data had been collected it was analyzed with two different methods. Affinity diagram was used as a method to analyze the qualitative data, the interviews and the observations. Qualitative analysis inspired by descriptive statistics was used to analyze the quantitative data from the survey.

4.4.1 Affinity Diagram

Affinity diagram is a method for analyzing qualitative data and is based on the KJ-method, developed by Jiro Kawakita (Courage & Baxter, 2005). The idea behind the method is to use a bottom-up technique where the analysis starts in the details and then develops into an overall picture. A similar thought is described by Auerbach and Silverstein when they talk about coding: “The central idea of coding is to move from raw text to research concerns in small steps, each step building on the previous one” (Auerbach & Silverstein, 2003, p. 35).

When an affinity diagram is carried out, the most common way to do is to write down relevant quotes or notes from the data on cards, then start to organize them according to relationship to other cards. It is important that each card contains only one sentence with a clear single meaning, and no abstract terms are being used (Mizuno, 1988). Before grouped together, the cards should be shuffled to eliminate any pre-existing structure. When grouping the cards no classification scheme or keywords should be used, the cards are not supposed to be classified, but to be grouped (Mizuno, 1988). The main idea of this method is to not have predetermined categories or headlines but to let these emerge when the cards are grouped together (Courage & Baxter, 2005). To make sure that no pre-existing structure is being used, “this sorting is done not by the basis of reason, but on the basis of feeling.” (Mizuno, 1988, p. 126).

When all cards have been grouped, they should be read once more and if some card is considered inappropriately sorted, it should be returned to the presorting pile of cards (Mizuno, 1988). Cards that does not fall into a specific group should be left alone, and not forced into a sorting scheme. Each lone card is instead considered to be a group of its own (Mizuno, 1988). If the number of emerged categories are considerably more than ten when the sorting is done, a new sorting takes place. This time the groups are given headings, and these categories of cards are then grouped together in the same way the single cards were in the previous procedure. This sorting is done as many times required to reach an approximate of ten categories (Mizuno, 1988).

The Affinity Diagram in this study

To analyze the data generated from the interviews and observations, the method used was affinity diagram. This method was used since it is an effective way to structure larger amounts of qualitative data, which was the case in this study. The advantage with this method is also that it provides a way to sort data without preconceptions. An example of how it may look when performing an affinity diagram can be seen in Figure 4.36.

Figure 4.36. Photograph of affinity diagram in the making

For the first two fairs, three different diagrams were made, one for the interviews at these fairs and one each for the field notes from the observations. The interviews were analyzed together since they treated the same subjects and the questions were similar. The observations, on the other hand, were of varying degrees of structure. The data from the different observations were of different types and focused on different things and were therefore decided to be analyzed separately.

Figure 4.37. Photograph of the affinity diagram with the interviews from Fair 1 and Fair 2 after the groups have been given headings

Quotes from the interviews were written on notes and then grouped together as in the method described above. When all the notes were placed on a board and grouped according to affinity, the notes were read through once again to see that the groupings were relevant. Adjustments were made and some groups were joined as they treated similar subjects. After further verification of the groups, every group got a descriptive heading, see Figure 4.37. The notes in every group were then placed on papers which were scanned in order to be the basis for the compilation of results. Examples of these papers can be found in Appendix VIII. The same procedure was performed for the observations from *Fair 1* and *Fair 2* respectively.

The results from *Fair 1* and *Fair 2* were used to generate a theory which was to be tested at *Fair 3*. The categories found in the affinity diagrams were evaluated with the *Research Question* in mind and the ones that were considered to be important factors were used when the interview questions for *Fair 3* were designed.

The interview template for *Fair 3* was constructed to test if the factors, identified during the previous analysis, were relevant and the analysis of the answers from that fair was conducted in a similar way as the ones for the previous fairs. The main difference was that the factors identified from the first analysis were used as predetermined categories to sort the answers from *Fair 3* along with a complementary category for the answers that did not fit into any of the others, see Figure 4.38. This made it easier to see if the answers from *Fair 3* supported the theory formulated after *Fair 1* and *Fair 2* or if the answers differed. Hence, it was possible to see if the theory could be strengthened or disclaimed.

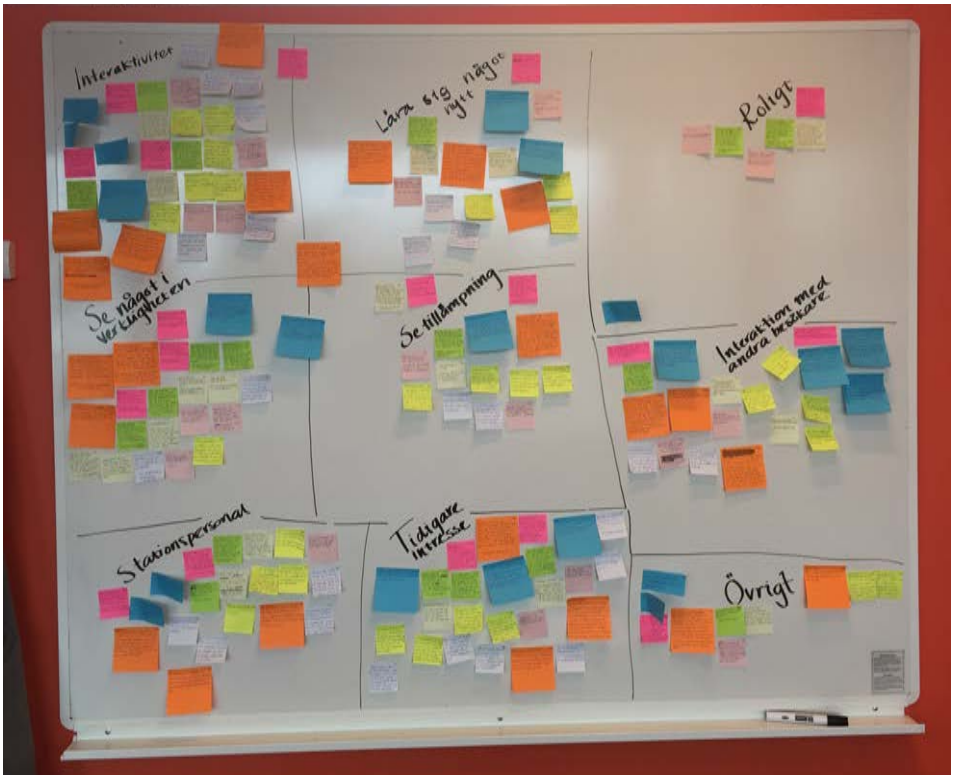


Figure 4.38. Photograph of the affinity diagram performed after Fair 3

In the analysis, most conclusions was drawn from the result from the interviews since this data was more explicit than the data from the observations. The observations might also be influenced by the difficulties with being objective as an observer. Furthermore, the theory was only tested with interviews at the third fair and therefore, the data from the interviews will be used more when concluding which factors that are important for the experience of the visitors.

4.4.2 Quantitative analysis

In addition to the analysis of the qualitative data, the quantitative data was also analyzed in order to provide results for the study. There are several different ways in which this can be performed, of which one is descriptive statistics. Descriptive statistics is described by Denscombe (2009) as a way to organize and present data as well as provide a basis for a fundamental analysis in an easy but accurate way. When conducting a quantitative analysis it is important to understand the differences between various data, "... the scientists who want to use quantitative data must understand what type of data they work with and understand the possibilities and constraints associated with specific types of numeric data." (Denscombe, 2009, p. 329 [our translation])

Two different types of data often mentioned in the literature are nominal and ordinal. As described in the quote above, it is important to understand the difference between these in order to be able to work with the data. A nominal variable is a variable which can be classified in different categories and these can not be ranked in a specific order. An example of a nominal variable is education. An ordinal variable is a variable which can be classified in different categories but unlike a nominal variable, these can be ranked in a specific order (Denscombe, 2009). An ordinal variable can for example be a scale where the options are integers from 1 to 5.

Another important aspect when performing a quantitative analysis is that there is enough data for the analysis to mean something. Edling and Hedström (2003) state that about thirty respondents can be considered a minimum for a quantitative analysis. There is also a number of ways to present the data. Frequency tables are one way of presenting the distribution of data and these can be used to create diagrams in order to visually illustrate how the respondents answered (Edling & Hedström, 2003). This provides an easy overview over the result which in turns can be used as a basis for a compilation of the data. Frequency tables only take one variable into account (Edling & Hedström, 2003).

The quantitative analysis in this study

In this study, descriptive analysis have been used which in this case means that data was collected, coded and then compiled in frequency tables, cross tables and bar charts. This was inspired by descriptive statistics but has been performed without regards to deviation or variation. These measures were excluded since the study has a non-probability sample which means that it is difficult to draw general conclusion, hence deviation and variation will not be relevant. The study obtained 202 completed surveys and to get a better overview of the data from the surveys, they were analyzed in the statistical program *IBM SPSS Statistics*. All the responses from the surveys were translated to numbers in order to be readable by the application and could then be analyzed and compared to each other. The questions where the respondents were able to fill in numbers between 1 to 5 were treated as ordinal data. The other questions, where the respondents had to choose one or several alternatives, were treated as nominal and translated to a different number for each category of answers.

For the questions where only the number of respondents who chose a specific answer was of importance, frequency tables of percentages were used. The frequency tables were then transferred to *Microsoft Excel* where bar charts of the numbers were created.

No further calculations were made, the diagrams were simply read and interpreted. When answering the *Research Question*, the quantitative analysis was not intended to provide results on its own, but to complement the results that emerged from interviews and observations.

5. Result

In this section, the result from the data analysis is presented. The data analysis was performed on the qualitative data from the interviews and observations as well as on the quantitative data from the survey. The result answers the *Research Question* and regards the different factors identified in the study. Quotes from the interviews is used in the following section in order to provide examples from the data collection. These quotes have been translated since the interviews were held in Swedish, a compilation of the quotes and how they have been translated can be found in Appendix IX.

Research Question

> What factors contribute to if exhibitions involving technology are perceived as interesting by adolescents aged twelve to nineteen years?

Figure 5.1. Illustration of the factors found in this study which are important for the experience of an exhibition

The data analysis was performed in two steps. The first analysis was made after two fairs and a theory was formulated based on that analysis. The theory was that the following factors are important for the visitors experience of the exhibition:

- Interactivity
- To see something in reality
- The staff's behavior

- To be subjected to something new
- To see an application for the technology presented
- Previous interest
- How entertaining the visitor perceives the station to be
- The possibility for interaction between visitors

The subsequent data collection was conducted in order to either strengthen or dismiss this theory and the analysis of that data showed that the theory presented above could mainly be strengthened. The factors and the results supporting that the factor is contributing to the experience of the exhibition are presented in the sections below. Figure 5.1 presented above illustrates a summary of the factors found in this study.

5.1 Result from the survey

The two most important questions related to the *Research Question* in the survey and the result from them will be presented in this section. These results will be referred to in the following description of the different factors but will be presented here in order to provide an overview over the distribution of answer and enable a comparison between the factors. The first question was *Which of the stations did you find the most interesting?* and the respondents were able to chose more than one option if necessary. How the visitors answered this question can be seen in Figure 5.2.

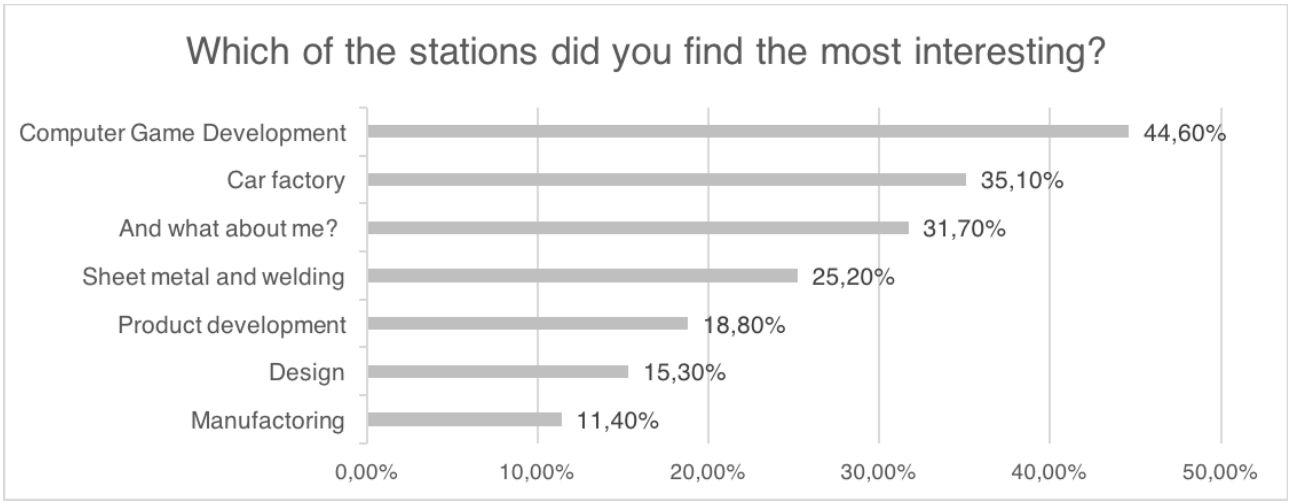


Figure 5.2. Diagram showing the distribution of the answers to the question: Which of the stations did you find the most interesting?

The second question relevant to the *Research Question* was *What was it that made the station/-s especially interesting?*, and here the respondents were also able to answer with several different factors. See Figure 5.3 to see how the answers to this question were distributed. To simplify the diagram, the options the respondents could choose from for their liking of the stations have been shortened. These are presented in Table 5.1 where both the options the respondents filled in, and how they were shortened in the diagram are presented. In *Other* the respondents had the possibility to fill in their own suggestions of factors important to them. The few respondents that chose to write their own factors of what made the stations interesting all wrote something that could already be found in the given alternatives. These answers have been treated as an extra vote for that factor in the compilation of the survey.

