CHALMERS

Conceptual Design of Temporary Exhibition Platform and Smart Grid Exhibition for Siemens Urban Sustainability Centre

Master of Science Thesis

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ABSTRACT

This project consisted of three main parts that were all performed for Siemens Urban Sustainability Centre in London. The centre will open in 2012 and its main purpose is to showcase sustainable technology for urban environments.

The first task of the project was to develop a platform for temporary exhibitions in the centre. The platform concept utilizes flexible solutions so that the exhibition information content can easily be changed for different topics. A document with strategies for successful exhibition communication, which can be used as a guideline when designing an exhibition, complements the platform concept. Together with the platform concept, a location for the temporary exhibitions within the Urban Sustainability Centre is suggested.

The second part of the project regarded an exhibition concept on the topic of smart grid. This concept is presented including both the information content about smart grid, and exhibition design solutions to communicate the message to the right target audience. The exhibition concept was made to fit the temporary exhibition platform, and it can be used to present and motivate why a temporary exhibition will be a good complement to the permanent exhibition in the Urban Sustainability Centre.

The third part of the project was to present an idea for an outdoor exhibit that relates to the temporary exhibition and to sustainability to be placed outside the centre. This exhibit makes use of the water area outside the centre, targets the broad public, and aims to create interest in sustainable technology and the Urban Sustainability Centre.

Throughout the project, a product development process has been applied and numerous methods have been used. The installations in the exhibition focus on interaction and visitor participation to increase engagement from the user. The project has a clear sustainability perspective and the smart grid exhibition will help the visitors see the necessity of a sustainable development and what role smart grid will play in the future.

PREFACE

This report presents a master's thesis project of 30 ECTS for Chalmers University of Technology in Göteborg, Sweden. The project was carried out in co-operation with Siemens and the time frame was from March 2011 to September 2011.

Siemens provided opportunities for field studies at different museums, exhibitions and trade shows, and Siemens facilities in England, Germany and Sweden.

Resources

- Project team: Petter Polson B.Sc. Industrial Design Engineering, Oskar Karlsson B.Sc. Sustainable Energy Systems.
- Project owner: Dr. Werner Kruckow Director at Siemens Urban Sustainable Energy Centre.
- Examiner: Dr. Pontus Engelbrektsson Assistant Professor at Design & Human Factors, Chalmers University of Technology.
- Supervisor: Dr. Lina Bertling Head of the Division of Electric Power Engineering, Chalmers University of Technology.

Acknowledgements

A lot of people have helped us out with this project and some of them deserve a special thank you.

First we would like to thank our project leader Werner Kruckow for letting us take part in this very interesting project, for taking time and sharing his feedback and insights on how to manage projects, and for letting us see different parts of the global Siemens organisation. We also want to thank the project initiator Bettina Peck for bringing us onboard, believing in our ideas, and assisting us throughout the project process.

Furthermore, we would like to thank our examiner and supervisor Pontus Engelbrektsson for all the support in the project, for always having time for us, and for the helpful meetings and feedback. Credit also to Lina Bertling for helping us understand the immensely complex topic of smart grid.

A lot of Siemens personnel are worthy of thanks for taking time to arrange and attend our meetings and visits at the offices in London, Frimley, Nottingham, Berlin, Erlangen, Nürnberg, and Münich. A special thanks also to Carol Gelder for actually making them happen. The architects from Pringle&Brandon who helped us with input and feedback, and the designers at EVENT who gave us insights in their work deserve credit.

Special thanks to Elin Löfblad at the Swedish Siemens office who helped us arrange this project and assisted us in all the administrative work.

Finally we want to thank our families for believing in us. We are very grateful for all your support. This could not have been done without you.

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1. BACKGROUND AND AIM

This section gives an introduction to the project, presents its scope and aim, and describes Siemens Urban Sustainability Centre where the project was carried out.

1.1 SIEMENS URBAN SUSTAINABILITY CENTRE

More people are moving into cities and both the global population and demand for resources grow. This makes the urban environment increasingly important to consider and due to dense populations, cities can become a problem as well as provide opportunities for the future. Innovative technological solutions are essential to ensure a sustainable future and Siemens wishes to take a leading role in this development. Therefore, Siemens is building an Urban Sustainability Centre on the Docklands in East London. The centre will open in the summer of 2012 and will serve as an arena to showcase sustainable technology and solutions for urban environments. The Urban Sustainability Centre will be a new landmark in London's Green Enterprise District and will both showcase sustainable technology to the general public, and work as a meeting place for city planners, decision makers, architects and industry representatives from around the world. The Urban Sustainability Centre will consist of two parts: the Exhibition Crystal and the Corporate Crystal.

Figure 1.3 Exhibition crystal

Figure 1.1 Petter at the USC construction site in London

Figure 1.4 Centre by night

Figure 1.2 Centre from the Royal Victoria docks

The Exhibition Crystal will hold a permanent exhibition on sustainable technology that targets the general public and aims at creating interest and informing about sustainability. The exhibition design company EVENT has the overall responsibility for the design of the permanent exhibition which will consist of 2000 square meters of interactive installations. EVENT will also design installations to be placed in the outdoor area around the Urban Sustainability Centre. The building itself will also showcase sustainable technologies with solar photovoltaic cells on the roof, thermal storage facilities in the ground, and efficient ventilation and building management system.

The Corporate Crystal will contain conference facilities, office spaces, meeting rooms, and an auditorium that will both be used by Siemens and rented out to external users. One suggestion that has been addressed is to include temporary exhibitions into the Urban Sustainability Centre and place them in the Corporate Crystal. By placing the temporary exhibition in a higher security area it can target a more specific audience, such as Siemens customers from industry, politicians and city planners. The content of the temporary exhibition can be presented on a deeper and more advanced level and be more Siemens-related than the permanent exhibition. This makes the temporary exhibition a complement to the permanent one and allows for more targeted product display, which can be beneficial for Siemens.

Topics for the temporary exhibition can be e.g. electromobility, energy efficient buildings, offshore power generation, or smart grid technology. Each temporary exhibition is suggested to run for three months at a time on a rolling schedule and can be supported by conferences, meetings, music events and art exhibitions relating to the topic. There is also space available in the outdoor area around the Urban Sustainability Centre for an exhibit which can relate to the temporary exhibition.

1.2 THE PROJECT

When the Urban Sustainability project started, one suggestion was to include temporary exhibitions to complement the permanent one. Siemens wanted to analyze if it was feasible to include temporary exhibitions into the Urban Sustainability Centre, and develop a concept for a temporary exhibition platform. To illustrate the potential of including temporary exhibitions Siemens also needed a concept for an exhibition on one of the suggested topics. Different topics were discussed and the topic of smart grid (See 2.1 Introduction to the Smart Grid on page 6) was chosen.

1.2.1 The project scope

The scope of the project was threefold and each part is presented separately below.

Platform for temporary exhibitions

The first scope of the project was to develop a concept for an exhibition platform that can be used for temporary

SUSTAINABILITY

Sustainability means capacity to endure. Sustainable development refers to environmental, social, and economic development that enables future generations to have the same opportunity for quality of life as today.

exhibitions in the Urban Sustainability Centre. Part of the task was to find a suitable location for a temporary exhibition in the Corporate Crystal and design a layout that can be used for different exhibition topics. Included in the platform concept was to present design strategies that can be used when developing the exhibition.

Concept for temporary exhibition on the topic of smart grid

The second scope of the project was to present a concept for one of the temporary exhibitions on the topic of smart grid. The exhibition concept should include both the information content and a design solution for how to communicate the content to the right target audience.

Concept for outdoor exhibit

The third scope of the project was to develop a concept for an outdoor exhibit which relates to the temporary exhibition and to the Urban Sustainability Centre.

1.2.2 Limitations

- The concepts needed to be realisable with respect to both technology and cost, but no detailed cost calculations were delivered.
- Some technical aspects of the installations were considered but no detailed information on construction and maintenance was presented.
- Actual construction of the exhibition was not included in the project scope.

1.3 AIM

The aim of the project follows the scope and was thus divided into three parts that are treated separately.

1.3.1 Platform for temporary exhibitions

The overall purpose of the Urban Sustainability Centre is to present sustainable technology solutions to the public. The temporary exhibition aims to extend the information already given in the permanent exhibition and give the visitors the opportunity to make a deep dive into certain topics. The platform concept must be flexible enough to be able to host different topics in order to enable that the same platform can be used for other temporary exhibitions in the Urban Sustainability Centre. Context, such as the building design and permanent exhibition content, should be considered in the platform concept design in order to make the temporary exhibition fit into the building and complement the permanent exhibition. Besides presenting information, the temporary exhibition should work as a platform where different actors can meet and discuss challenges and solutions.

1.3.2 Temporary exhibition on Smart Grid

The concept for the temporary exhibition on the topic of smart grid aims to give the visitors an interactive experience and a better understanding of smart grid technology and its part in the energy system. The exhibition should present Siemens' view on the topic of smart grid and promote Siemens as the best partner and supplier of smart grid products. The concept further aims to present the topic in an interactive, inspiring and informative way that appeals to the right target group.

The project should answer the following questions:

- **What** information on smart grid should be communicated to the targeted audience?
- **How** should this information be presented?

By answering these questions this project aims to increase awareness and interest in smart grid and its role in a sustainable future. This facilitates the transition into a smart grid infrastructure and more sustainable user behaviour and Siemens is promoted as a trustworthy, competent and reliable partner in smart grid development.

1.3.3 Outdoor exhibit

The outdoor exhibit aims to attract people's attention and induce interest in the Urban Sustainability Centre. The concept for the outdoor exhibit will be an installation directed to the broad public and it needs to fulfil specific requirements in the outdoor area. The outdoor exhibit concept aims to give the audience an interactive experience that will raise questions and make them interested in sustainability and the Urban Sustainability Centre.

2. THEORY

The theory section of this report consists of two parts - an introduction to the concept of smart grid and one part regarding design theory. The smart grid theory is the basis for defining the Exhibition Content Description document (see appendix) and the design theory outlines how content can be successfully communicated to the target group.

2.1 INTRODUCTION TO THE SMART GRID

The world's energy demand is increasing rapidly, especially in the developing countries, and the global population is growing. At the same time it is becoming more and more obvious that the world's resources are finite and that the way energy is produced and consumed need to change into a more sustainable usage. On the one hand, there is climate change due to greenhouse gas emissions from the energy and transport sector. On the other hand, the fossil resources that today stand for about 85% of the world's total energy supply will eventually run out (International Energy Agency, 2010). Great transitions need to be done in order to change the energy mix into renewable sources and to use energy more efficiently.

"Think of the smart grid as internet brought to our electricity system."

The most clean and sophisticated way of utilizing energy is in the form of electricity, a high quality energy carrier that can be transformed into all other sources in a controlled way. Today we stand before an electricity revolution where large parts of the energy systems worldwide will use electricity as the predominant energy carrier, e.g. by transforming the transport sector into electrical vehicles. However, this electrification of our societies is not possible with today's electrical grids.

Today's grid is characterized by centralised, large scale production and hierarchical distribution from the power generator to the consumer through high voltage transmission networks and low voltage distribution networks. In the future, both supply and demand will be less predictable and more complex. On the supply side, there will be more intermittent sources e.g. wind, solar and wave power plants. There will also be more small-scale decentralised power production that needs to be handled as well as large scale renewable energy plants. On the consumer side of the electricity chain there will be a higher demand from new electric vehicles and more electronic equipment in houses and industries that need a stable supply of electricity. To meet this future demand, the electric grid has to develop into a smart grid that can both secure the balance between production and consumption and guarantee the availability of high quality electricity.

2.1.1 Defining the Smart Grid

Due to the complexity of the concept, there are many definitions of a smart grid. The definition depends on what the driver is for developing a smart grid in different countries and what part different actors play in the development. One definition that summarises the concept is to say that a smart grid is an electricity network that can intelligently integrate the behaviour and actions of all users connected to it in order to efficiently deliver

SMART METERING

Electricity metering that communicates with both the consumer and the grid. Smart metering helps the consumer to monitor and optimise their energy consumption based upon their demand and the energy price (which can be set in real-time). At the same time the smart metering enables utilities to collect the necessary information to be able to balance the supply and demand in the grid by analysing consumer behaviour and projected electricity generation.

sustainable, economic, and secure electricity supplies (European Technology Platform, 2011). A shorter way to summarise it would be to say "Think of the smart grid as internet brought to our electric system" (Litos Strategic Communication, 2008).

Another approach to describe the smart grid would be to take the technology perspective and define it through the products that build it. Communication technology is central in a smart grid and the information is used for optimising the electricity transmission and distribution from suppliers to consumers. Smart metering that keeps track of production and consumption is therefore an important part of a smart grid. Other examples of technologies that will be part of a smart grid are building management systems which optimise the energy use in homes and smart consumer products that use the information from metering to shift the electricity consumption to off peak hours when it is cheaper for the user (Flick & Morehouse, 2010).

2.1.2 Drivers for smart grid development

The drivers for developing a smart grid are many and vary between different locations and situations. Research and development of smart grid is carried out all over the world so its development can be discussed from a global perspective. However, the deployment of smart grid solutions is much dependant on the region due to differences in the infrastructure age, growth in electricity demand, changes in the energy mix, and market structure.

Drivers worldwide

In Europe the main driver for smart grid development is the political will to change the energy mix so that more energy is produced from renewable sources. The European Union has set up targets for the year of 2020 that include more renewable energy and better energy efficiency (European Commission, 2011). In order to reach this there is a need for smart grid technology that can balance supply and demand without the need for excess power. In USA the situation is different due to an old and unreliable grid, especially the transmission grid. The country has had some costly blackouts and brownouts in the past and wants to secure its supply. New investments are being made into the electricity system and through smart grid development necessary investments can be postponed or minimised. China on the other hand is the region that grows the fastest at the moment and needs to build a lot of new grid to supply the energy demanding east part of the country with energy from sources in the west part of the country. To optimise the investments needed, a new grid will include smart technology (Larsson & Ståhl, 2011).

Sustainability, climate and renewable energy

To deal with climate change and other environmental issues related to an unsustainable use of fossil energy in the world, a global transition of the energy mix into renewable sources needs to take place.

The sun supplies the world with its total annual energy need in little more than an hour. Hence, the potential for using solar power to meet the world's energy demand is huge. Solar power can either be harvested directly or in

BLACKOUTS AND BROWNOUTS

Disturbances in an electricity grid can be of different kinds. A blackout means a power outage in the grid which shuts down the supply. A brownout is a voltage drop which can cause flickering lights and damage sensitive equipment.

the form of wind and hydro power. Wind power is growing fast today with a growth rate of about 25% per year (The Windpower, 2011) and will become a large contributor to the world's electricity supply in the near future. Direct solar power can be turned into electricity from either photovoltaic cells, or from thermal solar power plants.

The problem with integrating more renewable power generation into an energy system is that those sources are highly fluctuating (except for hydropower with dams). Electricity supply today is adapted to the demand of the users and needs to be more reliable than renewable intermittent energy sources. To allow for the expansion of renewable energy, the supply and demand relation must be balanced. Storage capacity is needed in the grid when there is excess power and the demand for electricity must be managed to match the supply. This calls for a flexible electricity price in combination with a grid that can communicate with smart home products (World Energy Council, 2010).

Energy security and efficiency

In many places around the world there is already a problem with old grids not being able to supply the electricity according to demand. Blackouts and brownouts in the electricity grid are costly and this problem grows as the world's energy demand increases and the fossil sources are running out. Power quality also becomes more problematic when more and more disturbing objects and sensitive equipment are connected to the grid. This calls for a smarter control of the electricity system to assure a safe and reliable supply of electricity of the right quality (International Energy Agency, 2011).

Today's electricity infrastructure is designed to meet the highest level of demand and during non-peak hours the system is underutilised. If demand was levelled, this excess power capacity would not be needed. Smart grid technology can manage this by providing incentives for consumers to shift consumption from peak hours to off peak hours. This is achieved by providing consumers with information about supply and electricity price, as well as through smart automated solutions which helps consumers make the most profitable choices (Larsson & Ståhl, 2011). This will open up a new era of consumer choice and enable household equipment, such as washing machines, to be programmed to start when the electricity price is low, normally during night time (Vattenfall R&D, 2010). Similarly an electric car battery can work as power storage and provide a household with energy when the electricity price is high. Such development will require technical equipment and the grid to communicate, as well as smart software solutions to make the consumer decisions as easy as possible (European Technology Platform, 2011).

2.1.3 Steps towards a smart grid

Steps that need to be taken towards a smart grid differ a lot between regions. What steps that need to be taken are generally depending on the current situation in the

DEMAND RESPONSE

In the traditional electricity grid, balance is kept by adapting the supply to the projected demand. In a future grid with more fluctuating renewable energy sources this relation will change into a Demand Response system, where the consumption is controlled by pricing signals to adapt the demand to the current supply. A demand response system will require smart technology that meters and optimises consumptions to even out the demand.

region and what the main drivers are for the smart grid development.

Technology development

Storage is said to be the biggest technological challenge for smart grid development and new and better solution for energy storage is needed in the future grid to level the supply from intermittent sources. The level of integration of renewable capacity depends on storage capabilities. Electricity storage will therefore play an important part in achieving self-sustaining areas on local or regional level. Another application for improved energy storage is within the demand response system, where securing the supply of electricity to the consumers is a crucial issue. Different storage technologies are needed for different applications and options to consider are batteries, pump power plants, flywheels and super-condensers (Larsson & Ståhl, 2011).

Market development

A smart grid development will lead to new market opportunities and the possibility for new actors to enter the energy sector. Examples of new actors are the aggregators that collect small scale power production and sell it on the existing energy market and the "prosumer" that both generates and consumes electricity.

One area that is important to develop is a demand response system that shifts and balances the load and decreases peak demand in the energy system. Demand response is one of the enabler of large scale expansion of intermittent power production and will need smart metering infrastructure, distribution management and new price signals, as well as smart customer products and interfaces (Larsson & Ståhl, 2011).

Setting new standards

Smart grid technology will bring together many industry sectors that previously have not worked together and consequently combine different products into one solution. At the same time, large investments are necessary to speed up the smart grid development. This calls for good interoperability between companies and products to decreases the risks with the investments. Standards are therefore crucial for a variety of products and services in the smart grid field (International Energy agency, 2011), (International Electrotechnical Commission, 2010).

2.1.4 The road forward

Commercial scale demonstration projects are needed to capture real-world data in order to find out how the technology works with the market and regulation systems, as well as with the end-user. Large scale demonstrations will provide shared learning among the participating actors, decreased risk when investing in new technology, and best practice methods for smart grid deployment.

Since the road to a smart grid is unclear and can take different turns, and a lot of the development is new and groundbreaking, there is a need for different actors to meet and discuss problems and solutions. An exhibition on the topic can provide a meeting platform and thereby facilitate smart grid development.

PROSUMERS AND VIRTUAL POWER PLANTS

Consumers can also generate electricity and use it, store it or sell it to the grid and thus acting as so called "prosumers". Many small electricity generators can get together to produce electricity as a virtual power plant. A virtual utility is a cluster of power plants and storage facilities controlled by one Energy Management System. Coming together in a virtual power plant can be a way for small producers to get market shares.

2.2 DESIGN THEORY

All structured product design work is based on scientific theories, methods and models. In this project the theories of product design was applied to exhibition design. The following section discusses the main ones that were applied.

2.2.1 Experience design

The paradigm shift from technology-centred design to user-centred design has in recent years developed one step even further. According to certain theories (Desmet & Hekkert, 2007), all interaction between users and in-animate objects result in an experience, and the concept of "Product experience" is nowadays considered an important aspect of product design. Instead of designing products or services, one can shift the focus to actually designing experiences. The experience visitors are exposed to when visiting an exhibition was considered crucial for the effectiveness of the final design result and further investigations in the field of experience design were considered necessary for this project.

Product experience refers to all possible affective experiences involved in human-product interaction. Human-product interaction include instrumental interaction (e.g. using, operating managing products), non-instrumental interaction (this refers to interaction that does not directly serve a function in operating a product e.g. touching the soft seat in a premium car), and non-physical interaction (fantasising about, remembering or anticipating usage of a product e.g. "I expect this handle to break if I push it to hard"). The experience is also shaped by the characteristics of the user engaged in the interaction (e.g. personality, skills, background etc.) and those of the product (e.g. shape, colour, behaviour etc.). Finally, besides the type of interaction and characteristics of the user and product, the third element that affects the product experience is the context of the human-product interaction (Desmet & Hekkert, 2007).

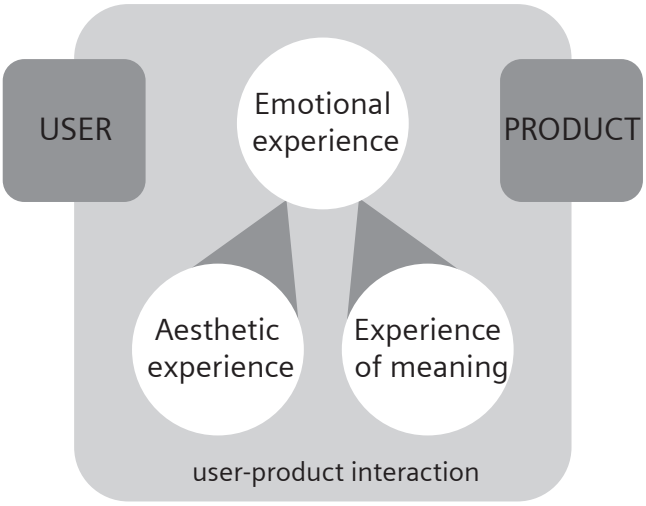


Figure 2.1 Product experience

Product experience can be divided into three main components: aesthetic experience, attribution of meaning, and emotional response, which together shape the total experience.

USER-CENTRED AND PRODUCT-CENTRED DESIGN

User-centred design is a design philosophy in which the needs, wants, and limitations of end users of a product are given extensive attention. Its predecessor, the product-centred design philosophy, had a heavy focus on innovation, sometimes forcing the users to change their behaviour to accommodate new products rather than letting the needs of the users shape the product.

Aesthetic experience denotes a products capacity to affect our sensory modalities. For example, an object can be pleasant to look at, have a nice texture, or even smell enjoyable. The degree to which the perceptual system manages to detect structure, order, or coherence and assess the feature's novelty or familiarity typically determines the affect that is generated from this sensory stimulus.

Attribution of meaning is closely connected to cognitive processes within the user. Interpretations, memory retrieval, and association are all important procedures that shape the meaning that is assigned to a certain product. This aspect is clearly very individual and thus vulnerable to e.g. cultural differences; a person from a western culture might attribute different meanings to colours, shapes and symbols than an individual from an Asian culture.

As shown in the illustration above, the aesthetic experience and the attribution of meaning both affect the emotional response. Emotions in this case refer to the active phenomena typically considered in psychology and everyday life, e.g. love, desire, fear, disgust, etc. and are critical for the product experience. Contrary to popular belief, emotions are not arbitrary but rather the result of a cognitive but often unconscious process and thus, in this sense, quite rational (Desmet & Hekkert, 2007).

2.2.2 Designing emotions

According to the section above, all encounters with in-animate objects and products create experiences which in turn induce emotions. Given this, designers might find it important to include emotion in the intentions of their design efforts. Emotional responses can also effect customers' preferences when it comes to purchase decisions and might therefore have a considerable influence on a product's success. Because of this reason, designing for emotions is an important viewpoint when developing products, services or experiences that ultimately aim to sell; in this case Siemens solutions. Desmet (2002) claims that because emotions are not as intangible as they seem, designers *can* influence the emotional impact of their designs.

When discussing designing emotions it is important to try and define the concept of emotions, this field is closely linked to psychological affect. The term affect, or affective state, is generally used to refer to all types of subjective experiences that are valenced, i.e. good or bad, pleasant or unpleasant etc. Russel (2003) improved this one-dimensional model by introducing the state of physiological arousal into the assessment. This resulted in a two-dimensional circumplex model of core affect.

This model illustrates the entire span of different core affects, from calm and unpleasant, to activated and pleasant. The core affect's position in the model moves around throughout the day when interaction is made with different products and it responds to our experiences with these products.

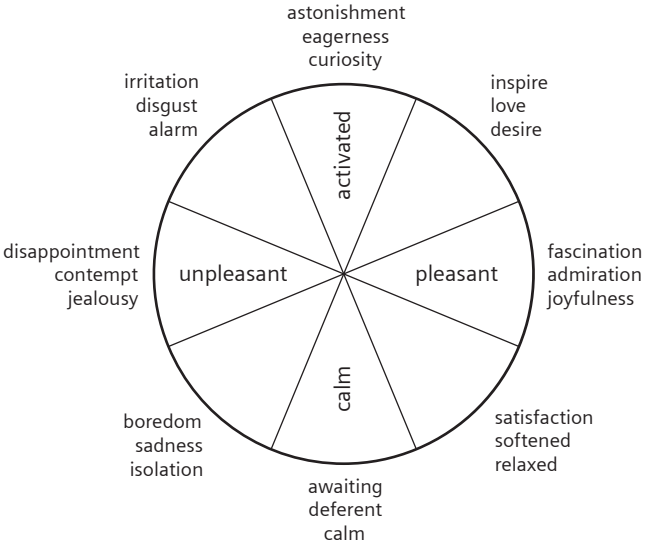


Figure 2.2 Circumplex model of core affect

3. METHOD AND EXECUTION

In this section the methods used in the project are described, both in theory and how they are used. Analysed results of the different studies are presented in the next section. The project process is illustrated in the figure below and the different parts are described further.

3.1 PROJECT PLANNING

Initial planning part of this project consisted of making a MECE analysis, a Gantt chart and a stakeholder overview. During the project process weekly reports were sent to the project owners and a project log book was written. These methods are described below.

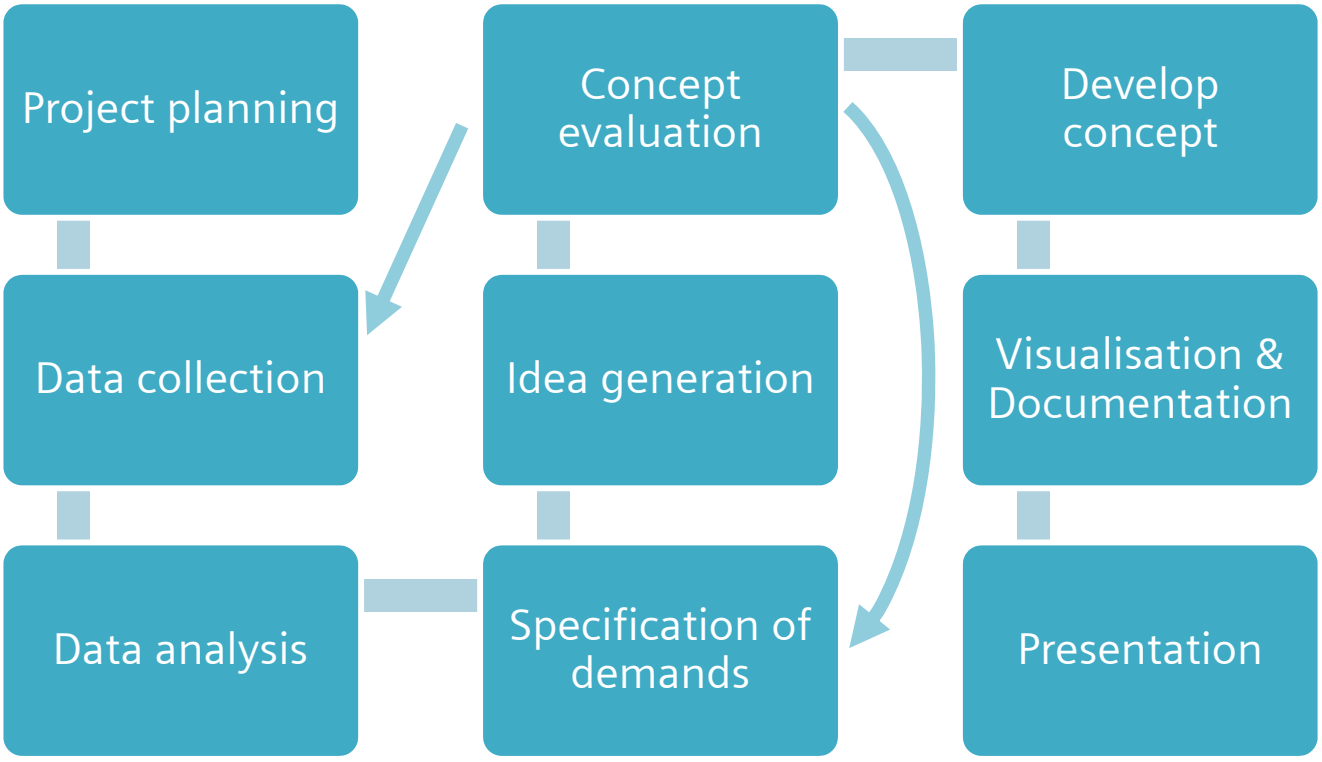


Figure 3.1 Project process

3.1.1 MECE analysis

MECE stands for Mutually Exclusive and Collectively Exhaustive and is a general grouping principle. It is generally used for dividing a complex problem into solvable sub-problems. The result of the MECE analysis is visualized with e.g. a tree diagram structure. The procedure includes breaking down the core problem of the project into sub-problems that are, on each and every level of the tree diagram, mutually exclusive and collectively exhaustive. Mutually exclusive implies that no sub-problem should represent or overlap any other sub-problem and collectively exhaustive denotes that the set of all sub-problems, taken together, should fully characterize the total core problem (Tom Spencer, 2011).

The MECE analysis carried out in this project helped to form an initial proposal of what the main questions of the project were, what information that was already available, what information that needed to be collected, and what activities that should be undertaken to collect this information. This proposal was then used to generate the first Gantt chart.

3.1.2 Gantt chart

A Gantt chart is a type of flow chart used in project planning to graphically illustrate a projects different phases and the relationship between them. The chart consists of horizontally oriented bars on a timeline. Each bar represents a process or activity and the length of the bar and where it starts and stops illustrates at what time that particular phase should start, the amount of time set aside for it, and when it terminates. The different bars' sizes and positions present a graphical overview of the workload and project planning for the entire project (Pinto, 2007).

In this project a Gantt chart was produced at the start of the project time period to get an estimation of how much time the different processes were allowed to take. This gave a useful overview of what activities that should be processed during each week. The Gantt chart was also attached to the weekly report to communicate the progress in the project process to the project owners.

3.1.3 Stakeholder overview

The stakeholders of a project are the individuals or groups that are likely to be affected by the project and/or its result. The stakeholders can be certain individual persons, specific target groups, general culture groupings, commercial companies, governmental entities etc. A stakeholder analysis is the process of identifying these and sorting them according to their impact on the project and the impact the project will have on them. This information is then the basis for assessing how the interests of those stakeholders should be addressed for a successful project result (Olsson & Skärvad, 2007).

The stakeholders of this project were illustrated on a mind map where the size of each bubble represented the impact that particular stakeholder had on the project. This overview helped to summarize the different requirements and define how conflicting demands from different actors related to each other.