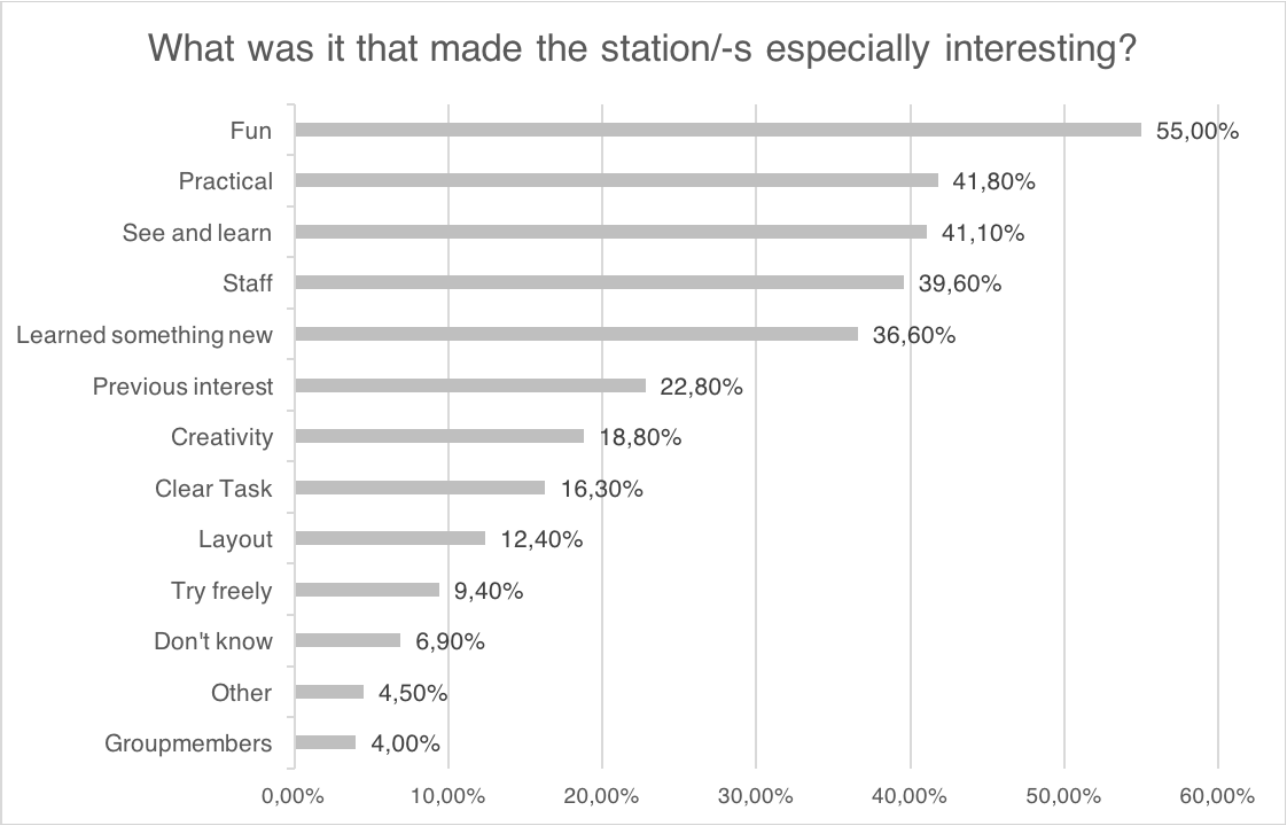
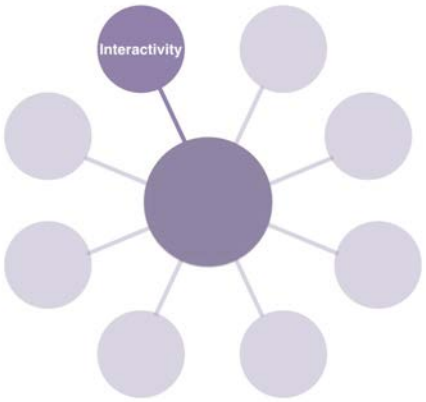


Figure 5.3. Diagram showing the distribution of the answers to the question: What was it that made the station/-s especially interesting?

Formulation of alternatives in the survey	Formulation of alternatives in diagrams
I had the opportunity to try something practical	Practical
I had the opportunity to see and learn how something works	See and learn
I found that the staff at the station were good	Staff
I had fun	Fun
I had a clear task at the station	Clear task
I had the opportunity to try things free on the station, without a definite goal	Try freely
I got to be creative	Creativity
I had a previous interest in the topic/area	Previous interest
I learned something new	Learned something new
The others in the group thought it was interesting	Groupmembers
I like the layout/appearance of the station	Layout
I don't know	Don’t know
Other	Other

Table 5.1. The options which the visitors could choose to explain why they found a station extra interesting and how the options have been shortened in the diagrams

5.2 Interactivity



Interactivity was after *Fair 1* and *Fair 2* believed to be a factor that affects the experience of the visitors. The theory generated after those fairs was that *Interactivity is an important factor for the experience of the visitor*. In this section, the result that led to that theory as well as the result from the last fair where that theory was tested are presented.

As stated in Section 3.2, the definition for interactivity used in this study is the one provided by the Oxford English Dictionary, namely that *interactive* is something "Reciprocally active; acting upon or influencing each other." (Oxford University Press, 2016). Exhibits which does not have a reciprocal response but where the visitors are able to do something practical have been called *active* in this study. The game analogy for different degrees of interactivity will also be used, which is also described further in Section 3.2.

Out of the seventeen interviewees at the first two fairs, ten of them talked about the importance of doing something practical or seeing something for real instead of only listening to an instructor talking about the subject. Some of them mentioned that it was important for their understanding to actually do something practical, that it was easier to understand when they were able to try it for themselves and explore the technology on their own.

"*... it is hard to understand without doing with your hand but to study, it takes a lot of time*." (2:8)

"*To try and see, but it is like that automatically when you get to feel and try for yourself what it is like to do it. So you get a little more understanding* [...]" (1:6 - On answering "*What was best at the exhibition?*")

Another aspect raised by these interviewees is that they perceived the stations/workshops where they could try something as more fun than the others.

"*When I, for example, got to try to weld and also play computer games and... that was the most fun. When you got to do things yourself*." (2:3)

"*Yes, it was this with the camera. That was the most interesting. The others were more like.. Well, I think it is more fun when you get to do something yourself*." (1:2)

When asked what they wanted to change at the fair, the most common suggestion was to make more parts of the exhibits hands-on, to be able to touch and try even more. This opinion occurred in both *Fair 1* and *Fair 2*.

"*Yes, to be able to do as much practically as possible and not get as much talk but more to do stuff*." (2:3 - On answering *"Do you have any suggestions on improvements for this fair?"*)

"*A little more that you got to test yourself*" (1:7 - On answering "*What could have been better with this exhibition?"*)

During the observations at *Fair 1*, one workshop that stood out regarding popularity was *Augmented Reality*, where the visitors got to guide each other with VR glasses. It was noted during the observations that the visitors tended to stay the longest time at this workshop and many people were gathered around the area in order to see and try this activity during the entire time of the observations. This workshop was also the most interactive of all the stations observed at this fair. If compared with the definition of interactivity stated above, the exhibition is reciprocally active since the visitor gets a response depending on what the other person at the station does. So even if the exhibition itself is not acting back, the visitor will get a response which is depending on the own actions of the visitor. The degree of interactivity is medium. There is a definite goal, to build the construction, but there are several ways to make it happen. The workshop had, however, a weakness in the fact that only two people at a time could be fully interactive and other visitors at the station often lost interest quickly. At this station, it was also critical that the technology involved worked flawlessly all the time, and at the times that it malfunctioned, the engagement of the visitors dropped rapidly.

This was consistent with the responses received from the interviews at that fair, where many visitors named *Augmented Reality* as their favorite workshop and when asked what they wanted to change, many of them mentioned that they wanted to do and test more. None of the other workshops at *Fair 1* were considered interactive according to the definition formulated in Section 3.2, some of them were active though. A few of them were still mentioned in interviews as interesting but this have been considered to be related to other factors than interactivity.

As described above, the observations at *Fair 1* indicated that interactivity could be a factor of importance for the experience of the exhibition. This was also strengthened by the result from the interviews. These indications were used to specify the observation template for *Fair 2*. The way the visitors interacted at the stations and if that seemed to make them interested in the subject were therefore specifically observed. Four of the seven stations at *Fair 2* have been noted to have some element of interaction, *Computer Game Development*, *And what about me?*, *Sheet Metal and Welding* and *Product Development*. *Design* and *Manufacturing* were deemed to be active. *The Car Factory* was neither interactive, nor active in the sense that the visitors themselves performed any activity but mainly focused on them listening to the instructors. The only part that could have been active, when the visitors were to order a car, was not performed by the visitors themselves. They instead told their order to the staff and the staff then interacted with the exhibit.

In the survey from this fair, *Computer Game Development* was chosen most frequently as a popular station, with 44.60% of the respondents choosing this as the most popular station, see Figure 5.2. The observations from this fair shows that *Computer Game Development* had one interactive part, where all the visitors tried a computer game, and one more passive part, where they listened to a presentation. Some things noted from the gaming part was that the visitors started to talk to each other and became active. They also seemed to enjoy it as they were eager to play several times and came back to play after the presentation as well. That *Computer Game Development* was chosen as the most popular can therefore be considered to strengthen the theory that interactivity is an important factor for a station to be perceived as interesting.

Manufacturing had occasions where one of the visitors were active, mainly by taking out the finished detail from the machine or pressing a button to start the operation. This, however, were mainly actions where only one visitor in the group performed an activity while the rest stood by and watched. *Manufacturing* was also the station that got the lowest response rate among popular stations in the survey, only 11.40% of the visitors found this station most interesting. The observations from *Product Development* showed that one or more of the visitors in the group were offered to try to model something in the CAD program. This was noted as interactive since the visitor got a response of his/her actions from the program and the interactivity was of a high degree since the visitor was able to freely choose what to model. In this station, activity was also observed in relation to the 3D printers where the visitors could feel the finished models from the printer. The

actions that were mainly noted to raise an interest was when the visitors got to interact with the computers and model something on their own. The group who watched a classmate model seemed more interested and the ones who actively tried the program tended to ask more questions, which can be interpreted as if the interactivity led to an increased interest.

Sheet Metal and Welding had two parts which were interactive, one where all the visitors who wanted could try welding and one where they could try a simulator. The real welding seemed to increase the interest of the visitors as they were focused when they performed the welding and the people standing on the side looking seemed interested and wanted to try for themselves after watching someone else try it. At the simulator, the visitor who was active was focused on the activity but the visitors standing on the side seemed less interested as they often focused on something else, such as their cell phones or talking to each other about things not related to welding. Both the simulator and the welding were activities of a low degree of interactivity, there were defined tasks to perform and only one way of doing so.

The station *And what about me?* was interactive on a medium degree as the visitors got to draw their own picture and the station then focused on these drawings. The visitors seemed more interested in the subject since it was regarding something which they had made themselves. In one group, the visitors took notes on what was said about their drawing, something which can be perceived as a high interest in the station. This station was also the third most popular according to the survey where 31.70% of the respondents named this station extra interesting, see Figure 5.2. *Design* was partly interactive. It started out with a presentation, then the visitors got to do a quiz walk where they were active as they were to answer questions. The quiz also involved products and material which could be felt, something that many of the visitors also did. This, however, was the second least popular station according to the survey with 15.30%.

One station which was not interactive but still was popular among the respondents in the survey was *the Car Factory*. This was the second most popular station but according to the definition of interactive used in this study, this station had no interactive elements.

When choosing reasons for the liking of different stations, 41.80% of the respondents chose *I had the opportunity to try something practical* as an important factor, see Figure 5.3, which further strengthens the theory of interactivity as an positive influence on the experience of the stations.

At the last fair, all eight interviewees stated that they experienced the stations where they got to interact as positive and it made the experience better if they had the chance to try something practical. The visitors said that it was easier to understand it when they got to experience it, and that it is easier to remember the things you have tried relative to what you only been told. The majority also felt that it was fun to try things at the fair.

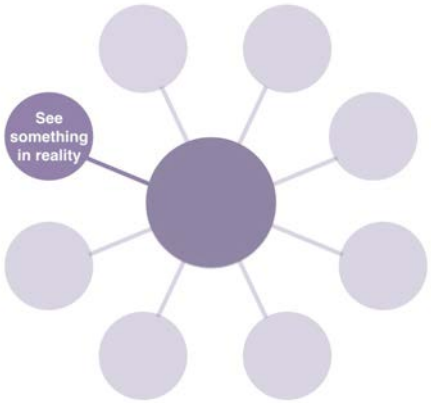
”*But yeah, you really noticed the difference, like when he said that they do not see much in the truck and you really saw that one does not see very much up there where they sit*.” (3:2)

”*I thought that the simulator was most interesting, because there you got to experience the most*” (3:3)

”*I think it was much more fun and you learned a lot easier from it. You remember it because you have been there yourself* [...] ” (3:8)

These interviews can be considered to strengthen the earlier theory, that it is important for visitors to be free to interact at the exhibits, as well as have the opportunity to try things practical. This leads to an increased interest, a more positive experience and may help the visitors to learn more at the exhibit.

5.3 See something in reality



To see something in reality was considered to be an important factor for the experience of the visitor since it was related to one of the most commonly mentioned factors in the survey performed in connection to *Fair 2*, see Figure 5.3. *I had the opportunity to see and learn how something works* was chosen by 41.10% of the respondents as an important factor and that was the third largest percentage. This factor had almost the same percentage as *I had the opportunity to try something practical*, which had 41.80%, and these two factors are closely related. If one is allowed to try something practical it usually means that it is possible to see the technology in reality when you test it. So if a station is interactive, in most cases it also makes it possible for the visitors to see something in reality. Conversely it does not work the same way, however. A station where the visitor can see something in reality and learn how it works does not automatically enable the visitor to interact with the station. In this thesis, *See something in reality* will be used to describe the situations where the visitors get to see something that is physically at the fair. This can for example mean that the visitors get to see a real robot instead of a picture or a video of one.