3.1.4 Weekly report

Continuous communication between the project execution team and the project owners is important to secure progress and useful results. Project owners need to know the status and progress of the project to know that it is on the right track or if any further resources need to be put in place to take the project forward.

For this purpose, a Weekly Report template was produced for this project. The report was sent out on a weekly basis and in a brief and concise manner discussed the following: project outline, recent activities, results, next step, identified problems, solutions, and assistance needed for the project. The whole report fitted on an A4 sheet and gave the project owners a quick overview of the project, its current status, and whether their assistance was needed at the moment.

3.1.5 Project log book

A project of this size and time span covers a lot of different processes, studies and activities and to keep track, a log book was written. This was mainly for internal use, to keep track of events and results and to be able to back track at any time in the process.

3.2 DATA COLLECTION

Based on the MECE- and stake holder analysis, and input from the project owners extensive data collection was carried out. Literature studies, user studies, observation studies, and market studies were performed to collect the data necessary for the project progress.

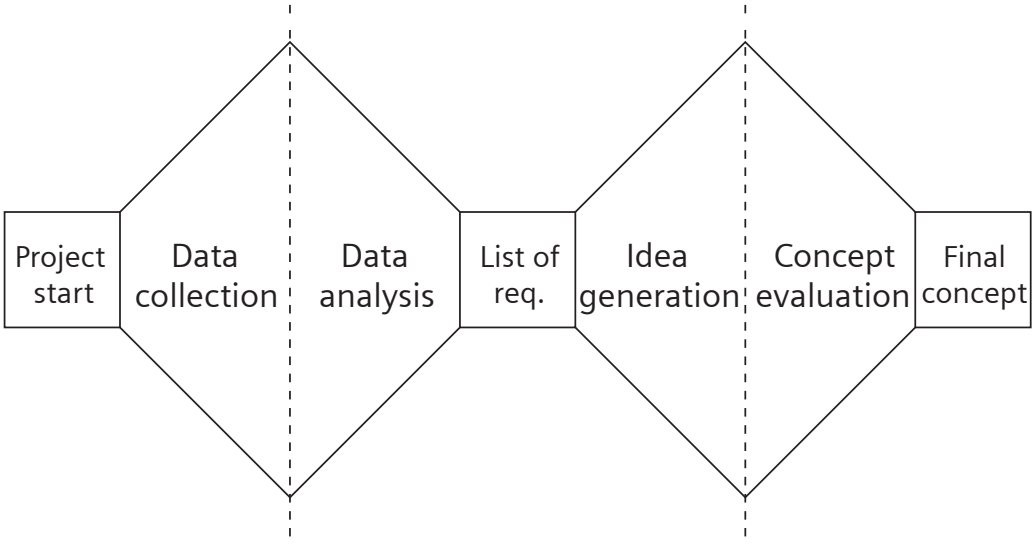


Figure 3.2 The design process

3.2.1 Literature studies and seminars

To gather the theoretical information necessary to perform this project, literature on the topics of smart grid, experience design, and designing emotions was consulted. The literature was picked out from library consultations and the internet or recommended by the project supervisors or other involved personnel. See Bibliography for complete list of literature.

As a complement to the literature studies, seminars were attended at two different occasions. Visual forum is the leading Scandinavian visualisation conference and was held for the seventh consecutive year at Lindholmen Science Park, Göteborg 2011-05-03. It focuses on visualization technology for businesses, researchers, academia and the public sector. The seminars at Visual Forum mainly concerned visualisation and learning. The seminars at Elfack discussed the current smart grid development status. Elfack is a tradeshow regarding electricity, targeting industry representatives. It was held at the Swedish fair in Göteborg 9th May 2011 to 12th May 2011. Transcribed records of the seminars are presented in the appendix (See Appendix V - Seminar transcripts on page 88) and analyses of the results are presented in the result section.

3.2.2 User studies

The user studies performed in this project were mainly question based methods. Question based user studies consist of interviews and questionnaires and can either be very structured or more unstructured. Structured interviews and questionnaires follow a certain template very strictly whereas in unstructured ones the questions asked depend on what answers that are received.

Which are the main bottlenecks for smart grid development?

-Smart grid Questionnaire

Interviews

During a personal interview an interviewer asks an interviewee a set of questions. If an interesting topic comes up the probing technique can be applied. The probing method encourages the interviewee to develop certain interesting answers or comments on a more detailed level and describe their opinions and emotions around the subject. Interviews generally generate qualitative data and are therefore a powerful tool to collect new information.

The interviews in this project were usually semi-structured with partly prepared questions and partly open discussions. The probing method was used to focus on interesting topics that came up during the interviews.

Siemens personnel (See Appendix VI - Interview transcripts on page 92) were interviewed to gain more knowledge on Siemens' view on smart grid and their strategies for exhibition design. Interviews with external persons were also held to increase understanding in different aspects of exhibition design and communication. The Siemens personnel and others involved in the USC that were interviewed were chosen by Siemens. Their roles were as experts on smart grid or as stakeholders in the USC project, e.g. the architects of the building or the design team working with the permanent exhibition.

Questionnaires

Questionnaires are a good way to collect data from a large number of people. It is essentially a question based method that uses written or digital documents to communicate the questions and collect the answers. In general there are two types of questions in a questionnaire; ones with fixed answer options or ones with the possibility to write the answers freely. Questionnaires with fixed options are mainly used to collect quantitative data whereas allowing the user to write freely also collects qualitative data.

To gain an answer set that is relevant to the project it is important to consider the selection of people that fill in the questionnaire. The selection can be representative, meaning that the people who fill in the questionnaire are similar, on as many levels as possible (knowledge level, gender, age, cultural background, occupation etc.), to the group that is targeted regarding whatever the questionnaire means to investigate. Another way to make a selection is what is called a critical selection. With this method focus is put on the critical aspects of the investigated subject and people who comply with these criteria are chosen. If designing a mobile phone for elderly people it might be beneficial to do a critical selection and collect data from people with rheumatism or other motoric handicaps.

Since an important part of this project was to communicate the topic of smart grid, the target audience's knowledge level on this topic was of interest. To be able to communicate interesting information in the exhibition and not repeat what they already knew a smart grid questionnaire was constructed (See Appendix X - Questionnaire on page 105) to get a better understanding of the target group's idea of the concept. The questionnaire study was carried out among 12 professionals within the electricity- production, transmission, distribution, and installation field at the Elfack fair in Göteborg. This selection was considered critical for the target group regarding the criteria:

- Technology interest
- Types of professions
- Knowledge level on the topic smart grid

Criteria such as e.g. age, gender, or nationality were not taken into account. The questionnaires were filled in at the fair in coffee shops and similar and then analysed with box diagrams.

Later in the project process, after presenting the initial concepts, a concept survey was used to summarise feedback. Each of the concepts was presented visually and in text and the participants were asked to give their feedback in a digital survey form. This data was then analysed and summarised into a table.

3.2.3 Observation studies

Observation studies are a very helpful complement to the question based methods. Observing how users interact with products can generate a lot of useful input that user studies such as interviews possibly would miss. An important advantage of observation studies is that the amount of information that is gathered through visual observations is not limited by what the interviewee believes is important, which might be the case with interviews. Also, the interviewee's ability to phrase and communicate the point might also limit the information transfer and thus the usefulness of the study. A disadvantage is that the method doesn't generally detect emotions, attitudes or preferences.

The observation can be structured or unstructured and different technical aids can be used such as cameras or audio recorders. In *direct observations* the observer observes without interfering with the observed. In *participating observations* the observer is allowed to ask questions about whatever is investigated during the study. This probing technique might generate additional qualitative data but might also distract the user from performing the task the way as would be the case if the user was unobserved.

Observation studies were an important part of this project to gain more knowledge in how visitors interact with different types of exhibition installations, to gain more experience in exhibition design, and also get inspiration for different exhibition solutions.

The observation studies were executed at five different locations listed below. The first three studies were *direct observation studies* done at museums and exhibition centres. The studies focused on how different installations worked, which ones that were popular and why. By also testing different interactive installations ideas and inspiration on exhibition design and interaction methods were gained. The two last studies were done at fairs and tradeshows in a more quantitative manner. The visitors' behaviour around different installations was observed, and exhibits that attracted most attention were studied more closely. The results and analyses are presented in the Result section.

Universeum, Göteborg

Universeum is a Science park with both permanent and temporary exhibitions. Some of the exhibitions focus on animals and nature and there are for instance an aquarium part and a rain forest in the building. Other exhibitions are covering different science topics such as how the human brain works or what forensic science means. Universeum is mostly targeting families with children and uses mostly interactive installations for the kids to play around with.

The museum of Natural History, Göteborg

This is a typical natural history museum presenting animals and plants, both current and extinct. The target audience is mostly families and school classes and the installations are mostly non-interactive.

Elfack at the Swedish Fair, Göteborg

Elfack is a big tradeshow on the topic of electricity, targeting a variety of industries with business in electricity installation, power generation, electricity transmission and distribution, and consumer products. Besides the exhibitions there are also seminars and forums discussing current topics such as smart grid development.

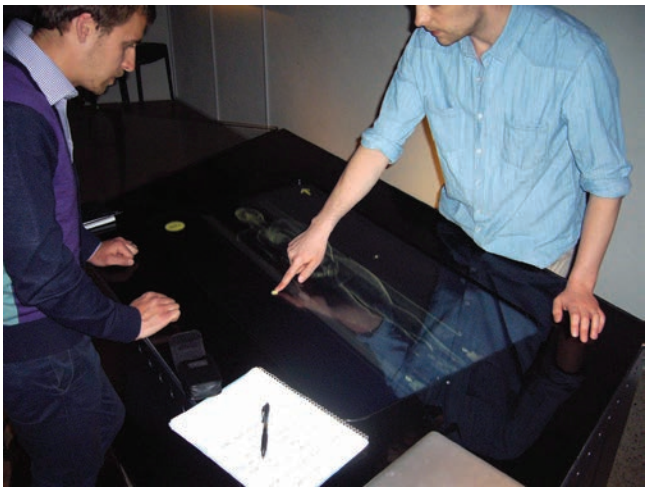


Figure 3.3 Guide presenting the Virtual Autopsy Table at Visualiseringscenter

Figure 3.5 Petter constructs molecules in interactive installation at Visualiseringscenter C

Figure 3.4 Oskar interacts with digital animals at Visualiseringscenter

Figure 3.6 Petter uses haptic senses at Visualiseringscenter

Visualisation centre C, Norrköping

Visualisation Centre C in Norrköping is an exhibition centre demonstrating how visualisation and interaction can be used to communicate different messages. The centre runs in cooperation with the University of Linköping and targets the broad public, students, and industry. All installations are interactive and present how new technology can enhance the experience and understanding of different research topics.

Visual Forum, Göteborg

Visual forum is an annual fair for visualisation technology where companies present and showcase their products and partake in seminars and workshops on different topics related to visualisation and communication.

CIRED at Frankfurt Messe, Frankfurt

CIRED is a leading forum for the electricity distribution community. Every second year it holds an international electricity conference where companies in electricity distribution participate. The 2011 exhibition was held in Frankfurt Conference Centre and focused on smart metering, smart grid, and management of an aging infrastructure.

Figure 3.7 Oskar trying out 3D goggles at Visual Forum

Figure 3.9 Petter trying interactive spherical screen at Visual Forum

Figure 3.8 Oskar in front of the Frankfurt Congress Centre during CIRED

Figure 3.10 Petter interacting with Siemens installation at CIRED

3.2.4 Market studies

To learn about other similar exhibitions around the world on the topic of smart grid a market study was performed. The following criteria were analyzed for the different exhibitions:

- Initiator
- Location
- Time frame
- Description
- Core message
- Target audience
- Communication strategy

This resulted in a graphical box chart illustrating some similarities and differences between the different exhibitions. The x-axis of the chart was rated from *public* to *industry*, the y-axis from *information centred* to *experience centred,* and the different boxes position and size represent whether the exhibition targets an industrial audience or the broad public and if it uses an information- or experience centred communication strategy.

3.3 DATA ANALYSIS

All the collected data was analysed with respect to each data type. Qualitative information from interviews, interaction observation studies, and literature, was generally processed with a KJ-analysis. The quantitative data, on the other hand, was translated into graphical diagrams that were then interpreted. The analysis resulted in a Communication Strategy document, a List of requirements for the temporary exhibition platform and for the outdoor exhibit, and an Exhibition Content Description for the smart grid exhibition.

3.3.1 KJ-analysis

This method was developed by the Japanese anthropologist Jiro Kawakita and is used to structure large amounts of qualitative data. The core idea of the method is to break down the information into smaller homogenous parts and then rearrange them according to their interrelations. This can be done digitally, in e.g. word processing software, or by cutting out sentences from an interview transcript paper and gluing them onto a piece of paper. The basic procedure would be this:

A sentence or paragraph is cut out and put on a new paper. Then a new sentence is cut out and placed on the same paper, right next to the first one if the information content or opinions expressed in that sentence matches the first sentence, or on its own if it relates to something completely different. These steps are then repeated until all the sentences are gone through. You will now have several different groups of sentences representing the main topics of the information content. These groups can now be named and summarised and the sizes and inter-relations of the groups can be interpreted.

3.4 LIST OF REQUIREMENTS

Result of the data analysis was translated into a list of functions for the temporary exhibition and the outdoor exhibit. The functions were screened and questioned in order to make sure that overlapping functions or irrelevant or superfluous ones were removed. After this screening only the true requirements for the design were left and this list was then run through a KR-matrix in order to weight the individual requirements against each other.

3.4.1 KR-matrix

A KR-matrix is a way to systematical assess the internal hierarchy of the requirements of a design. Every requirement is compared to all the other ones and a subjective assessment of which one that is more important for the product success is made. This results in a score for each of the requirements which then can be translated into a weighting of the functions. See Results for weighted Lists of requirements (See 3.4 List of requirements on page 20) and Appendix for entire KR-matrices (See Appendix XII - Kr-Matrices on page 109).

3.5 IDEA GENERATION

Based on the list of requirements, extensive idea generation was carried out. Several methods for this were utilized but some techniques were common for all of them.

Going through all of the requirements systematically and try to generate sub-solutions for each and every one of them can be a good way of producing a wide range of ideas. By then focusing on the whole system completely different ideas can be generated and this continuous shift of focus from single requirements versus the whole system is a useful technique.

Another important aspect when idea generating is the level of abstraction. When raising the level of abstraction the actual reasons and underlying causes for a problem or a requirement are considered, and solutions to the problem are generated instead of just fulfilling a requirement. This way of thinking will generate quite radical, but nonetheless new, ideas that might have been missed if keeping the level of abstraction too moderate.

3.5.1 Brainstorming

This method aims to stimulate a group of people to generate a wide range of ideas in a short period of time. Its strength lies mainly in the way it discovers new angles on existing problems and uses synergic dynamics within the group to generate radically new ideas. Therefore, the composition of the brainstorming team can be of great importance. The guideline is to try and achieve a group of participants with slightly different background and possibly also a different relation to the subject for the brainstorming. Open communication, free from criticism, is fundamental for the method to function and a positive, exploring mentality is recommended.

There are several ways of executing the brainstorming concept. A very common more chaos based way is to simply, verbally and with sketches, try to generate as many solutions to the problem at hand as possible. Another procedure is to individually generate solutions, sketch them onto a paper, and then pass it on to the next person who will then continue to develop those ideas. Whichever one of these proceedings you prefer, it is essential to keep a strict time plan for the session, e.g. brainstorming for 20 min, then break for 5 min.

Image board

An image board is essentially a collage of pictures that represent the expressions and/or colours, shapes, environments, etc. that the final project result should match. The image board can be said to be the result of the visual and expressional design analysis and is also an important tool to ensure that consensus is met within the project group concerning this. The image board can be used as a mediating tool for brainstorming or general idea generation and should generally be present at all creative processes in the project.

Persona

A good way of representing a products target audience is by using a persona. The persona can consist of both pictures and narrative relating to a desired user or customer's daily behaviour patterns and features. The persona should use specific details, not generalities, and try to induce a personal understanding of the represented target user group. As with the image board, the persona should be present at all creative processes and act as a mediating tool for the idea generation to make sure that the ideas actually fit onto the target group.

Osborn's idea spurs

Osborn's idea spurs, or SCAMPER, is a tool to aid and enhance the brainstorming technique. SCAMPER stands for: Substitute, Combine, Adapt, Modify/Magnify/Minify, Put to other purposes, Eliminate, and Rearrange/Reverse. These advices are meant to open up new ways of approaching the problem and looking at it a different way. The word Substitute should for instance make you

Figure 3.11 Petter giving presentation during brain storming work shop


Figure 3.12 Participants of the brain storming work shop

consider substituting part of your product/process/problem for something else. By looking for something to substitute you can often come up with new ideas.

Work shop

Several brainstorming sessions were held in the project team to generate solutions for the three main objectives; the temporary exhibition platform, the smart grid exhibition, and the outdoor exhibit. To also collect ideas from people with an external view on the project a brainstorming work shop was hosted. Eight different people with different backgrounds and interests (industrial design engineering and engineering physics) were invited to come and reflect on the three above mentioned topics during 2 hours. After a brief explanation of the project background and scope, the participants were split into two groups, equipped with pans and papers, and encouraged to generate ideas through four different 15 min sessions.

Session 1 concerned general exhibition ideas and the persona discussed above was presented. With a high level of abstraction the groups discussed general strategies on how to best communicate information to the target audience at hand. Different types of media technology and didactical methods were discussed and assessed.

At session 2 the topic of smart grid was introduced and explained. Waiting with introducing the topic until after the first brainstorming session was a conscious decision to try to avoid potential bias and rather produce untainted ideas. However, after this brief intro to the subject the participants were encouraged to generate ideas on how to visualize the concept of smart grid and communicate the different aspects of it to the target audience.

Learning through games was an interesting concept discovered earlier in the research and the third brainstorming session in the work shop considered this. “How can the concept be adapted to the target audience?” and “What representation and media technology can be used?” were some of the questions discussed.

The last session was about the outdoor exhibit. The two groups were asked to consider general ideas on displaying objects in an outdoor setting as well as exhibits on the topic of smart grid.

Ideas generated at the work shop were used when developing the different concepts for the smart grid exhibition and the outdoor exhibit. A transcript of the result from the workshop can be found in the appendix (See Appendix XVII - Brainstorming workshop results on page 115).

3.5.2 Morphological matrix

A morphological matrix is used to visually display the different solutions for different requirements of a product problem. By combining these solutions into concepts, as many combinations of ideas as possible are considered. This method was applied to the macro structure of the temporary exhibition and different concepts with different shape and number of stories was developed.

3.5.3 Concept generation

The final part of the idea generation process was to summarize all the different ideas to get an overview and try to detect patterns. To achieve this all the ideas were sketched onto post-it notes and put onto a large white board. Utilizing the KJ-analysis principle, the post-its were then ordered according to different criteria and grouped into clusters. By picking post-its from each group and combining them, different initial concepts for the temporary exhibition and outdoor exhibit were

Figure 3.13 Post-it wall during idea generation

produced. These were then evaluated and screened which led to deletion of some of them and merging of others. By combining the most promising features, three concepts for the temporary exhibition and four concepts for the outdoor exhibit were finally accomplished.

3.6 CONCEPT EVALUATION

After generating the different concepts for the temporary exhibition and the outdoor exhibit, these concepts needed evaluation. This was done with PUGH Matrices and by a presentation for the stakeholders.

3.6.1 PUGH Matrix

To evaluate concepts and ideas in a structured way a PUGH matrix can be used. When using the method, the concepts are all compared to a reference object with respect to the different weighted requirements. The total score for each concept then decides which one of the concepts and the reference object that fulfills the requirements to the largest extent.

This method was executed in four different heats. In the first one, the three exhibition concepts were compared to Siemens exhibition at the CIRED fair in Frankfurt. This comparison confirmed whether the new concepts were superior to an existing one concerning the list of requirements for the project. For the other three heats, the concepts were compared to each other. The result of this evaluation showed which one of the three concepts that showed the most potential.

3.6.2 Stakeholder feedback

There are different ways to collect feedback from the stakeholders of a project. In this project a concept presentation was given to a stakeholder group after half of the project time period. The presentation was complemented with a survey.

Concept presentations

The purpose of presenting concepts to stakeholders is to gain feedback on the ideas on different levels. To get opinions on the concepts as a whole, as well as on certain details of the designs, it is meaningful to present a wide variety of designs.

The three concepts for the temporary exhibition and the four ones for the outdoor exhibit were presented to a panel of project owners and other Siemens personnel at Siemens UK's headquarters in London. The concepts all represented different approaches to the designs and were quite radical in their layout. The main reason for this decision was to show the panel several different opportunities and to give them the chance to pick out their favorite features from each one of the concepts.

Concept survey

To structure the feedback from the concept presentation the participants were asked to fill in their opinions on each of the concepts into a survey (See Appendix XIX - Concept survey on page 120). The survey consisted of pictures and short paragraphs describing all of the concepts and their content and had text box areas for input. The survey was distributed digitally as an interactive PDF form. The opinions from the survey are analysed in the Result section (See 4.4 Concept evaluation on page 43) and a transcript of the result can be found in the appendix (See Appendix XX - Concept survey Results on page 128).

3.7 CONCEPT DEVELOPMENT

After receiving feedback from the Project owners, other Siemens personnel, and the architects, the three temporary exhibition concepts were merged into a final one. All the input regarding exhibition content as well as its general design was taken into account which made it on a more detailed level than before. Also, after feedback on the location of the exhibition, the most suitable space for it was decided. This space was then outlined, scale 1:1, in a big atrium for spatial studies. By walking around and getting a feel for the available space and experimenting with creating sub-spaces and corridors the final exhibition layout was developed. The temporary exhibition platform design was then modelled up in CAD software and defined further. By placing the design into a CAD model of the centre (provided by the architect firm) further adjustments of size and placement could be performed.

Figure 3.14 Trips to Nürnberg, Berlin, Erlangen and London

4. RESULTS AND ANALYSIS

The result section follows the same structure as the Method and Execution part of this report. Results from the data collection, data analysis, idea generation, and concept development are described and analysed. Parts of the data, such as interview transcripts, are summarised in this section, while the complete data is presented in the appendix.

4.1 DATA COLLECTION

The data collection is divided into literature studies, user studies, observation studies, and market studies. The results are listed and analysed below.

4.1.1 Literature studies

The results of the literature studies on smart grid are presented in the Theory section of this report. The theory on experience design and designing for emotions is discussed and analysed below.

Design theory analysis

Emotions affect our reasoning and actions and it is therefore important to consider them in all types of product design. If a certain product induces a more pleasant emotion than its competitors, this might make the buyer choose it over a similar product. These theories are assumed to also apply to exhibition design. Visitors leaving the exhibition with a positive feeling about the experience and Siemens approach to the smart grid concept will be more prone to engage further with Siemens.

Product experience and emotional design are very closely linked. When designing to induce certain emotions, the entire product experience must be taken into account. The aesthetical experience needs to be considered in every aspect; from colours, surface finishes and textures, to pictures, movies, sound effects, interaction, etc. Every visitor will attribute different meaning to the different elements of the exhibition depending on background, personality etc. It is therefore crucial to try to define the target user group so that the exhibition and its content can be adapted to induce the desired emotions within this group. All these aspects of the human-product interaction need to be considered and it is the whole system rather than specific explicit design cues that will induce the emotional response.

The circumplex model (See Figure 2.2 Circumplex model of core affect on page 11) of core affect offers a structured way of defining emotions and should be taken into account when designing the exhibition and its content. Active and pleasant emotions such as curiosity, inspiration and fascination might be beneficial in some parts of the exhibition, whereas more calm affective states, such as relaxed and satisfied, will be preferred in others.

4.1.2 Seminars

The seminars on exhibition design and smart grid that were attended at Visual Forum and Elfack is summarised and analysed below. Full transcripts of the seminar result can be found in appendix (See Appendix V - Seminar transcripts on page 88).

Analysis of seminars at Visual Forum regarding exhibition design

By incorporating a game aspect to an exhibit, the user will participate more actively and be more emotionally engaged, thus learning more about the topic. It is important to be aware of what pedagogical setup and vocabulary that is used in order to target the right audience. Just like the content and the technology, the pedagogical perspective plays a big role in every exhibition. To actually induce “action” is an important part of the communication that needs to be considered in the concept for the exhibition.

Using historical persons can be a good way to put things in perspective. To look at people instead of technology can illustrate how things have evolved. Paradoxical ways of presenting information (e.g. comic book style graphics to show science) attracts attention.

It is important to induce positive emotions and avoid a feeling of hopelessness when communicating and educating. The use of non-logical (purely aesthetical) visual, audible or tactile elements can enhance messages and create the right atmosphere. User involvement and the possibility to change and affect content make people more engaged, especially if combined with the “recognition-factor” e.g. being able to affect your own city in an exhibition simulation.

Analysis of seminars at Elfack regarding smart grid

Smart grid has become a fast growing area for research, technology development, and political discussions in the last couple of years. It has become the brand name for the change that is happening, and is needed in the electricity grid to maintain a balance between production and consumption when a higher capacity from renewable sources will be incorporated.

The biggest focus in Europe today is how to integrate more wind power in the energy mix and to facilitate the transition towards an electric vehicle fleet. At the same time, major investments are needed to upgrade the electricity grids worldwide in order to meet a higher

demand. Due to the energy situation and the existing grid, the necessary investments vary for different parts of the world.

Smart grid technology will enable new actors, such as small scale producers and new energy service providers, to enter the electricity market. New market solutions are needed to cope with the changes and to ensure necessary investments in the grid.

Technology development itself is not a bottleneck; the problem is how to get people to use the technology. Other bottlenecks are lack of standards in the industry, which slows down development and integration of the new technology, and unclear political steering.

4.1.3 User studies

The results from interviews and questionnaires used in the project are listed below. The interviews are divided into those with Siemens personnel and those with others that have helped with guidance in this project.

Interviews with Siemens personnel

A selection of the results from interviews with Siemens personnel are presented below. Complete interview transcripts can be found in the appendix (See Appendix VI - Interview transcripts on page 92).

Siemens in general

Siemens is an honest, trustworthy and practical company. It only presents real data and does not promise things it cannot keep. “Tomorrow is today” was a slogan Siemens used in an earlier exhibition which corresponds to the message; Siemens is not predicting the distant future but can provide the right tools and solutions today.

Siemens core values are:

- Employees – brain power
- Excellence - technology
- Innovation - technology
- Efficiency

Figure 4.1 Electric vehicle demonstration at Siemens Academie in Berlin

Smart grid message

There is a paradigm shift in electricity generation between the 20th and the 21st century. More renewable energy sources replace fossil energy which will bring change to electricity transmission and distribution. The load will follow power generation, instead of the other way around, and the current chain model for electricity distribution will be more complex. An increase in renewable energy and load shifting are examples of drivers for smart grid development. Others are the need for efficiency and reliability in the grid. Bottlenecks in the development of smart grid are the need for new infrastructure and new global standards among electricity generators and distributors, but also that people's mind set has to change. However, there is no need to wait for smart grid development to happen. Siemens has the solutions today, and not just as a "good provider" of smart grid products; Siemens want to present themselves as "THE company" in the smart grid field.

The exhibition in general

The temporary exhibition is more business oriented than the permanent exhibition. It will be placed in a higher security area and target a more specific group of visitors such as decision makers and buyers of Siemens products and systems. However, the broad public should not be excluded from the temporary exhibition. The exhibition will be part of a bigger package with conferences, performances etc. The way of presenting information must be flexible in order to simplify updating the content. New case studies and products will be developed, and they will need to be included in the exhibition once it is completed.

An exhibition designer has only 20 seconds to communicate the core message of an exhibition. It is therefore important to create a "wow-effect" and then communicate the content instead of the other way around. After the visitor's attention is caught, a story is needed to evoke emotions. Interactive installations work well, even on business-visitors, and are important to the exhibition to achieve engagement. By including challenges or competitions the visitors will be more engaged in the learning process, and there is no "age limit" to play games.

Smart grid specific exhibition

Important actors in the smart grid field can be found throughout the whole energy chain; from power generators to transmission and distribution system operators, to aggregators, city planners, and consumers. Siemens can provide both smart grid products and services to all of these actors. Starting from the customer's perspective when presenting product can be an effective strategy. If asking the question "What was the challenge?" one can emphasize what results Siemens' solutions actually brought to a certain case study. By creating this clear link between the solutions and the cases, the effectiveness of the products is communicated in a more tangible way. Important products in the Siemens portfolio are DEMS and the Smart Grid Compass.

Interviews with non Siemens personnel

A summary of the results from interviews done with non Siemens personnel during the project is presented and discussed below. The complete transcript can be found in

DEMS

DEMS stands for Decentralised Energy Management System and is Siemens software that monitors and optimises an energy system. DEMS can be used to control the energy production and consumption in any system from a house to a whole city with utilities as typical customers.

the appendix (See Appendix VI - Interview transcripts on page 92).

Exhibition techniques

In order to create interest, it is very important that an exhibition "tells a story". The different exhibits need to be connected and relate to each other in a relevant way. Interaction is another important topic to consider for an exhibition to attract and maintain attention from the visitors. People stay longer at the exhibit or installation and get more involved and engaged when they can influence the content. Interaction is important regardless of the target group, it works for all ages, professions etc.

Description of innovative technologies for interactive exhibits:

- **Multi touch tables** – A large touch screen oriented as a table that users can gather around and interact with. It is a suitable tool for mediating discussion whereas all the users are equal in the sense that they can all participate in the interaction.

- **Object recognition** – The multi touch tables described above can be used together with physical objects that are placed on it. The table can recognize predefined objects, identify where the object is placed, in what direction it is oriented, and interact with it.

- **Motion control system** – This type of technology can e.g. be found in different gaming consoles and uses cameras, accelerometers and sensors to detect motion. The user's movements are continuously registered which enables touch free interaction.

- **3D video** – By using 3D video spectators can get a thorough understanding of the spatial aspects of a concept and complex problems can be better communicated and discussed. A 3D movie also effectively catches the attention of the viewer.

- **Projection mapping** – This technology utilizes projection of images or movies onto irregular surfaces to create optical illusions. This can e.g. be used to add effects and atmosphere to the environment of the exhibition.

Smart grid

Actors in the smart grid development:

- Producers – can be large and small, global and local.

- Venture capitalists – new actors that invest in projects.

- Equipment constructors – building e.g. wind mills. Find new niches or adapt existing.

- Producers of smart home equipment

SMART GRID COMPASS

The Smart Grid Compass is a Siemens developed tool for tailor-made smart grid development. Since the energy systems and electricity grids worldwide differ a lot there are no one solution that works in all situations. The steps towards the smart grid vary and each project needs a unique solution. Siemens therefore provides consultants who can assess the situation and provide solutions.

- Aggregators – gathers information from different electricity generators for distribution.
- Users – can be "prosumers", i.e. both producing and consuming electricity.

Bottlenecks in the smart grid development:

- Standards – the government should involve in large infrastructure investments. In this case, standards are needed to get technology development instead of the other way around.
- "Technology lock-in" – people are locked into old ways of thinking, fresh ideas are needed. Smart grid is a new technology area and can be a way to get new ideas into an old business.