Out of the workshops at *Fair 1*, most had some aspects of showing the technology in reality. Three workshops were considered to not include this factor: *Environmentally Friendly Production*, *Networked Society* and *Internet of Things*. These were also the workshops where low activity was noted during the observations and at several times the instructors only held a short presentation of the subject after which the visitors left the workshops. *The Car Factory*, *Additive Manufacturing* and *Augmented Reality* were the three stations where the factor *See something in reality* was most obvious. At *the Car Factory* the visitors were able to see a real robot and to follow the assembly of a toy car. The observations indicate that this interested the visitors as many stopped to watch the factory and visitors were seen following the assembly process from start to finish. The *Additive Manufacturing* allowed the visitors to see a real 3D printer in action and also provided examples of printed models which the visitors could examine closer by looking at and touching them. An example of the effect of this was provided when the 3D printer was started in the middle of an observation and the visitors instantly became more interested in this workshop which could be seen in terms of more visitors gathering closer to the printer. *Augmented Reality* was mainly interactive, but as described above, this is closely connected to showing how the technology works for real. The visitors who interacted were able to see how the technology worked at the same time as they tested it. The visitors standing beside could partly see how the technology worked but it did not give them a full insight in the technology as they did not know what the visitor with the VR glasses saw. At this station the ones who tested seemed to find it very interesting, although this is more likely to be related to the factor *interactivity*. The ones who did not test seemed interested in testing the technology.

At *Fair 2*, all stations included the factor of seeing something for real except *And what about me?*. The difference in how popular these stations were can be seen in Figure 5.2 that shows the result from the survey. Since the majority of the stations showed the visitors something in reality it is difficult to draw any conclusions from this diagram. It can be noted that *And what about me?* is the third most popular station despite its lack of the factor *See something in reality*. Along with the other results it can therefore be said that this factor is important but not crucial for creating an interesting experience for the visitors.

The interviews from the first two fairs support the results presented above. Except for those who said that they found it more interesting if they were able to interact, three of the interviewees expressed specifically that it was important for them to actually see things in reality. This, according to them, increased their understanding compared to the stations/workshops with a more theoretical approach.

”[...] *you got like a picture of it instead of just hearing it purely theoretically*” (1:1)

”*The 3D machine, the glasses and the QR-scan, you can see what it is. It makes it easy to keep up and understand*.” (1:6)

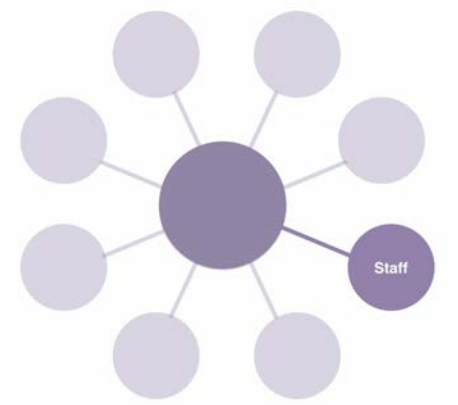
Based on the result presented above, *See something in reality* was considered to be a factor which contributes to how an exhibition is experienced by visitors. At *Fair 3* this was strengthened as seven out of eight interviewees at this fair said that seeing something in reality affected their experience in a positive way. Most of them described that they got a better understanding when they were able to see the technology in reality. One of them mentioned that this was especially important in the cases where it is hard to imagine on one's own how the technology looks or works. Some of the interviewees also said that it generally made it more fun or interesting if they were able to *See something in reality*.

”[...] *as I said before, you remember a lot more if you really see it in front of you*.” (3:8)

”[...] *then you get a bigger picture of what it is like. One understands it better and understand the situation instead of trying to come up something and then maybe you picture it incorrect*.” (3:7)

5.4 Staff

The data collection of this study was placed at fairs where information at all workshops or stations were mediated by staff. The staff were responsible for sharing the information with the visitors and in some cases lead them through the activities. The result shows that when staff are present at a station they also become an important factor for how the visitors experience the exhibition. In the survey, 39.60 % of the respondents entered that *I found that the staff at the station were good* was a contributing factor to if they found a station interesting. This was the fourth most commonly mentioned factor in the survey, see Figure 5.3.



In the interviews from the first two fairs, the visitors had a positive perception of the staff. Words like “interested”, “kind”, “nice” and “funny” were all mentioned in the interviews concerning the staff. The interviewees stated that it makes them more interested if the staff seems to be engaged in the subject which they are talking about. One of the interviewees also said that if the staff is nice, he/she is more likely to listen more carefully at the station.

”*The staff were all really nice, which makes you try to concentrate even if you are a little bit tired*.” (1:2)

From the observations it was noted that the way the staff were interacting with the participants seemed to have an effect on how engaged the participants became. When the staff asked open questions, questions with no definite answer, the visitors became more active as they had to think about the answer and in some cases discuss with other group members. Here, a difference could be noted compared to the stations where the

visitors only got to listen to a presentation. The participants paid more attention to the activities at the station when they were asked open questions. In the cases where close questions, questions with a given answer, were used no significant difference was noted in relation to if no questions at all were asked. At the station *And what about me?* the staff had an noticeable impact on the visitors. The staff here were perceived by the observers to talk more "with" the visitors than "to" them which means that it was more similar to having a conversation than a presentation. Here, they also used selected visitors in their presentation as examples, something that mostly seemed to make the visitors more likely to listen but could sometimes be seen as a bit uncomfortable for the person who was singled out. The main difference noted between this station compared to the others where the staff did not act this way was that the whole group of visitors became more active and listened more attentively.

Two negative things were mentioned in conjunction with the staff. The noise level was considered to be problematic as it made it hard to hear what the instructors said. The interviewee who mentioned this, however, also said that it was possible to understand what they were talking about anyway.

"*But then, I kinda hear one word, then not the next one, then I hear another one. So I probably understand what they mean. Or else, I ask again*." (2:5)

Of all the interviewees, only one had something negative to say about how the staff acted. This person was of the opinion that the staff did not organize the activities at the station in a good way which led to inactivity among the visitors and a disinterest for the subject. He/she meant that the staff were passive and did not take the initiative to talk to the visitors of the station.

"*They just look at us, and we just look at each other*..." (2:4)

Another thing noted during the observations was that the groups were sometimes a bit too big for everyone in the group to be able to hear and see properly. This sometimes led to that those who ended up a little further back, and thus could not see and hear the staff properly, lost their interest in the station.

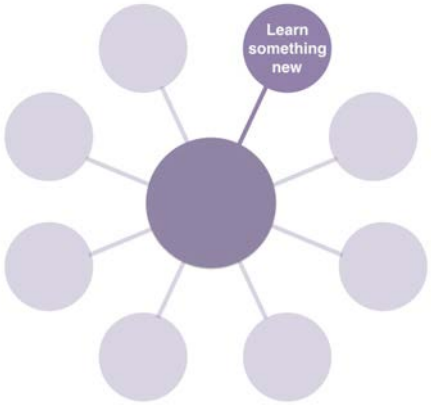
The result presented above led to the conclusion that *the Staff* is an important factor for the experience of an exhibition and at *Fair 3* seven out of eight interviewees strengthen that the staff affected their perception of the stations and the fair in general. The staff affected the experience of the visitor in a number of ways. For example by explaining things in a way that made it easy to understand, showing the visitors how things worked and answering the questions asked by the visitors.

"*Much better, because it's a bit boring when you just go around and you don't know what is what, but those who work here explained how it is and so*." (3:4 - On answering *"Did the staff affect the experience, if so how?"*)

One of the visitors said, however, that he/she wished that they had explained things in more detail.

"*They were very professional, but they were not particularly.. they were very careful not to be technical*." (3:6)

5.5 Learn something new



In the surveys, *I learned something new* emerged as a factor to consider as it was one of the more popular reasons for liking a station, chosen by 36.60% of the respondents, see Figure 5.3.

This also emerged as an important factor in the interviews from the first two fairs. When the interviewees answered the question of what made them think that a station was interesting, eight out of the seventeen interviewees mentioned the technology involved in the station, and the fact that they saw something new, which correlates well with the result from the surveys.

”*That you don’t see it so often in the everyday life.* [...] *Cool technology*.” (1:3)

”*That the robot could, like, think or so. That it kinda knew what to do*.” (1:5 - On answering *”What was particularly interesting?”*)

At the last fair, six out of eight people said in interviews that it made the stations better that they got to see something that was completely new to them. They also said that it was more fun, more informative and easier to keep up the focus. Three people also spoke of the importance that there are new elements in the experiences in order not to be bored.

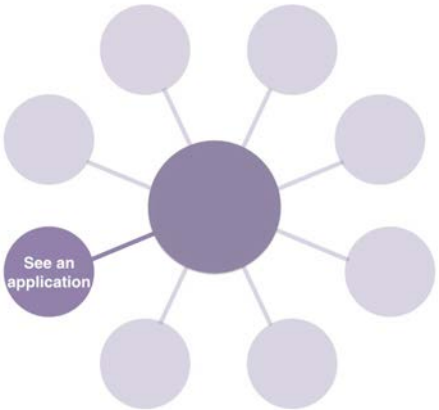
”*I like things I do not know better, because then I learn more*.” (3:6)

”*If I did not know it at all and had to learn something new, then it was like, exciting, I had to learn new things*.” (3:7)

One person did state, though, that it is important that not everything is new, for the information to be intelligible.

”[...] If you listen to the same things all the time, if you already know the stuff, it feels a bit boring just because you already know it. [...] if everything is new then maybe it is a little difficult to remember it.” (3:8)

5.6 See an application



As described above, to *Learn something new* was confirmed to be a factor which affects if the visitors find an exhibition interesting or not. In relation to this it was considered relevant to examine how important it was for the visitors to also see an application for the new technology presented. From the first two fairs there were four of the interviewees that said that they could imagine further opportunities which the technology entailed. They said that the fair gave them a wider picture on how the technology could make a difference in the everyday life and in working places in the future.

”*QR scanning, I thought was, it is quite practical and useful. Because I know that often when there is trouble where I work, it causes delays and one must first understand what it is that is wrong and you then have to fix it*.” (1:8)

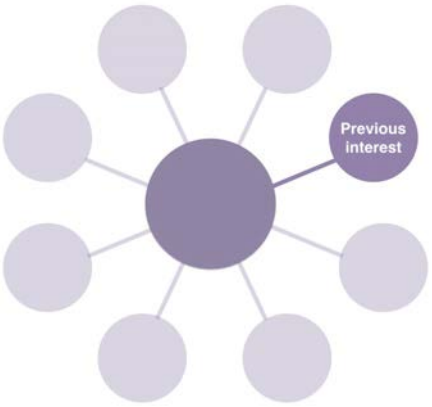
”[...] *it was just the idea of the bearings, the opportunities, how big and wide everything became*.” (1:10)

This factor was not itself included in the survey but emerged as a result of *Learning something new* getting a high percentage in the compilation of the survey. Therefore no quantitative result can support this factor. When the interviewees at *Fair 3* were asked if they believe that their experience of a station is affected by the fact that they are able to see a possible application for a new technology. All eight of the interviewees stated that it was an important factor and five of these said that it made it easier to understand the technology and that they learned more if they could see an application.

”*I get to see how such a thing really works, yes I personally think that is very important*.” (3:6)

”[...] *you learn more so that it becomes easier to understand and you can take it more for what it is in practice, as well as learn more and so. One can understand more*.” (3:2)

5.7 Previous interest



Some of the visitors at the first two fairs had a previous interest that affected how they experienced the exhibitions. In this study, all previous interests that may have had an impact on the experience were taken into account, both a general interest in technology as well as specific interests in certain stations/workshops. Two of the interviewees were very interested in computer games and one of them had read articles about computer game development before the fair. Two others mentioned that they have an interest in practical things as an explanation to why they like technology and why some of the workshop/stations were more interesting to them. One of the interviewees worked extra in an industry and was therefore able to imagine the applications for the new technology presented in the workshops at *Fair 1*. Another of the visitors builded a tractor on the spare time which means that this visitor had tried welding before and had a previous interest for construction.

”*I don’t know, I’m building a tractor right now, so then you go on and weld and yeah, such things*” (2:7)

Three persons also spoke about the importance of their previous interest relative to the visited stations.

”*It was fun with the game development, because I've been thinking about it*.” (2:1)

In the survey 22.80%, of the respondents answered that *Previous Interest* was important for them to like a certain station, which is neither a high or low value in comparison to the other factors, see Figure 5.3.

At the third fair, seven of the eight visitors interviewed mentioned that their previous interest in some way contributed positively to their experience of the fair/stations. That it became more fun, more interesting and/or more informative because of their previous interest. One visitor said that it would probably have been more fun if he/she had a prior interest.

Two people mentioned, however, that they do not believe that the previous interest matter so much if only the staff gives enough information for everyone to understand. Despite this, both of them mentioned that their previous interest in some way contributed to a more positive experience of the exhibits. One person also talked about the information that was given at the fair as a bit too basic and simple.

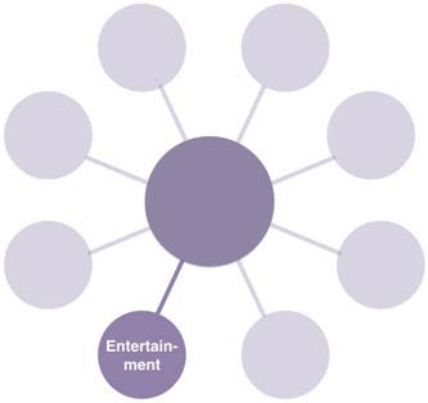
”*Yes, I think I learned more now when I thought it was interesting*.” (3:2)

”[...] the fact that I like technology made me listen and take the information in.” (3:3)

”*They took it very much from scratch, and so, then you have to not know as much or be as interested to find it fun*.” (3:7)

Based on these results, it can be argued that the visitors prior interest is of importance for how they perceive the exhibition, and a prior interest may lead to a more positive experience of the exhibition.

5.8 Entertainment



At *Fair 1*, only general observations were made regarding which workshop that seemed most popular, something which was not directly related to how fun the visitors had. This factor was therefore first studied at *Fair 2* where the factor was included in the survey and also was noted during the observations.

As it is hard to observe how fun a visitor is having, only apparent laughters were noted in order to reduce the effect of the observers own preconceptions. In this category, the majority of the notes came from the station *And what about me?*. The notes regarding this station mentioned that the participants were both laughing at the jokes the instructor made in the presentation as well as when they were performing the activity. The only other station mentioned was *Computer Game Development* where visitors were noted to laugh when playing the game at the station. This seems to fit well with the survey, where the highest value was noted at 44.60% of the *Computer Game Development* as one of the stations they liked best. *And what about me?* got 31.70% and was the third most popular station at this fair, see Figure 5.2.

In the survey the option *I had fun* got the highest score of 55.00% on the question of what made the respondents like a particular station, see Figure 5.3. This was the highest noted value for answers to the question of what made a station popular and the theory tested at *Fair 3* stated that this factor could be important for the experience of the exhibitions.

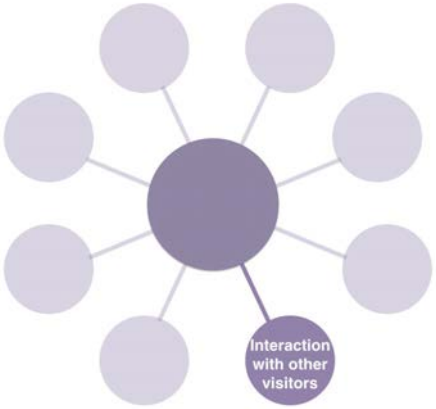
At the third fair, three of the eight people interviewed mentioned that it is important to have fun at the station in order to learn more and keep up the interest.

”*If it's fun then you learn a lot and you will remember it , so it's… Yeah, it's pretty good*” (3:3)

This factor is clearly most strengthened by the survey, where it received the highest noted value of all options about what made a station more popular. Since 55.00% of the more than 200 respondents did say that this was important for them to like a station, it may be an important factor in the design of an exhibition. It did, however, not clearly emerge in either the interviews or observations of this study that this factor is actually as important as the survey indicated.

5.9 Interaction with other visitors

It was observed at the first two fairs that the stations where the participants were able to interact with each other had a higher tendency to keep the visitors interested and active. During the observations this was noted to be when the visitors were talking with each other about matters concerning the subject and when they asked questions to the instructors. Interaction between visitors also seemed to make them more attentive to the presentations and more actively engaged in the tasks at the stations/workshops. The interviewees from *Fair 1* and *Fair 2* did not mention that interaction with other visitors was an important factor for the experience of the exhibition though.



At *Fair 1*, *Augmented Reality* was the workshop where the activity itself made the visitors interact with each other. They had to collaborate in order to complete the task at the station. This was also the station where most visitors seemed interested and which was most commonly mentioned in the interviews as the most interesting station. The only other workshop at *Fair 1* noted to make the visitors interact was *the Car Factory*. Here, the visitors did not collaborate on a specific task but several occasions were noted where visitors discussed with each other and talked about how the factory worked.

At *Fair 2*, there were three stations which were noted to include this factor in a greater extent than the other stations. This was observed mostly at *Design, And what about me?* and *Computer Game Development*. At the other stations the visitors interacted with other visitors only at the times when a question was asked and they discussed the answers with each other. The station *Computer Game Development* achieved to make the visitors communicate with others while playing the game. The visitors commented on what happened in the game and helped others to understand how to play. At *And what about me?* the visitors interacted with each other by talking about the pictures they had drawn and commenting on what the instructors said that it meant. The most interaction between visitors was observed at *Design*, where the activity was to answer the quiz questions in groups of two to three visitors. They discussed the answers with each other and talked about the questions, which dealt with different design objects. Out of these three stations, two were among the most popular stations in the survey, see Figure 5.2. *Computer Game Development* was chosen by 44.60 % of the visitors as the most interesting station and was by that the most popular station according to the survey. *And what about me?* was the third most popular station in the survey, chosen by 31.70 % of the respondents. *Design*, however, was the second least popular station. Only 15.30 % of the respondents in the survey chose this station has their favorite. In order to understand if the possibility to interact with other visitors is an

important factor for the experience of an exhibition, the visitors at *Fair 3* were asked about their opinion regarding this matter.

At this fair all visitors said that they got to interact with other visitors through discussions at the stations but they said that there was no possibility to collaborate with the other group members except for when they got to sit together in the different vehicles. The possibility to sit together in the vehicles was perceived by many of the visitors as a positive experience since it was more fun to do it together with others compared to if they would have done it by themselves.

”*I like working in groups too, so I thought it was very good and fun. It changes the experience a bit if you don’t have to stand and do everything on your own, to be with others and discuss, get second opinions and thoughts*” (3:7)

Six out of eight interviewees at *Fair 3* said that it was important to have the possibility to collaborate with others or to discuss with other visitors. The main argument mentioned by the interviewees was that it is easier to learn if you are able to discuss the information with others. The visitors also mentioned that if you share your thoughts with others you can learn things from one another which you would not have learned otherwise.

”*Yes, it affects me because you know when you get to share opinions and stuff like that, because if you just stand quietly and do not get to talk to someone and just listen, then it will not stick as good*” (3:5)

Two of the visitors also expressed a wish for more interaction with other visitors. According to them, more collaborations could have enhanced their experience of the visit at the exhibitions.

”*No, not collaborate, that we did not do much. We were discussing a bit at some of them* [*the stations*]*, but I feel like it was not enough*” (3:6)

6. Discussion

In this section, the result will be discussed in relation to the delimitations of this study, the conceptual framework as well as the methodology and the methods used to conduct the study. Aspects which might have influenced how the result turned out will be presented and reflected upon. Finally, the suggestions for future research within the area are summarized.

6.1 Delimitations

The factors identified in this study only reflect what affected the direct experience of the visitors at the fairs. There was no possibility to examine the long term effects of the visit and what factors that could have created a genuine interest for technology among the visitors. If the study had been conducted over a longer time period, it might have been possible to investigate this as well. The consequences from this limitation is that the factors presented in this thesis only can be said to affect the short term experience.

Since the data collection in this study was mainly carried out with informants in the age of twelve to nineteen years, the result will also only apply to this target group. The upcoming exhibition which this study aims to provide data for will have a larger target group, why the result from this study can not be directly translated to also apply to that target group. It will therefore be up to the constructors of that exhibition to determine whether the information in this thesis will be relevant enough to be used.

More detailed data could perhaps have been obtained if all the informants had been fifteen years or older, since sensitive questions then could have been asked in the interviews. In this study all such questions were treated solely in the survey. More detailed and profound results may had been obtained otherwise, which may have affected the outcome of this study. One possibility could have been to ask questions of sensitive nature to the interviewees that were older than fifteen years. This, however, was considered problematic since most informants older than fifteen visited *Fair 1* and not much data to answer the sensitive questions would be obtained from the two other fairs.

The data collection also took place at fairs where the visitors were not always allowed to move freely from station to station, but were led to the stations in a specific order. This may have affected the results of how the stations were perceived. In *Fair 2* this may have had an extra large impact as the stations there differed in both how interactive and active they were. It may have influenced how students perceived a station if they came directly from another station they found more interesting and vice versa.

The data collection of this study never contained entirely voluntary visitors at the exhibitions. The visitors who were interviewed, regardless of previous interests, always visited the exhibition for educational purposes with their school and had not freely chosen to attend. It is possible, though, that some of the visitor still had an interest in visiting the fair and would have done so even if it was not obligatory. If the visitors had visited the fairs on their own, they might have had a different attitude towards the stations/workshops which could have lead to other factors being discovered in this study.

The fairs were the data collection took place were focused on technology and the result in this study may therefore not be applied to other kinds of exhibitions. There was, however, one station which did not include technology. This was *And what about me?* at *Fair 2* where the visitors got to draw a picture. This station was one of the more popular ones and the factors found in this study also seemed to be of importance there. It is therefore possible that the result can be generalized to other kinds of exhibitions but not enough data has been obtained in this study to draw any conclusion regarding the matter.

6.2 Conceptual Framework

The conceptual framework of this study has been used to provide a background knowledge regarding Science Centers and exhibitions. It was also used to support the relevant factors which emerged during the analysis of the result. In this section the factors will be presented and discussed in relation to the information presented in the conceptual framework. This study was designed to investigate the factors that could be of importance for an exhibition supposed to be placed at a Science Center. The literature study that was conducted therefore included a number of areas that were considered relevant in relation to this. This led to interactivity being the dominant factor in the conceptual framework and the factors that do not relate to this in some way have therefore not as strong support of the literature. All factors that emerged have, however, some form of support in the literature study that were carried out.

6.2.1 Interactivity

In the result presented in Section 5, interactivity was after the theory generating phase believed to be an important factor for how the visitors experience an exhibition. This was later strengthened in the theory testing phase and the conclusion that interactivity leads to an increased interest, a more positive experience and helps the visitors to learn more was drawn.

The literature presented in Section 3 supports this conclusion to a high degree. Not very surprisingly, the area regarding *Science Centers* and the related areas *Interactive exhibitions*, *Maker Space* and *Experiential learning* all state that interactivity and experience are important in order to enhance the experience and to create more educative exhibitions. Since this is the main idea of these areas, the support found in this literature might be misleading in the sense that interactivity is presented somewhat uncritically. The majority of these texts however, are based on research and have in this study been perceived as reliable and can therefore be said to support that interactivity is an important factor. Below follow a number of examples from the literature that strengthen this.

In Section 3.1.2 it is described that Falk and Needham (2011) found that 85% of the parents visiting the California Science Center experienced that their children's understanding of science and technology had increased. This is not directly related to interactivity though since it could have been other aspects of Science Center which contributed to that result. It is, however, an indication that Science Centers have a successful way of presenting their messages and the main idea of Science Centers is that they are interactive in some way. Beside this numeric indication that interactivity leads to an increased interest, the thoughts which Science Centers are based on also support interactivity to be an important factor. Piaget and Dewey are mentioned throughout the conceptual framework of this study and their ideas about the importance of interacting in order to really learn something is a strong indication that interactivity is a factor affecting the experience of the visitors. It is important to remember though, that these are only two of many educationalists who have formulated theories regarding how the human being learns and several other learning theories state that there are other things more important than interactivity to explain how people learn. Dewey, however, states that it is empirically shown that physical activity appeals to a child's innate impulses and that makes the exhibition to be perceived as more fun which in turns makes learning easier.

Schlossberg, mentioned in Section 3.2, believed after talking to a number of experts, that it is better to design exhibitions where the visitors get to do something instead of only looking at something or listening to a presentation. These beliefs are also found among the initiators of the Maker Movement. As described in Section 3.4.2, the idea behind the Maker Movement is that practical exploration increases the understanding as well as the interest for technology so interactivity can be said to be an important factor upon which Maker Spaces are based. In the area of *Exhibition design*, there are also some examples that supports interactivity as an important factor. Here it is illustrated by a quote previously presented in the conceptual framework: "The element of choice is very important, as it allows the user to have a personalized experience. Many of us learn

by doing, not by watching or listening. The experience of interacting means the user will learn and retain the information in a memorable way." (Coates & Ellison, 2014, p. 174).

In the result, no clear connection can be seen between a high degree of interactivity, see the definition of interactivity in Section 3.2, and a better experience for the visitors. In the literature however, Schlossberg states that activities with a high degree of interactivity, meaningful activities as he calls them, are the preferred way to design exhibitions. Borun et al. (1998) also mention *Multi-outcome* as an important factor for family exhibitions. They mean that the interactions should be complex enough to create discussions, which will enhance the experience. Dewey (1938), on the other hand, says that an experience must have a clear purpose in order to create a meaningful learning. In this study, the focus have not been to investigate the different aspects of interactivity why these nuances within the factor might have been missed. No questions were asked in the interviews to investigate these differences and the only indication found regarding this is that *I had a clear task at the station* and *I had the opportunity to try things free on the station, without a definite goal* both were chosen by relatively few respondents in the survey. This result do not support the degree of interactivity to be of importance. The responses in the survey might on the other hand not be accurate, both due to the non-probability sample as well as the problems with formulation in these options. It is hard to know what the visitors actually interpreted when reading these options and it could therefore not be ruled out that the degree of interactivity is of importance for the experience of the visitor.

Another factor presented in literature related to *Interactivity* is that the exhibition should allow *Multiusers*, a term presented in Table 3.3 in Section 3.5. Borun et al. (1998) state that it is important that many users can interact at the same time. This is somewhat related to the result stating that *Interactivity* works best if many visitors gets to interact at once, see Section 5.2. When an entire group looks at one person who interacts, the group easily become passive and loses their interest in the exhibition.

Another aspect treated in the literature but not specifically examined in this study is how important it is that the experience is designed in an accurate way. Dewey, for example, states that all experiences are not optimal for learning (Dewey, 1938). Beard and Wilson (2006) present their learning combination lock in order to illustrate all the different parameters which affects the experience and which are to be taken into consideration when constructing an exhibition. Kolb (1984) also provides a framework for creating experiential learning with his four mode cycle. In this study, it has not been possible to investigate these different aspects further due to the time limit. The *Research Question* was interpreted to only concern finding the factors that are of importance for how a visitor experiences an exhibition and not to focus on the variation within these factors. Since these aspects are treated by three different sources in literature it can be considered likely however, that it is important to consider these when constructing an interactive exhibition.