Analysis of interviews

Siemens wants to be presented as the major smart grid technology provider. The temporary exhibition can be more Siemens oriented than the permanent one in the centre and the aim is to promote them to potential customers.

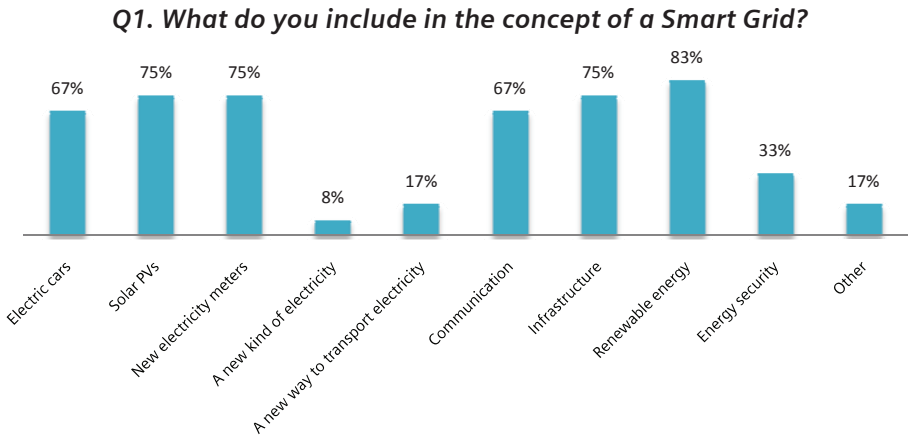
Siemens is a very large and broad company with competence and products throughout the entire energy chain, and this should be apparent in the exhibition. At the same time Siemens is realistic, does not want to give promises that cannot be met, and cares about its trustworthiness.

Smart grid products are available today and the technology development is no bottleneck, even if there are challenges. Fresh ideas and a change in people's mindset are needed for smart grid development to happen at the same time as standards are being set to facilitate the construction of the new infrastructure.

The exhibition should be mobile and flexible to be adaptable to changes in the content and context. It is important to catch the attention of the visitors quickly and keep it by having a story in the exhibition. Interactive installations are important to enhance the experience. Interaction induces engagement and work on all different user groups.

Results from questionnaire

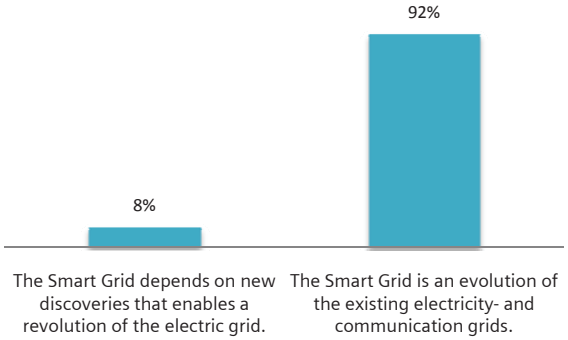
The questionnaire (See Appendix X - Questionnaire on page 105) was distributed at the Elfack fair to get a clearer view of what knowledge people in the electricity-related field of business have regarding smart grid development. The results from the questionnaire are presented in diagrams below. For each diagram there is an analysis of the results; whether they were anticipated or not and how they can be used in the design of the smart grid exhibition.



There were several alternatives that received a high score on the question what to include in the smart grid concept. Renewable energy got the highest result which claims that the participants see the smart grid as an enabler for more renewable energy sources in the energy mix. Most people rejected the alternatives "A new kind of electricity" and "A new way to transport electricity" which suggests that they have understood what smart grid is not about. The most

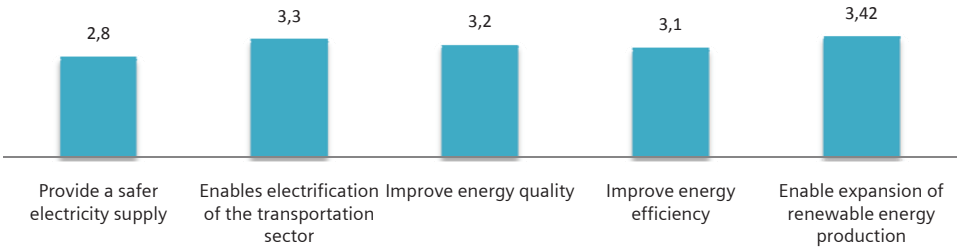
surprising number is perhaps the low result for "Energy security" which only a third of the participants suggested is included in the smart grid concept. Perhaps this is because energy security is not a big issue in Sweden compared e.g. the USA and therefore is not seen as a major driver for smart grid development. The benefits of a smart grid for a secure supply of high quality electricity can be emphasised to increase this awareness.

Q2. How will the Smart Grid emerge?



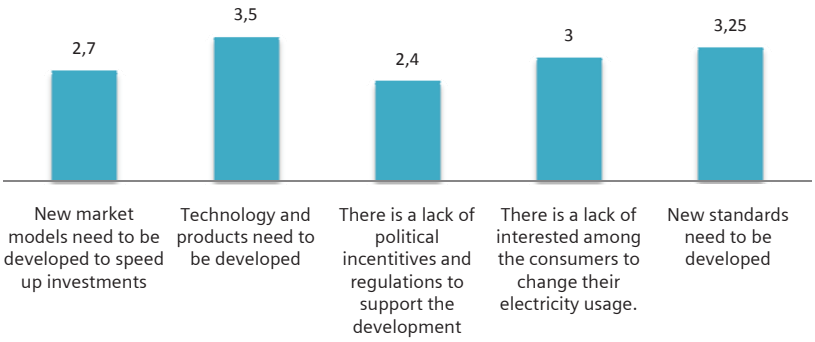
A strong majority of the participants saw the smart grid development as an evolutionary process rather than revolutionary. This indicates that most people in the business are aware that smart grid development is already taking place and that the technology and market solutions necessary will keep developing in the future.

Q3. The benefits of a smarter grid are said to be numerous. Which ones do you consider more important? (Average)



The answer set to the question of benefits with a smart grid is spread evenly over the alternatives. The possibility to change the energy mix into more renewable sources and to change the vehicle fleet into electrical were the most popular alternatives but the other answers were also common. This indicates that it is hard to identify one specific smart grid driver that is more important than others. Most people seem to value the many advantages with a smart grid rather than a certain benefit.

Q4. Which do you believe to be the main bottlenecks in developing the Smart Grid? (Average)



On the question of bottlenecks in the smart grid development the answers were pretty evenly spread out but some patterns could be noted. The most popular answer indicated that it is a question of developing new technology and products rather than creating the necessary market models and getting the political regulations in place. This is surprising because the people asked all worked in the energy business and could be anticipated to have faith in the technology. By presenting the technology that is here today and show that existing solutions can be used in the smart grid development, this attitude might change.

4.1.4 Observation studies

The studies resulted in a number of qualitative observations. A short selection of observations is presented below and a full transcript of these observations can be found in the appendix (See Appendix VII - Qualitative Observation studies on page 98). After the observations, a KJ-analysis of the results from the qualitative studies follows. The quantitative study at Elfack is presented on a separate sheet in the appendix but analysed in this section.

Universeum, Göteborg, 2011-03-30

All the decoration, furniture, lighting and music etc. worked together and created a sense of a whole. This added to the experience. Enclosed environments around installations made it easier to focus on the exhibits. The “creepy” interior and framing of one of the installations created a lot of anticipation and excitement. It was very obvious that something scary was going to happen but it was not clear exactly what.

At one installation the user got to act as a reporter and record a weather forecast that was shown on a TV screen afterwards. This installation was very appreciated and engaging. It was fun to get to act as a famous person and then see the result on a TV screen. The users wanted to look and talk exactly like the real TV reporters which triggered competition and engagement.

Figure 4.2 Well thought through interior design and lighting at Universeum, Göteborg.

The Göteborg museum of Natural History, 2011-04-20

A huge model of the killer whale attracted interest from the visitors. Its big sculptural forms fascinated and were beautiful to look at. Big, macabre, scary, disgusting or in other ways bizarre exhibits fascinated, attracted attention and got a lot of viewing time. 3D-objects enhanced the spatial experience and gave depth to the exhibits. To see the animals in their context was interesting and added to the understanding. Putting an image or a painting behind an exhibit created a sense of depth which made you feel as if you were actually there yourself.

> *Interactive installations can be both spectacular and playful*
>
> *- Discussions at Visualisation Centre C*

Not many interactive displays were used, but at one place there was a shark the visitors could touch. Touching the sharkskin was interesting and the feel of the texture on your fingertips gave a more vivid experience.

An exhibit about smaller birds was perceived as very cluttered. They had jammed very many birds in the same cabinet which made it hard to focus on a single one. This was a shame since they were all very interesting and unique. It was hard to follow the "story" and focus on items if there is no clear "red thread".

Visualisation Centre C, Norrköping, 2011-04-28

From interacting with the installations and observing other visitors during the tour in the centre a number of observations were made. A selection of these is listed below and the full observation result is presented in the appendix (See Appendix VII - Qualitative Observation studies on page 98).

Lego city

This installation visualised the city of Norrköping in white Lego. By projecting different colours on houses, rivers and streets, different messages could be communicated. This enabled several "layers" of information in the same model which made it more space efficient.

Since the visitors recognized the city, they became more engaged in the exhibit and listened to the information presented by the guide more carefully. It would be interesting to use something similar with London in the Urban Sustainability Centre.

Not all messages that were communicated came across as intended. Different messages require different means of communication.

The food on the table

This was a multi touch table installation that showed what climate effect different types of food have. The user got information about the food by placing paper discs with illustrations, which represented a certain food type, on the table.

By combining the digital screen with physical objects the users got more involved in the interaction process. To have to physically pick up and place the paper disc on the table was intuitive and at the same time encouraged action from the user.

The exhibit was easy to understand and use for first time users and worked smoothly. Other types of objects could have been used instead of the paper discs, such as models of buildings or power plants etc.

Archaeology game

In this computer game the users were encouraged to dig for fossil. If the player managed to find three fossils before the time ran out, the player then got to answer some question about the animal, whose remains were found, and then earned a medal.

The game targeted children but highlighted the fact that playfulness and challenges can be a powerful tool when presenting information.

Visual Forum, 2011-05-03

The observation studies at Visual Forum resulted in notes on the different installations regarding the content, technology used, and its popularity. These results are listed in the appendix (See Appendix VII - Qualitative Observation studies on page 98) and summarised here.

Having a large or in other means prominent attractor helps to catch the attention of the visitors. By enclosing the installations with rollups or walls, the attention was kept for a longer period of time. The popularity of the installations increased when interactive exhibits were used. By letting the visitors test the technology themselves the interest in the product and company increased. Showing high-tech 3D technology and eye-catching movies also caught the visitors' attention and created interest. Showing 3D scanned virtual images of

a well know location created a feeling of familiarity and made the visitors curious of knowing more about the technology. Give-aways were appreciated by visitors and made many people stop at installations which otherwise had few things to attract attention with.

KJ-analysis of the qualitative observation study result

The results from the three qualitative observation studies were KJ-analysed and gathered into the categories listed below. For each category some conclusions are made and these conclusions are further developed in the Exhibition Design Strategies for Successful Communication document in the Final Concept section of this report.

Attract attention and create interest

An exhibition must first attract the attention of the visitor to get a chance to communicate messages. This can be done with an attractor that draws the attention of the user and focuses it on the topic of the exhibition.

Exhibition structure

To maintain the users' attention throughout an exhibition it is important to tell a story and the structure, and how the exhibition is organised needs to support this. The user should immediately get a clear picture of the topic of the exhibition, and an overview should be presented before detailed information.

Aesthetics and interior design

The aesthetical impression of an exhibition is important. It needs to work as a whole to create the right atmosphere, and at the same time all details need to match the rest of the exhibition to keep a harmonized experience.

Interactive experience

Using interactive objects and letting the user participate in a game or challenge increases the interest and creates emotions. Through interaction that appeals to all senses, the experience can be both more fun and engaging and at the same time more informative for the user.

Evoke emotions

One of the main objectives with the exhibition is to make the visitor feel the desired emotions to complement the information message.

Installation solutions

Information needs to be communicated in a way that facilitates learning and if objects and products are being presented, they should be placed in their context to make it easier for the user to relate to them.

Quantitative observation study at Elfack

The observations from the Elfack fair were summarized into a 13 by 16 matrix with the different companies/exhibits on the one axis and the different aspects that were observed on the other. Features like size, popularity, interactive objects, colour scheme, personnel, giveaways etc. (See Appendix VIII - Quantitative observation study on page 102) were studied. The different cells were then colour-coded with respect to the degree of impact it was considered to have on the exhibition's popularity.

Interpretation

The analysis shows that the following are very important features for a successful exhibition:

Installations that visitors can interact with (e.g. buttons, touch screens, heat cameras, actual products that you can touch and try) appeal to people's curiosity and attract people to the space. By combining this with a game or a challenge (e.g. arm wrestling, ball games, computer games etc.) it also appeals to the audience's playfulness and/or competitiveness which attract even more attention.

The exterior and interior design of the exhibit is an important communication tool. The first thing that the audience will see when approaching the exhibit is the attractor. If this is placed in a position for increased visibility and if it is designed in a way that generates emotions such as surprise and curiosity (impressive screens, appealing design) it will attract visitors. The next thing that the user will pay attention to is the overall design of the exhibit. If the colour scheme, surface finish, lighting, placement of the installations etc. harmonise with the company's brand and the content of the exhibition, the exhibition will be perceived as well thought through and thus interesting.

Some exhibits aspired to create environments that the user would recognise from other contexts (e.g. living room, beach bar, hard ware store). This playfully conflicting experience (e.g. having a sandy beach inside of a fair) creates surprise and interest and attracts people. By incorporating a calm café area into your exhibit you give the visitors the opportunity to escape the hysterical environment of the fair for a while and enjoy a cup of coffee or tea and a nice relaxing experience.

Other giveaways in the form of food were also extremely popular. The exhibits that offered e.g. hamburgers were constantly very crowded. A trade show involves a lot of walking and taking in new impressions which consumes quite a lot of energy and thus making the visitors

hungry and constantly on the lookout for free hot dogs, sandwiches, coffee, beer, wine etc.

Another very important ingredient of the exhibit is the personnel. Not only do they need to aesthetically match the rest of the exhibition but also provide service and knowledge to the visitors.

4.1.5 Market study

The results from a market study comparing four other smart grid exhibitions is shown below, followed by an analysis of the results.

The Magic Box

Initiator: The State Grid Corporation of China

Location: Shanghai World Expo

Time frame: May 1– October 31, 2010

Description: Fair exhibition. A metallic square building with a crystal cube embedded inside. The box is made up of 112 pieces of LED panels, 14.9 meters wide and 13.9 meters high.

Core messages: The movie told a four-minute story about comfortable future life made possible by intelligent power systems. Visitors experienced three stages; first "meet with" the electricity, "get to know" and further be "intensely linked" with electricity. From video screenings visitors could also learn how the State Grid meets electricity needs of a vast country like China.

Target Audience: Visitors of the Shanghai World Expo. The broad public.

Communication strategy: The visitors were invited to stand at the centre of a 20-meter-high cubic theatre with six screens covering the walls, ceiling and floor. These powerful audio and visual experiences aimed to give the visitors intense sensations like e.g. surfing in the sea and being engulfed by waves, or standing on a cliff and then dropping.

(http://en.expo2010.cn/c/en_qy_tpl_107.htm)

Grid IQ Experience Centre

Initiator: General Electric

Location: Atlanta, Georgia, US.

Time frame: Opened January 20, 2011.