6.2.2 See something in reality

As described in Section 5.3, the factor *See something in reality* is closely related to *Interactivity*. If something is interactive it usually involves the factor that the visitor gets to see something in reality. It does not go reversely however. There are few segments in the literature which supports this factor to be of importance. The main reason for this is believed to be that the focus when conducting the literature review was to investigate areas related to an exhibition at a Science Center. Since the main idea of Science Centers is to allow the users to interact, there are few examples of successful exhibitions where the visitors are not able to interact but only able to see something in reality. It is also hard to draw a distinctive line between how much of the effect on the experience that is due to the interactivity and how much that is due to seeing something for real since both these often occur simultaneously.

In the literature described in Section 3.1.1, it can be concluded that the earlier forms of Science Centers were more focused on including the factor *See something in reality*, than *Interactivity*. These museums and Science Centers distinguished themselves in relation to traditional museum by actually showing things in

reality to the visitors, for example staged chemical reactions and placing industrial engines as part of the exhibition in order for the visitors to actually see how they operated. Based on this, it could be argued that *See something in reality* is a step towards *Interactivity.* It is better than a passive presentation but not as effective as letting the visitors practically participate. This is also strengthened by what Amthor (1992) stated regarding that people remember 20% of what they hear; 40% of what they see and hear and 75% of what they see, hear, and do. To see something is better than just to just hear something, according to Amthor, but it is even better to also do something.

Other indicators in the literature, although vague, that *See something in reality* is an important factor is when Beard and Wilson (2006) state that *'Loudness' of stimulus* is something that affects our experience, see Table 3.2 in Section 3.3. This means that our experience is affected by how attention-grabbing something is. To *See something in reality* could be argued to create a 'louder' stimulus than if only listening or seeing a picture of something. This assumption is also supported by the statements in the interviews where visitors claimed that it was easier to remember things they got to see in reality.

6.2.3 Staff

The fairs visited during this study were all fairs where the information provided were given by staff at the stations/workshops. It emerged from the first two fairs that the staff had a great impact on how the fairs were perceived and this was confirmed during the last fair. In this study there was no opportunity to compare how it would have been if the information had been provided in a different way. Some interviewees talked about how the information was either too complicated or too basic, and the troubles with noise-levels during the presentations were brought up during the interviews.

To connect to what emerged from the literature, staff will here be treated only in terms of how the information is mediated to visitors. This is due to the fact that the literature used in this study do not treat staffed exhibitions. Lake-Hammond and Waite (2010) say that the design of an exhibition should aim to increase the holistic experience for the visitors by choosing the the right methods of presentation as well as how the information is organized and adopted to the audience, see Section 3.5. One thing that can be noted, with the design-aspect in mind, is that when the information is given by staff that hold presentations, the same information has to be given to the group as a whole. There is little or no opportunity to adapt the information to the individuals in the group. The guides may although adapt the information for each group as a whole. They can simplify the presentation if some individuals seem to not understand, the risk is that the visitors that already found the information too basic will then lose their interest. Likewise, the guides risk losing those who initially thought it was too difficult if they offer an individual who wants to know more further detailed information.

McKenna-Cress and Kamien (2013) state that it is important to present the information in a way that satisfies both the average visitor as well as the amateur enthusiast and it should suit the needs of the visitors, see Section 3.5. With staff delivering the information this is, as mentioned before, hard to accomplish. This study has therefore not had the opportunity to thoroughly look into what added value an adaption of information could actually provide.

The result in this study was rather focused on the importance of the how the staff were acting towards the visitors. However, as mentioned above, this was not treated in the literature.

6.2.4 Learn something new

Learn something new appeared as a factor to consider in both the survey and the interviews, see Section 5.5. This factor also have some support in the literature. The main indicator presented in the conceptual framework is in Table 3.1 in Section 3.2. There, *Uniqueness* is described as an important aspect to consider

when constructing an interactive exhibition (Adams & Moussouri, 2002). In that section it is explained that "The visitors need to feel that they are experiencing something new. Although it is important that the exhibits are not totally unknown to visitors, in which case they can perceive the exhibits to be too difficult.". This statement is fully supported by the statements from the interviews where visitors say that it is more interesting to see new things but some of them also say that it can not be entirely new things presented since the information will then not be graspable. Borun et al. (1998) also include this factor in Table 3.3 in Section 3.5 where it is called *Multimodal*. By that, they mean that it is important that the exhibition "Appeals to different learning styles and levels of knowledge" (Borun et al. 1998, p. 23).

Beard and Wilson (2006) state that previous knowledge as well as previous experience will affect the new experience, see Table 3.2 in Section 3.3. However, they do not comment on in what way this will affect, whether it is good or bad to have previous knowledge about the experience. The Maker Movement, on the other hand, can be connected to this factor through their belief in the growth mindset. To be subjected to new things is essential when developing new qualities, which is the focus of the Maker Movement.

One challenge with including the factor *Learn something new* in a exhibition is that the information that is new to one visitor might not be new to another. Some of the difficulties with this are discussed earlier in Section 6.2.3.

6.2.5 See an application

This factor became interesting to examine after *Learn something new* had been indicated to be an important factor. Therefore this factor is only included in the result from *Fair 3* where all interviewees stated that they found it important to *See an application* when being presented to a new technology.

In the literature, Dewey (2004) is one of those who states that individuals learn from experiences and that those activities needs to be meaningful with applications in the real world. This supports the fact that an exhibition should place the content in a context and show the visitors how it can be used in reality. Borun et al. (1998) have in their table over factors important for a successful family exhibit included that it should be *Relevant,* see Table 3.3 in Section 3.5. This is clarified to mean: "Provides cognitive links to visitors' existing knowledge and experience" (Borun et al., 1998, p. 23). This could also be interpreted as meaning that it is important for the visitors to understand the content in relation to already familiar things, for example to see how it can be used in real life. No other support of this factor can be found in the literature and since it has only been studied at one of three fairs, the support for that this factor actually affects the visitors' experience of an exhibition is rather low.

6.2.6 Previous interest

During the first two fairs it emerged that the visitors' former interests had a great influence on how they perceived the fair overall. This was confirmed during the last fair. Even the interviewees who stated that a prior interest may not be such an important factor mentioned that their own earlier interests had affected them positively in how they experienced the fair. It is hard to say how this previous interest did actually affect the visitors, or if they had been more or less positive regardless of it.

It is, however, strengthened by the literature presented in the conceptual framework, that this is an important factor. In Section 3.2, Adams and Moussouri (2002) describe that in order for an interactive exhibition to feel meaningful it must encourage the visitors to bring their own personal knowledge to create their own experience. They also state that it is therefore important to have an understanding of the visitors' prior interest and experience. Beard and Wilson (2006) define an experience of the visitors as a meaningful engagement with the environment in which they get to use their previous interest, this is presented in Section 3.3. On the matter of *Exhibition design*, presented in Section 3.5, McKenna-Cress and Kamien (2013) also

state that it is important to remember that the individuals will always be affected by their own experiences and knowledges before the exhibition.

It is also important to be able to customize the information provided at an exhibition. To capture the visitors without any previous interest, the information needs to be basic and simple enough for everyone to understand. The information must also be precise and detailed enough to appeal to those who have a greater prior interest, which is also discussed in Section 6.2.3 and Section 6.2.4.

6.2.7 Entertainment

In the survey, the most commonly chosen reason for liking a station was *I had fun*, see Figure 5.3 in Section 5.1. This was not a factor that emerged in the interviews from the first two fairs, and was only vaguely strengthened by the third fair. The literature does not say much on this matter either, although Beard and Wilson (2006) state that what emotions the visitor brings to the exhibition and the emotions the exhibit raises are filters that may affect the experience, see Section 3.5. These filters indicate that it can be important for the exhibit to be entertaining, although it is never clearly stated. Dewey (1985) also stresses the importance of allowing the children to follow their impulses and by using these the education becomes fun which leads to an easier learning, see Section 3.3. This can also be comprehended as *Entertainment* being an important factor for learning and creating engagement.

Since this study mainly focused on the qualitative methods and the survey was only meant to strengthen the result found from interviews and observations, this factor can be said to have a vague support in this study. Due to the high percentage in the survey it was still decided to be included in the result as a factor to consider when designing an exhibition.

6.2.8 Interaction with other visitors

During the first two fairs it was noted during the observations that the stations where the participants had the opportunity to interact with each other had a higher degree of involvement from the visitors. They became more active, asked more questions and seemed more interested. This was not supported by the interviews from these two fairs though. To confirm this as an important factor it was included in the interviews of *Fair 3* where all the interviewees mentioned that it made the station more interesting if they had the opportunity to interact with the other visitors, and that it made it easier to learn.

This factor can not be seen as fully confirmed only based on the results of the data collection, but it occurs, however, in the literature where the importance of cooperation is highlighted by a number of sources. Vygotskij, presented in Section 3.1.3, talked about how the learning always takes place in a social context, and formulated *the learning potential* of a child from this fact (Phillips & Soltis, 2014). Vygotskij did state that there were tasks a child could solve with the help from an adult, but this may also be applied to two visitors with different previous experiences since they can be seen as having different learning potentials. Based on this, an individual should be able to cope with and learn more with the received help and feedback of other visitors.

In Section 3.2, Adams and Moussouri (2002) also state that “a successful interactive experience is one that makes the visitors a part of a group.” They also argue that for an exhibition to be successful it should aim to get the visitors to interact with each other.

6.2.9 Other factors

Apart from the factors which have been found in this study, the literature also describes a number of other factors important for an exhibition and how it is perceived by the visitors. The reason why these have not been found in this study is most likely due to the design of this study as well as the time available to collect and analyze data. This study has been influenced by the fairs available to visit at the time of the study, in regards to both their visitors and their design. Due to this some factors were not possible to find in this study. The following factors described in the literature have not been found in the data collection but could be an indicator of things that are of importance for how an exhibition is perceived.

Adams and Moussouri (2002) present two themes which they claim to be important for an exhibition to appeal to its visitors which have not been seen in this study. The first is a *Multi-sensory dialogue*, explained in Section 3.2 as "The exhibitions needs to engage the visitor on a variety of levels. It should also offer real problem-solving and foster creativity. The visitor needs to feel a social pay-off for the effort put in the exhibition". This factor was not a part of the results in this thesis and the reason might be that none of the stations/workshops where the data collection was conducted included this factor or that the questions used in the data collection did not enable the possibility to find it. The second theme mentioned by Adams and Moussouri (2002) was *Cultural Connections*, explained in Section 3.2 as "A successful interactive exhibit can broaden the visitors understanding of how they fit in the culture, which is important since visitors like to place themselves in context". This factor was not found either in the data collection, the reasons for this might be the same as for *Multi-sensory dialogue* described above. There is also a possibility that these are factors with less influence than those found in this study and was therefore not found.

The factors which Beard and Wilson (2006) present in Table 3.2 in Section 3.3 also include a number of examples that were not found in this study. Two of them, *Choice* and *Location*, were supposedly not found due to the lack of possibility for the visitors to freely choose which station to visit. *Choice* is thereby impossible to test and *Location* is possibly something which the visitors reflect less upon when they have no other choice than to be there. *Emotions*, *Concept of self* and *Personal needs/want* are three factors which have not been studied due to difficulties to influence these by the design of the exhibition. These are factors which according to Beard and Wilson (2006) filter our experience but it is impossible to, with the design of the exhibition, change the emotion a visitor has before entering an exhibition or what the person wants to learn or experience at the exhibition. McKenna-Cress and Kamien (2013) also state that the emotions and misconception which the visitor has regarding the subject prior to the visit will have a strong influence on the experience. They say, however, that one can adjust to these by identifying the target group's knowledge and feelings before constructing the exhibition.

In regards to the area *Exhibition design*, there are also a number of factors which have not been found in this study. McKenna-Cress and Kamien (2013) write about the importance of presenting just the right amount of information at an exhibition. Not so much that the visitors feel overwhelmed but enough information to cover the subject and to be educative. This is something that was mentioned in some of the interviews but mostly in the sense that the visitors felt like there was to much focus on presentations. It was also often stated in relation to a comment where the visitor said that he/she would like to do things more practically. It is therefore hard to say that these statements mean that it is too much information at the exhibition, it could also mean that the information is communicated in the wrong way.

Coates and Ellison (2014) emphasize the importance of exposing the information in a way that makes it accessible for the audience. They talk about visibility and context as key factors to consider in order to assure this. In this study, most factors are in some way related to the context of the information. *Interactivity* and *See something in reality* are, for example, both factors which explain in what context the information is presented and how it is made accessible for the visitors. Visibility is not included in this study as a factor though. Some observations were made where it was noted that the groups were too big which made it hard for everybody to see and hear what was presented. These results only emerged from the observations

however and were not mentioned in any of the interviews. It was therefore decided that it was not possible to state that visibility is an important factor for the experience of the visitors.

Another factor which is mentioned in the literature but that was not found in this study is narrative structure. This means that the objects within an exhibition should be meaningful in relation to each other and the context which they exist in. Lake-Hammond and Waite (2010) argue that an important part of Exhibition Design is to connect the different parts of an exhibition in order to create a complete meaning. In this study, this could possibly have been studied by investigating how well the stations/workshops at the fairs worked in relation to each other. The interviews contained a question about how the visitor perceived the fair in general but no answers which can be related to the narrative structure were obtained. In order to study this, more specific question regarding the relation between the station should have been asked.

Lastly, a number of the factors presented in Table 3.3 in Section 3.5 have not emerged in this study. These regard mainly the physical aspects of the exhibition and how it is constructed. Borun et al. (1998) mean that a successful family exhibit should be *Multi-sided*, which means that the family can gather around an exhibit so that everyone can see it at the same time. Even though these factors specifically applies to families, it is likely that this factor is relevant for all exhibition visited by people that are coming as a group. This factor has not been studied in this thesis apart from the observation mentioned earlier where it was noted that it was sometimes hard for everyone to see what was shown at the station/workshop. The exhibition should also be *Accessible* for everybody according to Borun et al. (1998), who state that it is important for a family exhibit to be comfortable for both children and adults to use. This has not been an issue to investigate in this study since the target group has been rather narrow, people in the age of twelve to nineteen years. At a Science Center with a wider target group it might be a relevant factor to consider though.

6.3 Context of the data collection

The three fairs that were used for the data collection in this study may have affected the results in a couple of different ways. The most important difference is that the fairs themselves and their content may have affected the outcome of this study. *Fair 1* was a trade fair for the operation and maintenance of manufacturing industry, and the visitors at this fair therefore were likely to already have an interest of the subject. The visitors who were included in the data collection of that fair in general attended a technical or industrial education, which probably made the fair and its content seem more relevant to them. At *Fair 2* and *Fair 3* the students who visited the fairs had not yet selected orientation of education and the interests at these fairs were therefore more widespread.

6.4 Methodology

The methodology of this study is of great importance to evaluate in order to understand the eventual effects this might have had on the results. In this section, the use of triangulation, Grounded Theory and the sample will be discussed as well as the consequences of the choices made during the study.

6.4.1 Triangulation

During this study, methodological between-method triangulation was used. For triangulation to be considered useful, an either complementary or initially contradictory result is desired. In this study the results were complementary, which means the triangulation was not redundant. This was not only due to that the

methods gave complementary results, but also because the different methods were used to provide answers to different questions. The interviews did provide result that would not have been possible to observe and the observations revealed things which the informants were not necessarily aware of, and could therefore not be obtained through interviews. The survey enabled an analysis of a larger number of visitor than what could be obtained through interviews. If triangulation had not been used in this study some of the results would have been missed.

6.4.2 Grounded Theory

This study started out with no predetermined theory, but an extensive data collection. The data was then analyzed, new data was gathered to disclaim or support the theories and conclusions were drawn from these results. The result might have been different if a theory was first generated and the data collection then was designed from this. This could have given a more detailed and thorough result regarding the issues treated by this early theory. However, there is a risk that many of the factors would have been missed if this approach had been used, since the knowledge of the area was not sufficient enough at the beginning of the study. A theory generated at the beginning of the study would therefore likely have led to that factors would have been overlooked rather than detected.

6.4.3 Research Sample

In this study a non-probability sample was used, since all data collection took place at three fairs and the visitors of these fairs were therefore the only informants available. The result of this study can therefore not be considered to be general enough to be applied to an entire population, but only apply to the target group included in this study. As described in Section 4.2.3, a probability sample was considered practically impossible to achieve in this study since it was not possible to contact a random person in the sample in order to collect data. It is therefore important to remember when the conclusions in this thesis are presented that they only apply to the visitors of the three fairs studied.

6.5 Methods

The choice of methods used in a study affects how the result turns out. The methods of this study and how they were applied will be discussed below. Both the methods for data collection and the methods for data analysis are included in this section.

6.5.1 Observations

Some of the observations in this study were performed without the consent of the participants and without them knowing that they were part of a research study. As stated in Section 4.3.1, it is in general ethically questionable to perform hidden observation. The only source that was found saying anything concrete about this was NESH (The Norwegian National Research Ethics Committees). NESH states that informed consent is not necessary if the observation takes place in a public space and no sensitive information is involved, both of which apply to this study. The decision was therefore taken to follow these guidelines and use hidden observations.

The observations at the second fair were open, on the other hand. This may also have affected the outcome of the observations. As described in Section 4.3.1, open observations can affect the actions of the visitors. When someone is aware that he/she is being observed, the person can change the actions unconsciously. The effect

of this was aimed to be minimized by the discretion of the observers and by keeping a low profile when conducting the observation. It is still hard to guarantee that no visitors were affected of being observed.

A difficulty which always occurs in observations is the observers ability to be objective. There is always a risk that the observers apply their own values and experiences to what happens and therefore it is never certain that what was noted as being observed was what actually happened. For example, when studying the factor *Entertainment*, laughter was noted to correlate with how fun the visitors were having. This was the observers interpretation of the situation and might not have been accurate in all cases.

Another problem that was discovered in the transcription of the observations was that to a large extent, it is the anomalous happenings that were noted. This led to the stations that did not involve much activity in general, were noted each time something active occurred. In the same way, the stations that were generally more interactive, were rather noted when they were not. Based on the notes made during the observations, it was therefore difficult to say something about what actually had taken place at each station. When analyzing the observations, this was taken into account by not regarding the number of notes per station to be as important as the entire perception of the different stations.

Another factor that may have influenced the observations is how the fairs were designed. During the first fair the observations were meant to cover the whole area of the exhibit. The exhibition covered quite a large area, and even if it was divided between the two observers, it is possible that events, that could be of interest for the study, were not able to be observed. During the last two fairs, selected groups of visitors were followed by observers around the different stations. There is therefore less risk that something of value was overlooked at the stations that were being observed. There is instead a risk that something of value for this study occurred in the groups that were not.

During the first fair, the visitors at the exhibition were not always within the target group for this study. The observations were therefore carried out only on the visitors who were perceived to be in the right age range. This may have led to that some events being missed, as it appeared to involve visitors perceived to be outside the target group, although they were actually within the age range. It may also have led to that some events noted involved visitors who do not fit within the target group for this study.

6.5.2 Interviews

Since the interviews all took place at the scene of the fairs there were a number of confounding factors that may have affected the outcome. The noise throughout the interviews was relatively high and it could sometimes be difficult to hear each other. There was not always an opportunity to get away from the stations/ workshops and it happened that the interviewee’s friends or classmates passed by. This may have affected both how exhaustive the answers were, and even how the interviewee chose to answer.

The last two fairs had fairly precise schedules, which meant that there was little time left for interviews. Some of the interviews were therefore a bit stressed and thus shorter and possibly less profound than they otherwise might have been. Some of the interviewees also seemed to think that the interviewers were representatives from the fair, which may have influenced them to respond in a more positive way than they would have otherwise.

There is also a risk that the interviewers may have affected the outcome of the answers. When transcribing the interviews it emerged that one of the interviewers got generally more positive responses than the other. This is something that might have been caused by differences in how the interviewers were acting or just a coincidence. It is therefore impossible to say if the results were in any way affected by the one asking the questions but there is that risk.

Two of the interviews were also conducted with people who did not have Swedish as their mother tongue, which may have led to confusion both during the interviews and the transcription. Even if some mishearing may have occurred in relation to this, the risk that this have significantly affected the result was deemed to be small.

6.5.3 Survey

When the survey was designed, the difficulties with analyzing questions with multiple options were not taken into account. Because of this, a number of questions where respondents had the opportunity to tick one or more options were included. This made the analysis of the survey more complicated, since there were too many dependent variables and not enough independent ones. There were, for example, no possibility to analyze the reasons for liking a stations against the popular stations, since the respondents may had ticked more than one option for both these questions. If the quantitative analysis had been taken more into account when designing the survey, the result of the analysis would probably have been more useful.

The survey conducted in this study had a low response rate but a high number of collected answers. The low response rate means that the result might be skewed but since the sample in this study already is a non-probability sample it was decided that a higher number of answers would be prioritized over a high response rate. Due to this, the survey was decided to be distributed over the Internet so that more visitors would have the possibility to fill out the survey. If the survey had been distributed manually at the fair, it was estimated that less answers would be obtained but with a higher response rate. This decision may have affected the result in the way that it is more likely to not represent the entire target group but on the other hand, it have provided more answers to base the analysis on.

Another problem with the survey was the difficulties with assuring that the respondents interpreted the options in the same way as they have been used in this study. The options were also formulated before any theory regarding the factors was developed. It is therefore possible that the options in the survey does not directly correlate with the factor it is later used to support.

6.5.4 Affinity diagram

When an affinity diagram is conducted, the outcome is always influenced by the individuals who are implementing the analysis. It is therefore impossible to say that the exact same categories and result would have been obtained from an analysis carried out by someone else. Since the basic idea of an affinity diagram is to use an instinct in order to sort the data it is not likely that the data would have been sorted in the exact same categories if the study was performed again. However, the main advantage with this method is that no predetermined categories are used and no information from the data collection is thereby forced into a certain category.

In the final analysis, the affinity diagram was not used in the exact same way as the literature dictates. Instead of grouping the notes together and then give titles to the groups, headings from the previous analysis were used and the notes were placed into these categories. This was done since the last data collection only was used to confirm or deny the results that emerged from the first analysis. There is a possibility that other categories may had arisen if this last analysis was performed without predetermined headings. Although, a complementary category was used in order to allow sorting of the statements that did not fit into the previous categories. This reduced the risk of missing new factors but there is still a possibility that some of these were missed since predetermined categories already were stated.

6.5.5 Quantitative analysis

The quantitative analysis was complicated due to the problems with the design of the survey discussed earlier in Section 6.5.3. This created difficulties with analyzing some of the issues, such as stations and factors, in relation to each other. In these cases bar charts of the number of respondents per option were used instead. Correlations were therefore in some cases impossible to obtain.

6.6 Future research

As in most time limited studies, there are matters which have not been possible to research while writing this thesis. The most important of those matters have been identified and in this section follow suggestions for future research within this area in order to complement the result of this study.

To cover all the factors that might be of importance in the design of an exhibition, some further studies would need to be conducted within these areas:

- Fairs where the visitors get to move freely between the different exhibits need to be further investigated to see what makes an exhibit more likely to be visited.

- Research on a wider target group than the one in this study needs to be conducted in order to assure that the result applies to the entire target group of the exhibition which is to be developed.

7. Conclusion

In this study, the aim has been to understand the relevant aspects for the construction of an exhibition involving technology in order to make it inspirational and informative for adolescents. In order to do so, a research question was formulated where the factors that contribute to how the visitors experience an exhibition is investigated. Below follows a conclusion which answers the *Research Question* and sums up the result of this study.

Research Question

> What factors contribute to if exhibitions involving technology are perceived as interesting by adolescents aged twelve to nineteen years?

This question is best answered by the eight factors identified in this study. These factors are in some way indicated to contribute to how the visitors experience an exhibition. Some of the factors have been strongly confirmed by the results to be important for the experience while some of the factors are only vaguely indicated by the results to be of importance.

7.1 Interactivity

Interactivity have been strongly confirmed to be an important factor for how an exhibition is experienced. The results from both the qualitative and the quantitative analysis from all three fairs indicates this. *Interactivity* seems to lead to an increased interest, a more positive experience and will help the visitors to learn more at the exhibit. It is also supported in literature that this is an important factor.

7.2 See something in reality

To *See something in reality* is an important factor for the experience but not to the same extent as the related factor *Interactivity*. This is supported by the results in this study but not as distinctly in the literature. *See something in reality* makes it easier for the visitors to understand the content of the exhibition and can also make the experience more fun or interesting.

7.3 The Staff

The Staff can be concluded to be an important factor for the experience of the visitors in those cases when instructors are used at an exhibition. This was confirmed throughout the data collection of this study. *The Staff* can affect the experience in both a positive and negative way. It is therefore an important factor to consider, especially how they interact with the visitors and what feelings they project regarding the subject. In the literature, no specific indications regarding *the Staff* to be an important factor was found.

7.4 Learn something new

In both the interviews and the survey, the result in this study indicates that *Learn something new* is a factor contributing to the experience of the visitors. This factor makes the visitors experience the exhibition as more fun, more informative and makes it easier for them to maintain focused. In the literature, there are also several indications that *Learn something new* is an important factor.

7.5 See an application

To *See an application* was only indicated to be a factor in the interviews of *Fair 3* since it became interesting to investigate when *Learn something new* emerged to be of importance. In the literature there are some statements that support *See an application* to be an factor which will affect the experience of the visitors. All together, this is only vaguely indicated to contribute to how the visitors of an exhibition perceives it.

7.6 Previous interest

Previous interest emerged as a factor at the interviews conducted at both *Fair 1* and *Fair 2*. This was strengthened by the interviews at the last fair. The literature stated that it is important to take visitors' previous interests into account when designing an exhibition and thinking about adapting the content to this.

7.7 Entertainment

I had fun was the most commonly chosen reason for liking a station in the survey conducted in connection to *Fair 2*. It was also noted during the observations that *Entertainment* seemed to be an important factor. This was, however, not confirmed to be an important factor by any of the interviews and not much on the matter was found in the literature. Entertainment can therefore be considered to be rather vaguely confirmed as a factor of importance.

7.8 Interaction with other visitors

Interaction with other visitors emerged as an important factor during the observations of *Fair 1* and *Fair 2*. It was confirmed to be significant for the experience by the interviews at *Fair 3* as well as the literature study. To *interact with other visitors* leads to an increased interest for the exhibition and it also makes the learning easier and more fun.