Description: Interactive Experience Centre

Core messages: Present GE's company-wide commitment to solving customers' challenges in innovative ways with more efficient, reliable and sustainable energy solutions. Educate and inform about the global energy landscape and the GE technologies modernizing the electrical grid. Create understanding for smart grid solutions and their potential to change how power is generated, delivered and consumed. Showcasing how utilities, regulators and consumers can enact measures simultaneously to achieve a greater degree of energy efficiency.

Target Audience: Utilities, consumers, regulators and policy makers.

Communication strategy: iPad-guided tours that visitors can take. The centre also features in-depth technical demonstrations to help educate utility engineers.

(http://www.gepower.com/about/press/en/2011_press/012011.htm)

Siemens Smart grid tour

Initiator: Siemens U.S.

Location: Visiting a selection of U.S. states.

Time frame: April 22 to December 2, 2011.

Description: Road show consisting of a semi-spherical rigid construction picturing the earth.

Core messages: Siemens provide cutting-edge smart grid solutions which can help meet tomorrow's growing demand for power and bring smart generation and smart buildings a step closer. The tour also displays the latest in Smart Grid developments, standards, and industry trends, showcases unique solutions and presents previews of future innovations.

Target Audience: Industry and authority; utilities, governments, and technology and service providers.

Communication strategy: Spherically projected video. Interactive learning through educational sessions, networking with other leaders in the industry, consultation from industry experts and debates on the future of Smart Grid.

(http://www.smartgridtour.com/)

ABB Smart Grid Centre of Excellence

Initiator: ABB U.S.

Location: Raleigh, North Carolina, U.S.

Time frame: Opened September 22, 2010.

Description: Technology and demonstration centre devoted to smart grid development.

Core messages: The centre will include a testing and development laboratory, a verification centre to certify customer solutions before deployment and showcase ABB's smart grid technologies and collaborative partnerships.

Target Audience: Industry and public.

(http://www.smartgridexpo.jp/en/
About-INTL-SMART-GRID-EXPO/
About-INTL-SMART-GRID-EXPO/)

Analysis

The four different smart grid centres' similarities and differences where visualized in a market positioning matrix. The position along the x-axis denotes whether the target audience group is mainly the broad public or industrial actors. Each centres positioning on the y-axis indicates if the communication strategy chosen is experience or information centred. The matrix shows that the centres sponsored by Siemens, ABB and GE have chosen to mainly target industry and employ a more information centred approach to the communication strategy. *The Magic Box*, on the other hand, encompasses more experience oriented features and focuses on targeting the broad public. The upper right quadrant is quite empty indicating that there is a gap in the market for experience centred exhibitions that target industry.

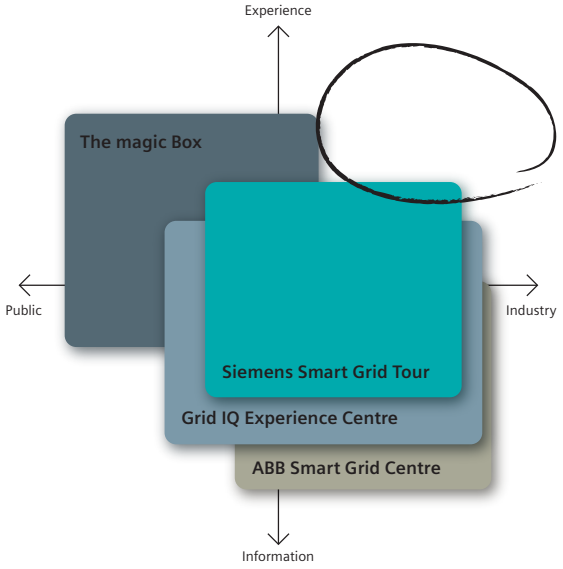


Figure 4.4 Market study matrix

Figure 4.3 Siemens Smart Grid Tour 2010

4.2 DATA ANALYSIS

The analysis part of the project resulted in an Exhibition Content Description that contains the actual information that needs to be communicated in the smart grid exhibition, a list of requirements on the temporary exhibition and the outdoor exhibit, and a communication strategy to be used in the exhibition.

4.2.1 Exhibition Content Description

The Exhibition Content Description is a sheet that explains the content information in the exhibition. It is described below and the complete version is presented in the appendix (See Appendix I - Exhibition Content Description on page 74). The content of the exhibition was divided into five parts; background, benefits and challenges, actors and markets, road to a smart grid, and cases and solutions.

Background

This works as an introduction to the topic of smart grid, gives a historical background, and presents the energy situation in the world today. The concept of smart grid is defined from a technology perspective as well as from what challenges that must be solved with the new electricity grid. The different drivers for smart grid development are presented and differences around the world are discussed.

Even though most visitors to the temporary exhibition will have a good knowledge of the topic, it is necessary to get a mutual understanding of what smart grid is according to Siemens and why it is being developed.

Benefits & Challenges

This part focuses on comparing the new smart grid with the existing electricity grid. The differences are presented in a BOCI-graph with Benefits/Challenges on the y-axis and Opportunities/Issues on the x-axis (See Appendix XI - BOCI Analysis on page 108). By representing new possibilities with a smart grid with a bubble in this graph, the complexity of the development is illustrated.

Actors & Markets

The idea of this part is to illustrate how and where different actors are involved in the development of a smart grid and how their roles can change. From new technology and market solutions, new actors may enter the energy market and new business opportunities will evolve.

The purpose is to induce discussions among the visitors by presenting their parts in the system and to have them interested in taking part of the smart grid development. One important message is: If you do not act today, others may come and take over.

Road to the Smart Grid

In this part the path towards a smart grid is discussed. What steps that are needed depend on the situation in the energy system today and the shape of the existing

BOCI

BOCI stands for Benefits, Opportunities, Challenges, and Issues and is a graphical representation of new conditions when developing new technology and products. The BOCI-analysis is similar to a SWOT-analysis but focuses on positive changes.

electricity grids. This differs a lot around the world and there are few general solutions that work everywhere.

The message is that all smart grid projects are unique and that Siemens have the capacity and knowledge to analyse the situation and provide the right solutions.

Cases & Solutions

This part presents smart grid projects Siemens has performed and contains information about what products Siemens can be provided. However, the content will have to be updated and complemented by Siemens when additional smart grid projects have been completed and new products developed.

4.2.2 List of requirements

By analysing the results from literature studies, studies at other exhibitions, seminars, interviews, etc., lists of requirements for the temporary exhibition concept as well as the outdoor exhibit was made. The different requirements were weighted against each other so that a prioritised list was constructed.

To elicit emotions in the exhibition, to inform about the topic, and to inform about Siemens' solutions related to the topic, are the three requirements that received the highest score on the list. Other important requirements are to tell a story, induce discussions, be innovative and at the same time keep the flexibility of the exhibition. Some of the requirements are related to each other, e.g. to provide interaction and induce discussions are good ways to engage the visitors, and telling a story is an important part of eliciting emotions. Some less important requirements are to facilitate maintenance and to make sure that the exhibition design fits in any Siemens building. The lower scored requirements are not prioritised in the concept development.

Temporary exhibition

Requirement	Weight
Elicit emotions	5
Inform about the topic	5
Present Siemens Solutions	5
Tell story	4
Induce discussions	4
Engage visitor	4
Be perceived as innovative	4
Maintain visitor's attention	4
Feasible design	3
Intuitive understanding for first time users	3
Facilitate content flexibility	3
Provide interaction	3
Allow mobility	3
Reliable operation	3
Relate information content to context	3
Catch attention	3
Express innovation/futurism	2
Adapt content	2
Allow flexible placement	2
Express Siemens core values	2
Relate design to context	2
Deepened functionalities for experienced users	1
Fit into Siemens facilities	1
Facilitate maintenance	1

Figure 4.6 Weighted list of requirements - Temporary exhibition

Outdoor exhibit

Requirement	Notes/Limits	Weight
Evoke interest	Around the USC and/or Smart Grid. Target audience: Broad Public. People walking by and/or driving by and/or flying over.	3
Withstand weather	Rain, snow, and storm proof.	2
Relate to context	Building, garden and other outdoor elements.	2
Withstand vandalism		1

Figure 4.5 Weighted list of requirements - Outdoor exhibit

4.2.3 Communication strategy

The communication strategy can be divided into three main pillars; the information content, the didactical method, and the media technology. The information content is presented in the Exhibition Content Description summarised above and the media technology and didactical method are described below.

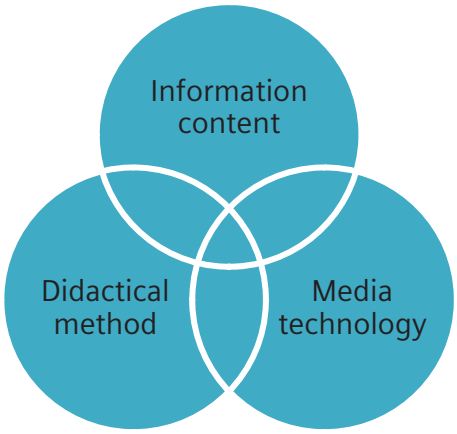


Figure 4.8 Model of communication strategy

Media technology

The media technology is the toolbox of input and output technology devices that are available when designing an exhibition. A mind map of different media technologies was constructed (See Appendix IX - Media Technology toolbox on page 104) to get an overview of the different technologies and devices that were considered in the exhibition design process.

Didactical method

From analysing the research results, a didactical method that discusses how to communicate a message in an exhibition was developed. The method divides the didactical process into five steps shown in the picture below. The ultimate goal with the exhibition is to induce action from the visitor, either by investing in Siemens products or by taking other initiatives related to the development presented in the exhibition. To inspire action the first thing that is needed is to attract the visitor's attention and make him/her interested in the topic. The next step is to get the visitor engaged in the exhibition and give him/her an experience. This experience will, if composed skilfully, elicit emotions within the visitor and these emotions will in turn lead to action. Throughout the exhibition the learning process must be supported by a story that is consistent and captivating.

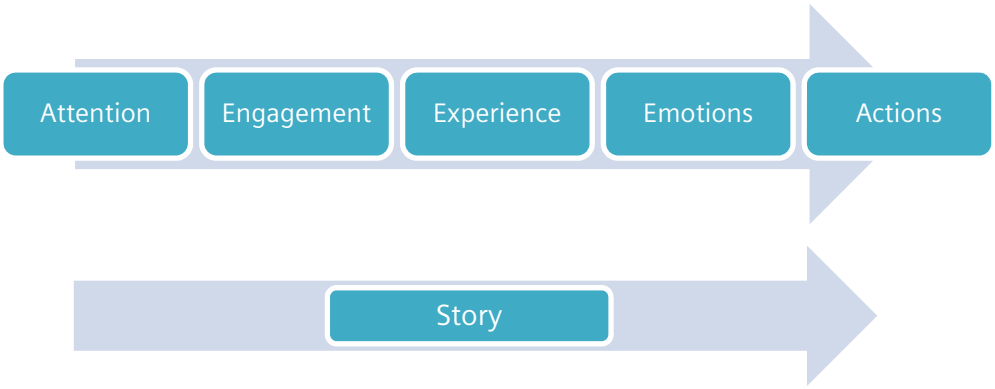


Figure 4.7 Didactical method for temporary exhibition

The exhibition design and content should also be created to elicit emotions according to a certain profile. The first thing the visitor should feel is interest in the topic and exhibits. After creating interest in the exhibition a feeling of importance should be communicated to maintain the visitor's attention. The next emotion to elicit is confidence so that the visitors will feel secure that Siemens can provide the necessary solutions to the important challenges presented in the exhibition. Finally, the visitor should feel excited to be a part of the development in order to end the exhibition with a positive and active emotion that can lead to the desired actions.

Figure 4.10 Emotional profile for temporary exhibition

Figure 4.9 Gaming experience at Frimley

4.3 IDEA GENERATION

The idea generation process resulted in three different concepts for the temporary exhibition on smart grid and four concepts for the outdoor exhibit. The concepts show the variety of ideas produced in the process, both regarding the general temporary exhibition platform and layout, as well as different ways of presenting the smart grid content. Refer to the Concept survey in the appendix for further descriptions of the initial concepts (See Appendix XIX - Concept survey on page 120).

4.3.1 Temporary exhibition concepts

The three initial concepts for the temporary exhibition on smart grid were called The Hub, The Tunnel, and The Mingling. The first two were two-story constructions with a set route for the visitors to follow around the exhibition. The layout consisted of a central hub construction with a room inside it and staircases leading to a second floor on top. These concepts were challenging conventional exhibition structures, while the third one used a more traditional layout with installations spread out on one floor, where the visitors can move around freely. In all three concepts a modular platform was used for projecting movies and images, and giving presentations. Another common feature was that the product and solution display was placed in a lounge area where the visitors could sit down, enjoy refreshments, and in a relaxed atmosphere learn more about what Siemens can offer. A concept for a smart grid challenge was also incorporated in all three exhibition concepts, but the other stations were designed differently so that as many ideas as possible could be included. The set route in the first two concepts allowed controlled storytelling throughout the exhibition.