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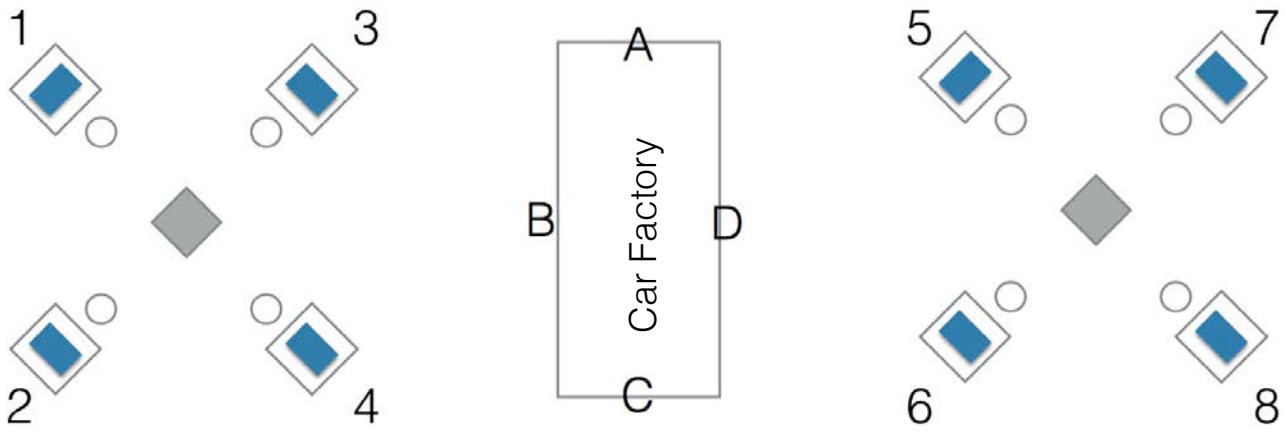
Appendix

Appendix I

Observation template, Fair 1



Overview of the exhibit including the number and letter codes that are being used in the notes.

Observe 15 minutes at a time, then take a break to summarize/develop notes.

When both observe : Observer 1 observes 1-4 and A-B
Observer 2 observes 5-8 and C-D

Date:_____ Time:_____

1-4

A-B

Date:_____ Time:_____

5-8

C-D

Appendix II

Observation template, Fair 2

Wednesday, March 16:
AM: Observe the stations and note the relevant factors
PM: Observing one group each (Group 1&2)

Thursday, March 17:
AM & PM: Observe one group each at both occasions (Group 3-6)

Note the station, group and time of which the observation regards.

Station:_____ Group:_____ Time:_____

Is the group generally positive or skeptical?

How active are the students in the group?

What is the interaction between station staff and students?

Station:_____ Group:_____ Time:_____

Is anything particularly positive or negative expressed about the station and its activities, and if so, what is it and regarding what?

Other interesting things?

Appendix III

Observation template, Fair 3

Four Stations

Station 1
Self-driving cars and vehicles of the future

Station 2
Environment

Station 3
Safety

Station 4
Connectivity

Date and time:_____

- What do the visitors do?
- What happens at the stations?
- Anything else interesting?

Appendix IV

Interview template, Fair 1

Information for the interviewee:

- The purpose of the study (A thesis that explores how exhibitions are perceived, a part of a larger project to spread knowledge about the new industry and smart factories.)
- What will the results be used for (The work culminates in a final report that is published and also presented at a final presentation.)
- The information will be treated anonymously (We do not collect any personal data except age and will only use the recorded material to the analysis of this project.)
- Is it okay to record the interview? (If not, end the interview and thank the interviewee)

Warm up question:

- How old are you?
- What is your current education? (Secondary school ? High school? What subjects?)
- What was your expectations for your visit to this fair? (Own initiative? With school class ? What do you hope to get out of the visit? Basis for secondary school or post-secondary employment? Job or school?)

Reflective questions:

- Has this exhibit changed your picture of the industry in some way? (If yes, in what way? Positive/ Negative? If no, what is your view of the industry?)
- What was it that made you decide to visit just this exhibit ? (Displays? Any particular part of the exhibit? Another person?)
- How did you experience this exhibit in general? (Why do you think you experienced it that way?)
- Something that was particularly interesting? (Why?)
- Something that was particularly uninteresting? (Why?)
- Would you consider to choose a further technical/industrial education? (Why/why not? What kind of education?)
- Do you think that a exhibit of this type could make a difference in such a choice? (In which way? Any specific part of the exhibit?)
- Do you have any suggestions for improvements to this exhibit? (Improvements of a specific workshop?)

Wind-up questions:

- Do you have anything to add that might be of interest to us?

- Thank the interviewee for participating in the study
- Leave a note with contact information and tell the interviewee to get in touch if they are interested in the final report

Appendix V

Interview template, Fair 2

Information for interviewee:

- The purpose of the study (A thesis that explores how exhibitions are perceived, a part of a larger project to spread knowledge about the new industry and smart factories.)
- What will the results be used for (The work culminates in a final report that is published and also presented at a final presentation.)
- The information will be treated anonymously (We do not collect any personal data except age and will only use the recorded material to the analysis of this project.)
- Is it okay to record the interview? (If not, end the interview and thank the interviewee)

Warm up question:

- How old are you?
- What is your current education? (Secondary school ? High school? What subjects?)
- What was your expectations for your visit to this fair? (Own initiative? With school class ? What do you hope to get out of the visit? Basis for secondary school or post-secondary employment? Job or school?)
- Which stations have you visited? (Design , CAD/3D, Welding , CNC, Science Center, University, Car factory)

Reflective questions:

- Has the stations changed your view of the industry/technology in any way? (Ask about the industry and/or technology depending on which stations that has been visited. If yes, in what way? Positive/Negative? If no, what is your view of industry/technology?)
- How did you experience this fair overall? (Why do you think you felt that way?)
- Something that was more interesting? (Any particular station? Why? Did you have a previous interest? Which parts of the station?)
- Something that was particularly uninteresting? (Any particular station? Why? Some specific parts of the station?)
- How did you experience the station staff, those who spoke at the stations? (Was it anything in particular they did that made you experience that?)
- Would you consider to choose an education in technology/industry? (Why/why not? Reconnect if they thought something was particularly interesting? What training?)
- Do you think that these stations could make a difference in such a choice? (In which way? Any specific part of the stations?)
- Do you have any suggestions for improvements to any of the stations you visited? (Improvements to a specific task?)

Wind-up questions:

- Do you have anything to add that might be of interest to us?

- Thank the interviewee for participating in the study
- Leave a note with contact information and tell the interviewee to get in touch if they are interested in the final report

Appendix VI

Interview template, Fair 3

Information for interviewee:

- The purpose of the study (A thesis that explores how exhibitions are perceived, a part of a larger project to spread knowledge about the new industry and smart factories.)
- What will the results be used for (The work culminates in a final report that is published and also presented at a final presentation.)
- The information will be treated anonymously (We do not collect any personal data except age and will only use the recorded material to the analysis of this project.)
- Is it okay to record the interview? (If not, end the interview and thank the interviewee)

Warm up question:

- How old are you?
- What is your current education? (Secondary school ? High school? What subjects?)
- What was your expectations for your visit to this fair? (Own initiative? With school class ? What do you hope to get out of the visit? Basis for secondary school or post-secondary employment? Job or school?)

Reflective questions:

- Did you perceive that you at one or many stations got to interact and practically try what was presented? If so, how/in what way?
- Did that affect how you experienced the station and if so, how?
- How did you perceive the staff at the stations?
- Did they (the staff) affect how you experienced the station and if so, how?
- Which of the stations did you find the most fun/interesting? Why?
- How important is it at this kind of stations that it is entertaining for you as a visitor?
- Did you have a previous interest of what was being presented at that station?
- If so, do you think that it affected your experience?
- Did you perceive that you at one or many of the stations got to see how something works for real? If so, how/in what way?
- Did that affect how you experienced the station and if so, how?
- Did you get to see something that was new to you at any of the stations?
- If so, did that affect your experience of the station and if so, how?
- Is it important for you to see an application for the technology? Why?
- Did you at any have the opportunity to discuss/collaborate with your team members?
- If, yes, which station and how did that affect your experience of it?

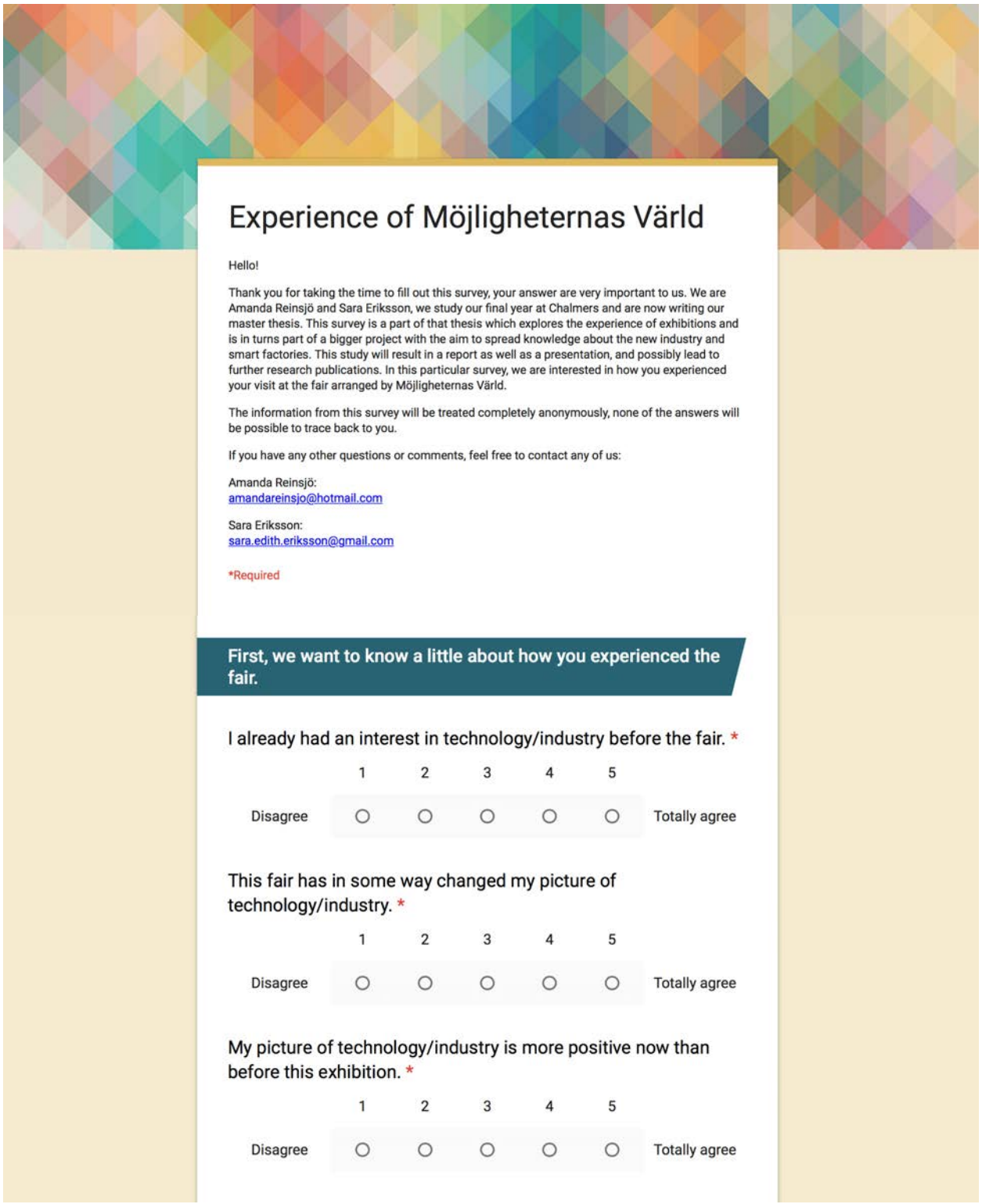
Wind-up questions:

- Do you have anything to add that might be of interest to us?

- Thank the interviewee for participating in the study
- Leave a note with contact information and tell the interviewee to get in touch if they are interested in the final report

Appendix VII

The layout of the survey



Experience of Möjligheternas Värld

Hello!

Thank you for taking the time to fill out this survey, your answer are very important to us. We are Amanda Reinsjö and Sara Eriksson, we study our final year at Chalmers and are now writing our master thesis. This survey is a part of that thesis which explores the experience of exhibitions and is in turns part of a bigger project with the aim to spread knowledge about the new industry and smart factories. This study will result in a report as well as a presentation, and possibly lead to further research publications. In this particular survey, we are interested in how you experienced your visit at the fair arranged by Möjligheternas Värld.

The information from this survey will be treated completely anonymously, none of the answers will be possible to trace back to you.

If you have any other questions or comments, feel free to contact any of us:

Amanda Reinsjö:
amandareinsjo@hotmail.com

Sara Eriksson:
sara.edith.eriksson@gmail.com

*Required

First, we want to know a little about how you experienced the fair.

I already had an interest in technology/industry before the fair. *

	1	2	3	4	5	
Disagree	○	○	○	○	○	Totally agree

This fair has in some way changed my picture of technology/industry. *

	1	2	3	4	5	
Disagree	○	○	○	○	○	Totally agree

My picture of technology/industry is more positive now than before this exhibition. *

	1	2	3	4	5	
Disagree	○	○	○	○	○	Totally agree

I would consider choosing a secondary school program in technology/industry. *

	1	2	3	4	5	
Disagree	○	○	○	○	○	Totally agree

I would consider to study further in technology/industry after high school. (For example, engineering or higher vocational school.) *

	1	2	3	4	5	
Disagree	○	○	○	○	○	Totally agree

Which of the stations did you find most interesting? (Insert more than one check if necessary) *

- [ ] Sheet metal and Welding (where you got to see how one welds)
- [ ] Design (where you for example got to guess the time period for different products)
- [ ] The Car Factory (the factory which produces toy cars)
- [ ] Computer Game Development (where you got to know more about game development)
- [ ] And what about me? (where you could talk to a science centre and perform a personality test)
- [ ] Manufacturing (where you got to see a CNC-machine in action)
- [ ] Product Development (where you got to see an example of a CAD program and how 3D printers work)

What was it that made the station/-s especially interesting? (Insert more than one check if necessary) *

- [ ] I had the opportunity to try something practical
- [ ] I had the opportunity to see and learn how something works
- [ ] I found that the staff at the station was good
- [ ] I had fun
- [ ] I had a clear task at the station
- [ ] I had the opportunity to try things free on the station, without a definite goal
- [ ] I got to be creative
- [ ] I had a previous interest in the topic/area
- [ ] I learned something new
- [ ] The others in the group thought it was interesting
- [ ] I like the layout/appearance of the station
- [ ] I don't know
- [ ] Other: _____

What do you think influences your choice of education/profession? (Insert more than one check if necessary) *

- [ ] Family
- [ ] Friends
- [ ] Own interest
- [ ] Possibility to get a job
- [ ] Other
- [ ] I don't know

Now we just need to get some additional information about who you are.

Right now I am in: *

- ○ High school
- ○ Secondary school

My parent/-s work in/as: (Seen more than one check if necessary) *

- [ ] Industry
- [ ] Science
- [ ] Engineering
- [ ] Other technical professions
- [ ] Other
- [ ] I don't know

I identify myself as: *

- ○ Female
- ○ Male
- ○ Non binary
- ○ Transgender
- ○ Agender
- ○ Other: _____

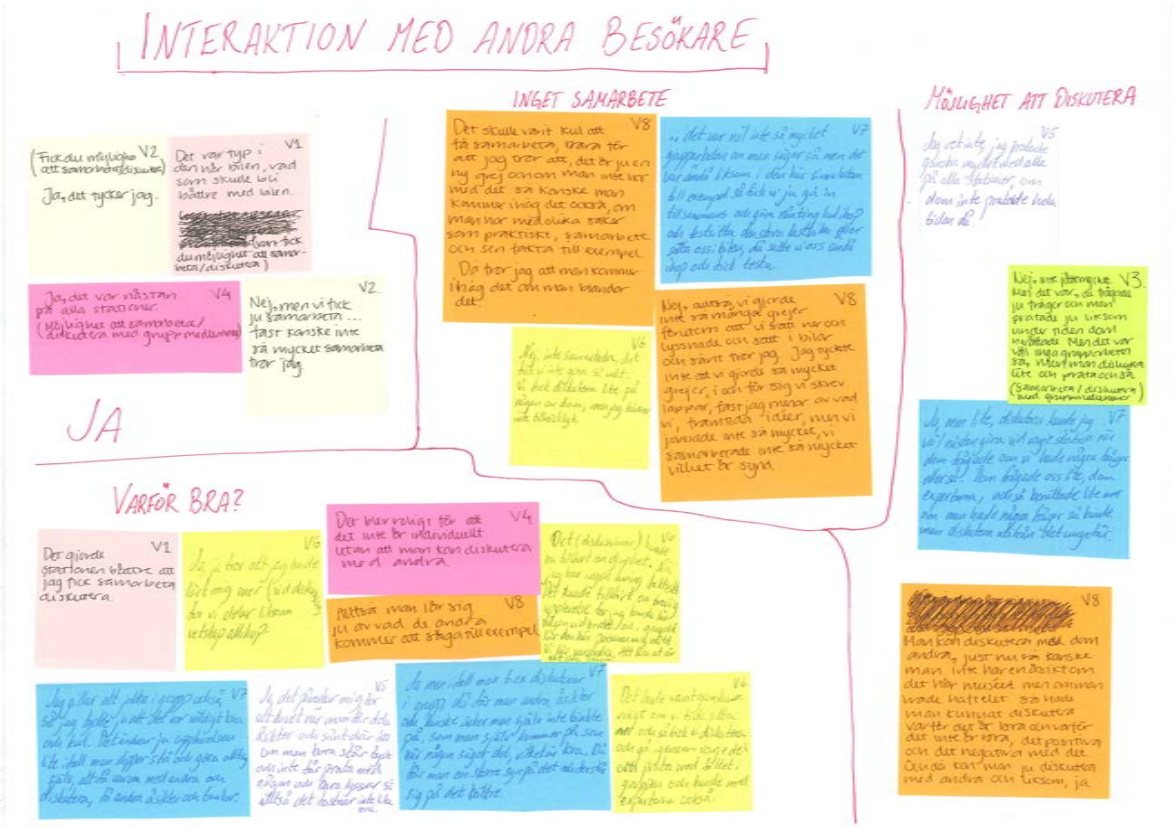
Appendix VIII

Examples of groups identified in the affinity diagrams

What was fun? - From the interviews at Fair 1 and Fair 2

Why was it fun? - From the interviews at Fair 1 and Fair 2

Interactivity - From the observations at Fair 2



Interaction with other visitors - From the interviews at Fair 3

Appendix IX

Quotes and how they were translated

The quotes are presented according to the sections used in Results. First the Swedish quotes is presented and after is a compilation of the English translations.

Interactivity

“[...] det är svårt att förstå bara utan att göra med handen utan att studera, det tar mycket tid.” (2:8)

“Prova på och se, men det blir ju så automatiskt när man får känna och prova själv hur det är att göra det. Så man har lite mer förståelse [...]”

“När man till exempel fick testa att svetsa och testa att spela datorspel och… det var roligast. När man fick göra saker själv.” (2:3)

“Ja, det var ju då det här med kameran. Det var ju mest intressant. Det andra var ju mer såhär.. alltså jag tycker det är roligare om man får göra något själv.” (1:2)

“Ja, men att man ska få göra så mycket praktiskt som möjligt och inte få så mycket prat utan mer få göra grejer“ (2:3)

“Lite mer som man fick testa själv.” (1:7)

“Men jo man märker verkligen skillnaden såhär när han berättar att man ser inte så mycket i lastbilen, och man såg verkligen att man ser inte jättemycket däruppe där man satt.“ (3:2)

“Jag tyckte simulatorn var mest intressant, för då fick man uppleva mest.” (3:3)

“Jag tyckte att det var mycket roligare och att man lär sig av det mycket enklare. Man kommer ihåg det eftersom man själv har fått varit med [...]” (3:8)

See something in reality

[...] man fick liksom en bild av det istället för att bara höra det rent teoretiskt” (1:1)

“Ja, för alltså med en 3D-maskin och glasögonen och dom här QR-scanningen så ser man ju vad det är, det är lätt att hänga med och förstå då” (1:6)

“[...] man kommer ihåg mycket mer om man verkligen ser det framför sig, som jag sa innan” (3:8)

“[...] då får man en större bild av hur det är liksom. Man förstår sig bättre på det och kan sätta sig in i den situationen istället för att försöka komma på något och så kanske man tänker helt fel” (3:7)
Staff

“Ja, alltså de [personalen] var alla jättetrevliga. Så då blir det ju mer att man försöker koncentrera sig även fast man är lite trött.” (1:2)

“Men jag hör typ ett ord, sen inte ett annat, sen hör jag ett till, då förstår jag antagligen vad dom menar. Eller så frågar jag igen.“ (2:5)

“Dom kollar bara på oss och vi kollar bara på varandra” (2:4)

“Mycket bättre, för det är lite tråkigt att, när man bara går runt och så vet man inte vad som är vad, utan dom som jobbar här förklarade och så och hur det är.” (3:4)

“Dom var väldigt professionella, men dom var inte särskilt, dom var väldigt noggranna med att inte vara tekniska” (3:6)

Learn something new

“Att man inte ser det så ofta i vardagslivet. [...] Cool teknologi.” (1:3)

“Att roboten kunde typ tänka eller så. Att den liksom visste vad den skulle göra.” (1:5)

“Jag tycker mycket bättre om saker jag inte känner till för att då lär jag mig mer.” (2:6)

“Om jag inte kände till det alls och fick lära mig någonting nytt då var det liksom såhär spännande, man fick lära sig nånting och fick reda på någonting nytt.” (3:7)

“[...] om man lyssnar på samma saker hela tiden, om man redan vet dom grejerna, så känns det ju lite tråkigt bara för att man redan vet dom. [...] om allting är nytt då kanske det blir lite svårt att komma ihåg det” (3:8)

See an application

“QR-scanningen tyckte jag var, det är ganska praktiskt och bra att ha. För jag vet ofta när det kan bli strul där jag jobbar så blir det väldigt mycket förseningar för man måste först förstå vad det är som är fel och så måste man fixa det ut efter det då.” (1:8)

“[...] det var bara själva idén i sig och möjligheterna, liksom hur stort och brett allting blev.” (1:10)

“Att jag får se hur en sån grej kan fungera i verkligheten, ja det tycker jag personligen är väldigt viktigt.” (3:6)

“[...] man lär sig mer så är det lättare att förstå och man kan ta det mer för hur det är i praktiken och liksom lära sig mer och så. Man kan förstå mer.” (3:2)

Previous interest

-”Jag vet inte, jag bygger en traktor just nu, så då får man hålla på och svetsa och ja, sånna saker.” (2:7)

“Det var rätt kul med spelutveckling för jag har funderat lite på det.” (2:1)

“Ja, jag tror att jag lärde mig mer nu när jag tyckte att det var intressant.” (3:2)

“[...] att jag gillar teknik gjorde ju att jag lyssnade och tog in informationen” (3:3)

“Dom tog det väldigt från grunden och så, då måste man inte veta så mycket eller vara så intresserad av det för att tycka det är kul.” (3:7)

Entertainment

“Om det är roligt så lär man sig mycket och man kommer ihåg det, så det är… ja det är rätt bra.” (3:3)

Interaction with other visitors

“Jag gillar att jobba i grupp och så, så jag tyckte ju att det var väldigt bra och kul. Det ändrar ju upplevelsen lite ifall man slipper stå och göra allting själv, att få vara med andra och diskutera, få andra åsikter och tankar.” (3:7)

“Ja, det påverkar mig för att du vet när man får dela åsikter och sånt där för om man bara står tyst och inte får prata med någon och bara lyssnar så, alltså det fastnar inte alls lika bra.” (3:5)

“Nej, inte samarbeta, det fick vi inte göra så mycket. Vi fick diskutera lite på någon av dom [stationerna], men jag känner inte riktigt tillräckligt” (3:7)

English translations

Interactivity

“... it is hard to understand without doing with your hand but to study, it takes a lot of time.” (2:8)

“To try and see, but it is like that automatically when you get to feel and try for yourself what it is like to do it. So you get a little more understanding [...]” (1:6 - On answering “What was best at the exhibition?”)

“When I, for example, got to try to weld and also play computer games and... that was the most fun. When you got to do things yourself.” (2:3)

“Yes, it was this with the camera. That was the most interesting. The others were more like.. Well, I think it is more fun when you get to do something yourself.” (1:2)

“Yes, to be able to do as much practically as possible and not get as much talk but more to do stuff.” (2:3 - On answering “Do you have any suggestions on improvements for this fair?”)

“A little more that you got to test yourself” (1:7 - On answering “What could have been better with this exhibition?”)

”But yeah, you really noticed the difference, like when he said that they do not see much in the truck and you really saw that one does not see very much up there where they sit.” (3:2)

”I thought that the simulator was most interesting, because there you got to experience the most” (3:3)

”I think it was much more fun and you learned a lot easier from it. You remember it because you have been there yourself [...] ” (3:8)

See something in reality

”[...] you got like a picture of it instead of just hearing it purely theoretically” (1:1)

”The 3D machine, the glasses and the QR-scan, you can see what it is. It makes it easy to keep up and understand.” (1:6)

”[...] as I said before, you remember a lot more if you really see it in front of you.” (3:8)

”[...] then you get a bigger picture of what it is like. One understands it better and understand the situation instead of trying to come up something and then maybe you picture it incorrect.” (3:7)

Staff

”The staff were all really nice, which makes you try to concentrate even if you are a little bit tired.” (1:2)

”But then, I kinda hear one word, then not the next one, then I hear another one. So I probably understand what they mean. Or else, I ask again.” (2:5)

”They just look at us, and we just look at each other...” (2:4)

”Much better, because it's a bit boring when you just go around and you don’t know what is what, but those who work here explained how it is and so.” (3:4 - On answering “Did the staff affect the experience, if so how?”)

”They were very professional, but they were not particularly.. they were very careful not to be technical.” (3:6)

Learn something new

”That you don’t see it so often in the everyday life. [...] Cool technology.” (1:3)

”That the robot could, like, think or so. That it kinda knew what to do.” (1:5)

”I like things I do not know better, because then I learn more.” (3:6)

”If I did not know it at all and had to learn something new, then it was like, exciting, I had to learn new things.” (3:7)

”[…] If you listen to the same things all the time, if you already know the stuff, it feels a bit boring just because you already know it. [...] if everything is new then maybe it is a little difficult to remember it.” (3:8)

See an application

”QR scanning, I thought was, it is quite practical and useful. Because I know that often when there is trouble where I work, it causes delays and one must first understand what it is that is wrong and you then have to fix it.” (1:8)

”[…] it was just the idea of the bearings, the opportunities, how big and wide everything became.” (1:10)

”I get to see how such a thing really works, yes I personally think that is very important.” (3:6)

”[…] you learn more so that it becomes easier to understand and you can take it more for what it is in practice, as well as learn more and so. One can understand more.” (3:2)

Previous interest

”I don’t know, I’m building a tractor right now, so then you go on and weld and yeah, such things” (2:7)

”It was fun with the game development, because I've been thinking about it.” (2:1)

”Yes, I think I learned more now when I thought it was interesting.” (3:2)

”[…] the fact that I like technology made me listen and take the information in.” (3:3)

”They took it very much from scratch, and so, then you have to not know as much or be as interested to find it fun.” (3:7)

Entertainment

”If it's fun then you learn a lot and you will remember it , so it's... Yeah, it's pretty good” (3:3)

Interaction with other visitors

”I like working in groups too, so I thought it was very good and fun. It changes the experience a bit if you don’t have to stand and do everything on your own, to be with others and discuss, get second opinions and thoughts” (3:7)

”Yes, it affects me because you know when you get to share opinions and stuff like that, because if you just stand quietly and do not get to talk to someone and just listen, then it will not stick as good” (3:5)

”No, not collaborate, that we did not do much. We were discussing a bit at some of them [the stations], but I feel like it was not enough” (3:6)