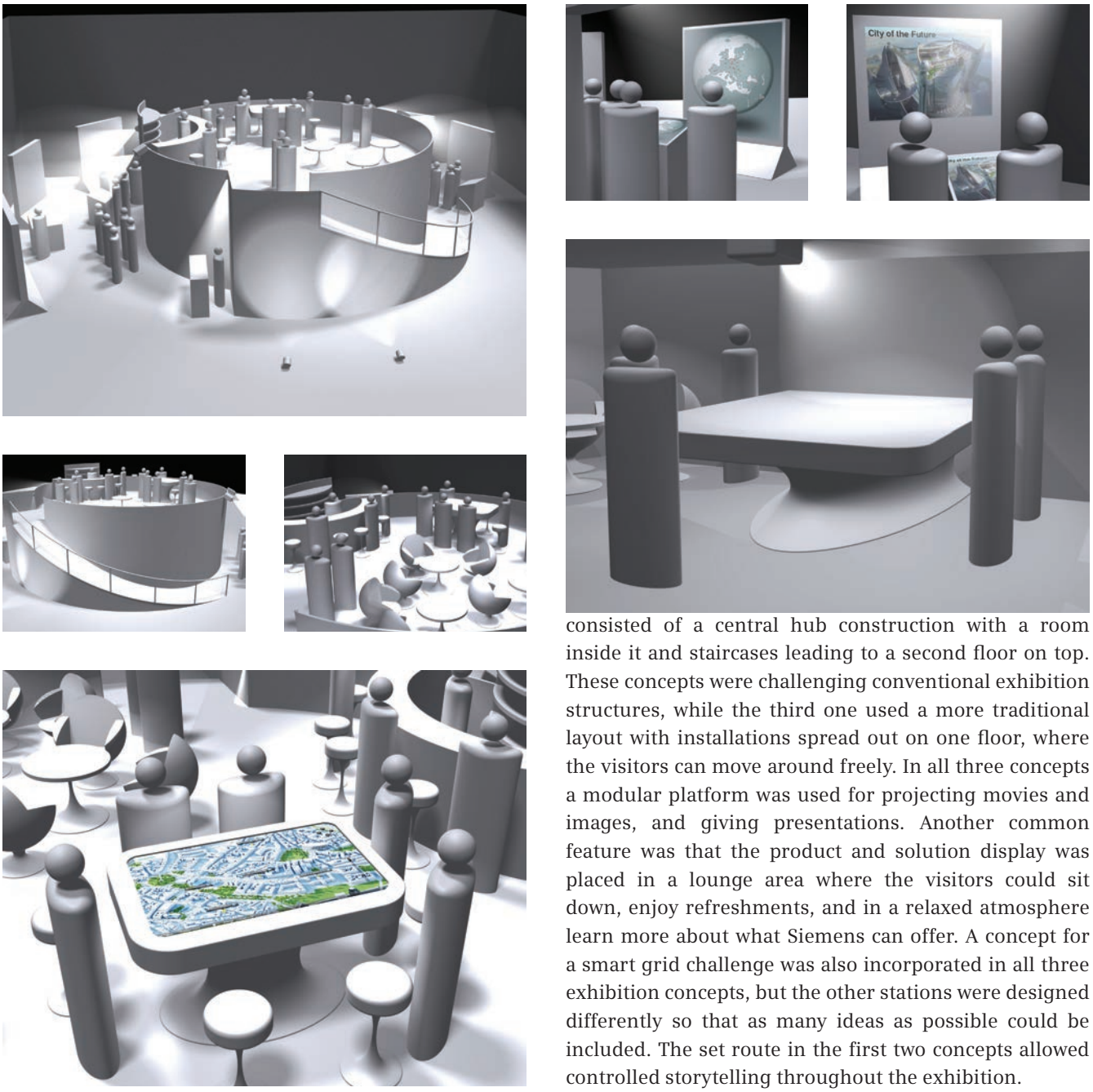
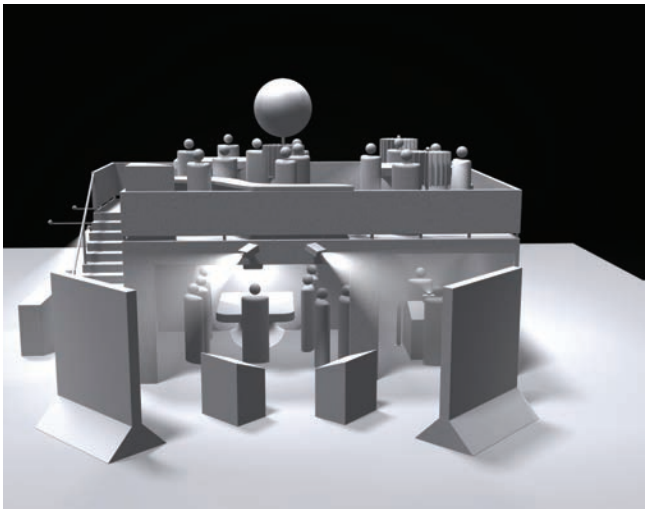
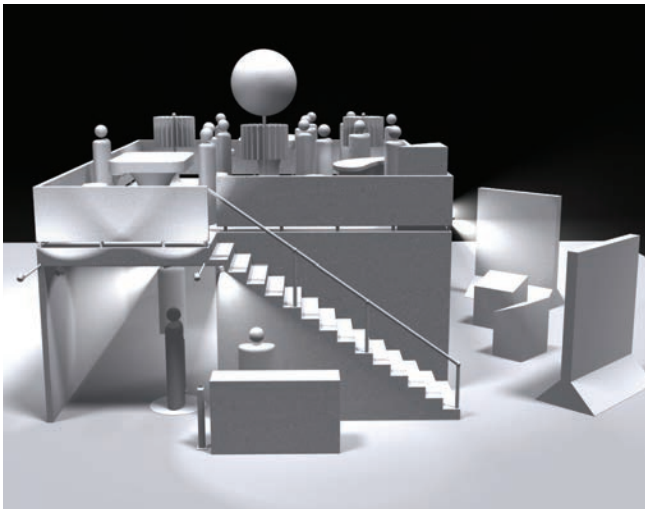


Figure 4.11 Concept 1 - The Hub





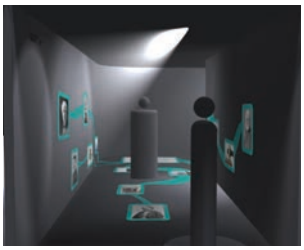
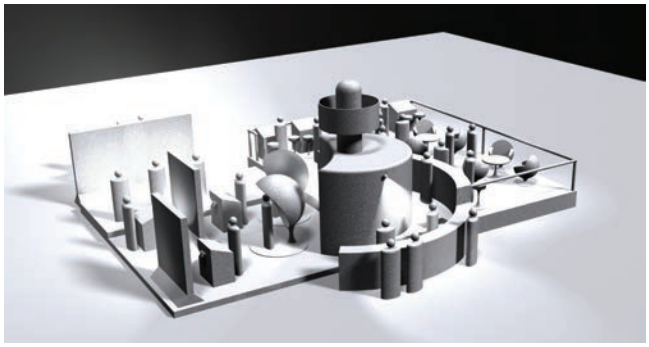
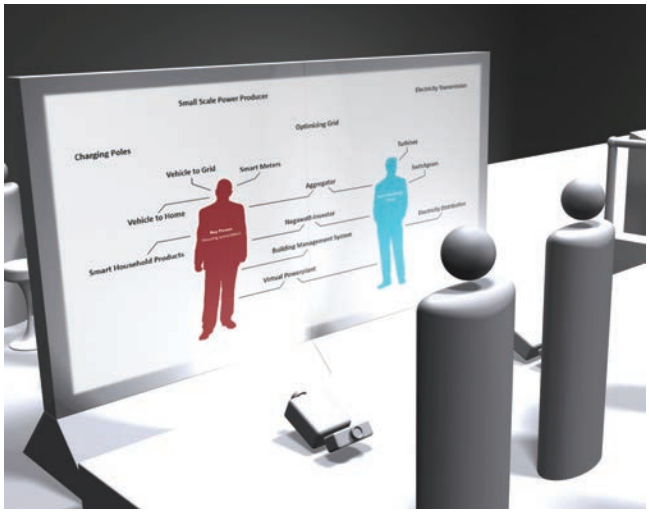


Figure 4.12 Concept 2 - The Tunnel





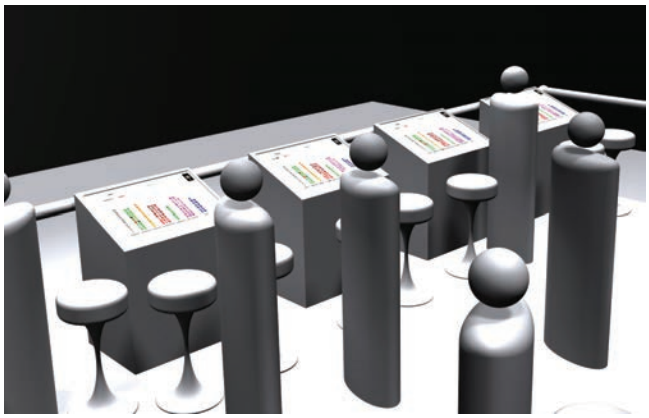


Figure 4.13 Concept 3 - The Mingling

4.3.2 Outdoor exhibit concepts

Since there were fewer requirements on the outdoor exhibit compared to the temporary exhibition, the concepts for the outdoor space varied a lot in design, technical solutions and in content. The concepts were called The Inverted Globe, Augmented Reality, Renewable Energy, and The Egg and are briefly described below. The Inverted Globe and The Egg worked well as attractors since they were large and eye-catching. The Renewable Energy concept made use of the water area next to the Urban Sustainability Centre and the Augmented Reality concept incorporated innovative technology which allowed futuristic virtual installations. By presenting concepts that are distinctively different from each other, a broad range of ideas could be incorporated, which generated interesting discussions on what features that were desired and feasible to develop.

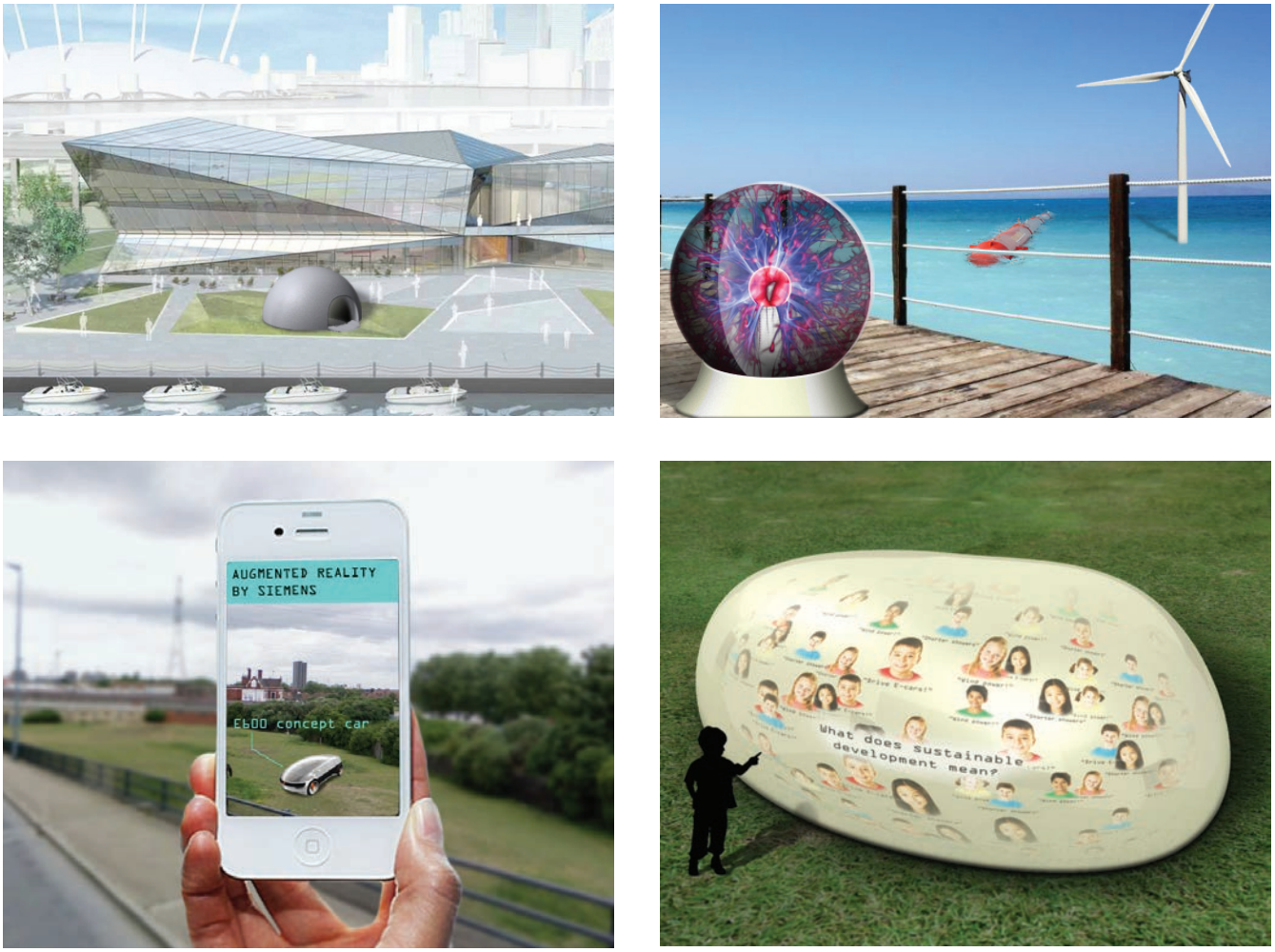


Figure 4.14 The initial four outdoor exhibit concepts

4.4 CONCEPT EVALUATION

The results of the concept presentation and survey are summarised in the table below. The complete answers to the survey can be found in the appendix (See Appendix XX - Concept survey Results on page 128).

Analysis of the feedback

It is important to consider all the feedback from the stakeholders so that as many important opinions as possible will be included in the final concepts. One clear trend in the feedback was that a two-story construction was not a feasible solution for the temporary exhibition concept since it would not fit into the building. However, the set route in The Hub

and The Tunnel was preferred over the free route in The Mingle. Another crucial feature of the temporary exhibition was to keep it flexible and continue developing the modular concept.

The concepts for the outdoor exhibits all received some good feedback and some negative opinions. A combination of the different concepts where all the appreciated features are merged into one concept was therefore suggested.

Modules & Lounge	A modular concept is good to ensure flexibility in the exhibition, which is very important. The relaxed lounge area is suitable for conversation.
Smart Pass	The idea of a smart pass is well received but the already existing RFID tags may be sufficient. Good for a high-tech company as Siemens.
Structure	A one storey concept is a must. The flexibility is important. "IKEA" concept with a set walking route and order of stations is good.
Station 1 – Smart Grid Introduction	The more simple, module based concepts with screens are popular. Back projected dome was not preferred. Tunnel concept different from Event's exhibition and would be remembered.
Station 2 - Actors and Markets	The game idea was very popular. The only concern is cost for development. It may be possible combine with the existing smart grid game and should be coordinated with the City of the Future to avoid overlap.
Station 3 - Cases and Solutions	The best combination would be to have an interactive table where people can gather and discuss and information can be brought home.
Outdoor concepts	Using the water is interesting but concept 3 (Renewable Energy) is not fully thought through. Augmented reality is innovative but could be combined with a physical attractor. Vandalism is an important issue to consider.

Figure 4.15 Table of stakeholder feedback on initial concepts

AUGMENTED REALITY

Augmented reality is a term for a live direct or indirect view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or other data. The technology can thus combines real world scenery with virtual images and let the user see virtual projections through e.g. a smart phone camera or other technical equipment.

5. FINAL RESULT

The final concepts for the temporary exhibition platform, the exhibition on smart grid, and the outdoor exhibit are presented in this section with written descriptions and visualisations.

5.1 TEMPORARY EXHIBITION PLATFORM

The concept for the temporary exhibition platform contains a suggestion on location in the centre, a modular concept for flexible exhibition layout, and a check-in station. This platform is general and can be used for other exhibitions on different topics in the Urban Sustainability Centre. The concept for the Smart Grid exhibition, which is an example on how to use the temporary exhibition platform, can be found in a later section (See 5.3 Smart grid exhibition on page 53).

5.1.1 Placement in the Urban Sustainability Centre

The preferred placement of the temporary exhibition is the office space and breakout area on the first floor. However, the structure is flexible and can be fitted into other possible placements as well. There are several reasons why the first floor is suitable for hosting the temporary exhibition. Firstly there is a reception desk already planned on the first floor, which can be used to welcome the visitors who will feel special and selected when going to a floor separate from the permanent exhibition. Secondly there will be more office space on the second floor, and just a small part of the total office space would be used for the temporary exhibition. The room on the first floor will also be large enough to fit an exhibition. Thirdly the breakout space can work as a lounge area where Siemens solutions can be presented in a relaxed atmosphere easily accessible from other part of the exhibition.

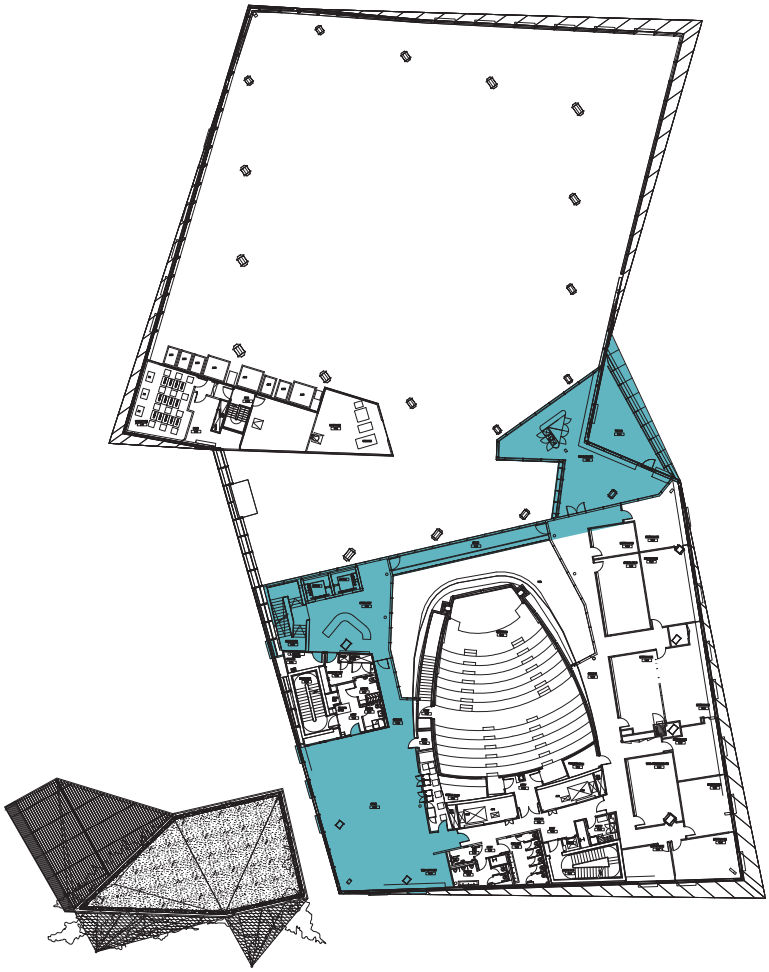


Figure 5.1 Urban Sustainability Centre - Location for temporary exhibition

5.1.2 Modular concept

The flexibility of the exhibition is achieved by using a general structure based on modules throughout the whole exhibition. Four different modules have been developed and are described below. All modules have a clean design with white high-quality plastic finish without any unnecessary objects or writings. This design communicates excellence which is one of Siemens' core values.

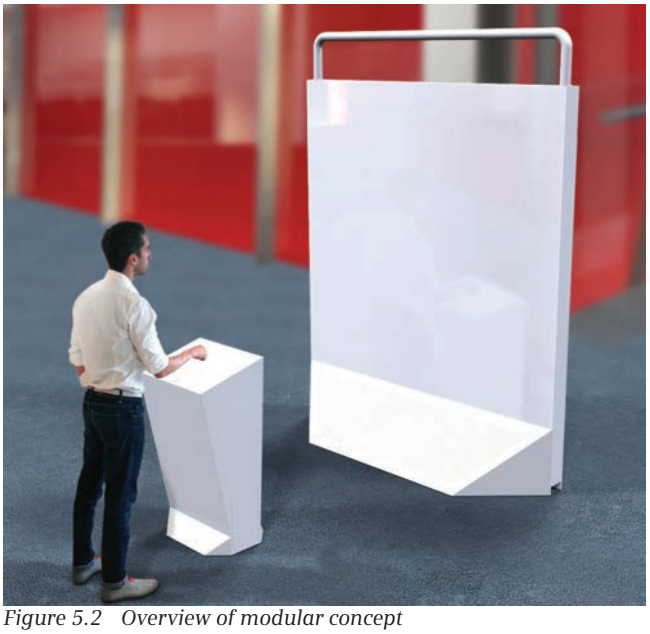


Figure 5.2 Overview of modular concept

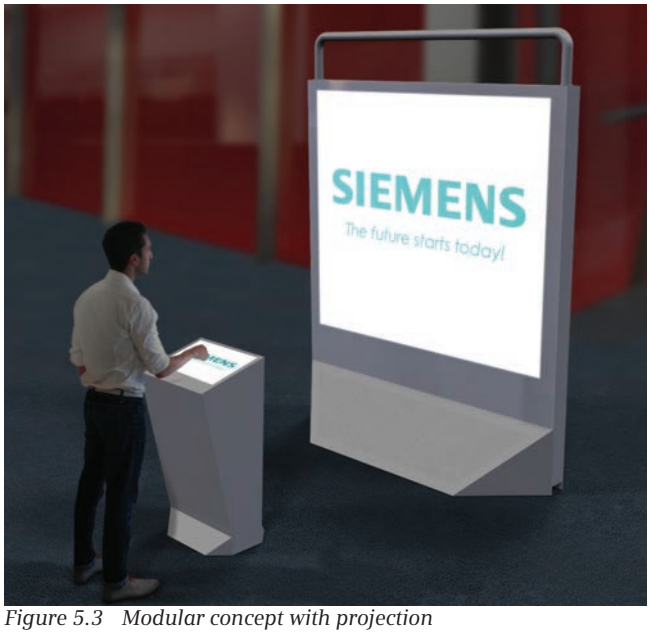


Figure 5.3 Modular concept with projection

Screen module

The screen module consists of a large white screen mounted on a stable base module. The screen is suitable to project pictures and movies on, and the base module contains speakers which enables both visual and audible experiences. Both the screen and base are easily movable and stackable to assure flexibility in the exhibition. The exhibition structure can be adapted to the content and the screen modules can stand on their own, on a row, or in a corner formation. On top of the screen there is a rack that can be used to hold projectors for projecting images in any direction. To increase the experience further, 3D projectors can be used instead of regular 2D projectors. The height of the screen module is adapted to the suggested location in the centre which enables enclosed room-like or tunnel-like constructions solely by placing the modules in certain ways.

Figure 5.4 Screen module - exploded view

Figure 5.5 Base module placed in storage box

Figure 5.6 Modular concept - Corner brace enables flexible placement

Figure 5.7 Wheels underneath screen module and racks on top.

Control module

The control module consists of a computer with a touch screen that controls the images and sound effects on the screen modules. The image shown on the touch screen is the same as the one projected onto the screen module and the control modules can be moderated either by the visitors or by Siemens personnel on site. Since only digital projections are used to display images and movies, the exhibition concept becomes very flexible in the terms of content. Whenever the content changes or is updated the computer can be reprogrammed to show the new content on the control module and on the screen modules.

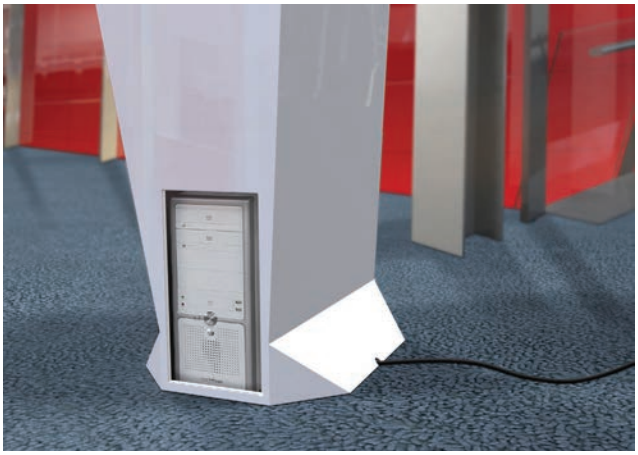


Figure 5.8 Control module with hidden computer inside

Figure 5.10 Projector mounted on screen rack

Figure 5.9 Speakers fitted into the base module. Cables are completely hidden underneath.

Game module

The game module (See Figure 5.16 SimGrid Challenge on page 57) consists of a large multi-touch screen table with object recognition technology. Around this module four to six visitors can gather around and together with Siemens personnel discuss interesting topics. The module is suitable to use when incorporating a game or other type of challenge in the exhibition. The table becomes a meeting platform where visitors sit down and interact with the challenge and with each other. From this interaction the users will get a better understanding of complex topics, meet other actors in their field of technology, and learn from each other.

Solutions display module

The solution display module (See Figure 5.19 Breakout space setting with solution display module on page 60) is similar to the game module but with a smaller table with a multi-touch screen without object recognition technology. One to four people can gather around the module at the same time and it can be controlled by either the visitors, Siemens personnel, or both at the same time. By placing the solution display modules in the breakout-space, the table becomes another gathering place where the visitors can meet and discuss Siemens' case studies and solutions in a relaxed environment. By using digital screens for product display, the exhibition becomes more flexible since only software updates are necessary when changing the topic of the temporary exhibition. The solution display screens can use 3D technology to increase the experience when showcasing products.

Part of the concept for showcasing case studies and solutions are the case and product templates which have been developed in this project. The templates enable Siemens to present cases and solutions in a coherent way which makes it easier for the user to find the desired information. By linking the case and solution templates to each other, the user can chose to either look into solutions directly or looking at interesting case studies and through them finding the related products.

5.1.3 Check-in desk

When arriving at the first floor, either by the staircase or by the lifts, the visitors are welcomed at the reception desk by Siemens personnel. Each person is asked to register their RFID-tag in a scanner and the receptionist helps them to create a personal Siemens account. This account is used to store interesting information throughout the exhibition and will be accessible afterwards through a webpage. After registering, the visitors have their picture taken and then receive a Smart-CARD containing their photo and information about how to reach their personal Siemens account on the internet. When logging in at the different stations by wiping their RFID-tags over the scanners, a digital version of the personal Smart-CARD together with the photo of

Figure 5.11 Smart-CARD

RFID

Radio Frequency Identification is a communication technology that uses small electronic tags which sends radio signals that are readable a short distance from the tag. This enables touch free reading similar to barcodes but by using radio signals instead of visible light the code is invisible (RFID Systems, 2011). RFID-tags are planned to be given to visitors in the Urban Sustainability Centre for quick identification when using installations.

the person, an avatar, appears on the screen. Interesting information is then stored to the personal Siemens account by draging it to the avatar.

The Smart-CARD concept creates a feeling of exclusiveness and recognition which enhances the experience that Siemens is a high-tech company and a reliable partner. The Smart-CARD also works as a giveaway which will remind the visitor of the exhibition at a later stage.

5.2 EXHIBITION DESIGN STRATEGIES FOR SUCCESSFUL COMMUNICATION

This document is developed from the analyses of the different literature, user, and observation studies in this project. The conclusions emphasise general aspects of exhibition design rather than presenting a concrete instruction manual and they can be considered as guidelines when designing similar exhibitions.

The document is divided into general exhibition guidelines and design strategies.

5.2.1 General exhibition guidelines

These recommendations should be considered before the actual design of the exhibition begins.

Purpose of the exhibition

The first thing to consider when making an exhibition is what the purpose with the exhibition is. If the purpose is to only inform about a certain topic or if the reason for making the exhibition is to showcase and sell products or services, the approach will be different.

Target user group

Similar to defining the purpose of the exhibition, who the target group is needs to be considered. The exhibition may target mostly children and families, or perhaps the target group is professionals from the industry. The target group significantly influences the message and on what level the information should be presented. Also the interior design and aesthetical expression should be adapted to the visitors, e.g. using more colours and playful sounds to attract children's interest and more clean design to appeal to professionals and adults.

Information content

After defining the user group the actual content of the exhibition can be decided together with the messages that need to be communicated. The information content should support the messages and the story of the exhibition and thus follow a line of argument. The information can be presented in layers so that the content is adaptable to different visitors with different background. It is important to make the information easily accessible with the option to go deeper into topics that are of greater interest to the different users.

Context

An exhibition is never fully isolated and the surroundings are often important to consider. The amount of available space limits the size of the exhibition and the type of context put different requirements on it. If the exhibition is one out of many at a fair and needs to stand out from the rest to catch attention, the ability to attract visitor and create interest is of high importance. If on the other hand the exhibition is to be placed in a certain building and rather needs to fit it, the focus will be on other parts e.g. the interior design.

Time frame and budget

The last of the general things to consider before start looking into the design strategies is what the time frame and for the exhibition is and how much money can be spent on it. If the exhibition is temporary the construction should be simpler to allow quick assembly and easy mobility. If the content of the exhibition will change but the structure will remain the whole exhibition needs to be flexible to allow updating. The time frame before the exhibition needs to be finished also puts limitations on the size and complexity of the installations. The budget is naturally very important to consider throughout the design process, as in all projects. The cost will depend on many things e.g. the rent, technical equipment, technology and software development, furniture and interior design, and people working with the exhibition during development and during the time it is in place.

5.2.2 Design strategies

These strategies are mainly collected from a KJ-analysis on the observation studies performed in this project. The strategies are divided into six different subjects according

to the KJ-analysis and cover both structural and technical issues as well as visitors' impact.

Attract attention and create interest

An exhibition must first attract the attention of the visitor to get a chance to communicate messages. This can be done with an attractor that draws the attention of the user and focuses it on the topic of the exhibition. By building the exhibit around a central attractor you will gain attention from a distance. The attractor also functions as a "heading" of what the content of the exhibition is about.

Very large objects and installations can more easily attract attention than smaller ones but the attractor should also be somehow fascinating to create interest. Scary, beautiful, impressive, disgusting, spectacular, or in other ways bizarre exhibits can fascinate the viewer. It is also good to add a level of surprise and anticipation into an exhibition to make the user more interested and excited. By using recognition, e.g. letting the visitor see his/her own face, company logo, or city, the visitor's attention and engagement is put to an even higher level.

Exhibition structure

To maintain the users' attention throughout an exhibition it is important to tell a story and the structure, and how the exhibition is organised needs to support this story. The user should get a clear picture of what the exhibition is about from the start and get an overview before detailed information is presented. There must also be a good balance in the amount of exhibition objects and a clear thought behind the location of the objects and installations so that the user can easily follow the story.

By having a structure with a clear entrance the visitors will feel special and important. Food or giveaways can also be used to make the visitor feel pampered or selected. Food also helps preventing fatigue and giveaways function as memorabilia.

Aesthetics and interior design

The aesthetical impression in an exhibition is important and it needs to express the content of the exhibition. It should work as a whole to create the right atmosphere, and at the same time all details need to match the rest of the exhibition to keep a harmonized experience. This should be considered when choosing colour scheme, surfaces, finish, and fonts etc.

If all parts of the interior work together, such as decoration, furniture, lighting and music, the right mood can be created which enhances the experience for the user. It is also possible to create the desired emotions from setting the atmosphere and context for the actual content and messages presented in the exhibition.

Interactive experience

Using interactive objects and letting the user participate in a game or challenge creates interest and elicit emotions. Through interaction that appeals to all senses the experience can be both more fun and engaging and at the same time more informative for the user. A combination of visual, haptic and audible stimuli in an interactive exhibit works well to engage the user and if the game aspect is included as well the installation becomes even more captivating. Games or challenges appeal to the audience's playfulness and competitiveness which attract attention and focus with the user.

Crucial for all interactive elements is that it needs to be operable without any technical or usability problems. If the technology does not work flawlessly, or it is unclear for the user how to interact with the exhibit, the user will feel frustration, disappointment or even anger. Service minded, helpful, and skilled personnel who can assist helps out.

Evoke emotions

One of the main objectives with the exhibition is to make the visitor feel something for the message to get through. The exhibition should give the audience a comprehensive experience. Visual, audible, and haptic stimuli should work together to elicit desired emotions. Even some "bad" feelings, such as disgust and fear, can increase the level of interest from the user. However, if the exhibition makes the user feel sad or guilty, he/she will probably just try to shake it off. The key is to evoke the right type of emotion and at the right moment.

Installation solutions

Besides having a clear structure and consistent design of the exhibition as a whole, the individual installations also need to be considered. To get the users' full attention it can be good to somehow screen off the installation from the surroundings and thus decreasing disturbances from the outside. This can be achieved by putting up walls or a roof around the exhibit.

The information needs to be communicated in a way that facilitates learning. Written information should be kept to a minimum and always be supported with pictures or other means of communication. By using projections or interactive screens, many layers of information can be presented on a smaller area.

If objects and products are being presented, they should be placed in their context to make it easier for the user to relate to them. It is also nice to use physical objects or 3D technology to enhanced the spatial experience and give depth to the exhibits. This will further facilitate the communication to the user who will feel more as a part of the exhibit and thus more participating. Another way to get the user more involved is to use familiar environments. By recognising a face or a city, the user will be able to relate to the exhibit and become more interested in the message.

5.3 SMART GRID EXHIBITION

The concept for the temporary exhibition on smart grid is divided into four stations representing the background, benefits & challenges, actors & markets, and cases & solutions in the Exhibition Content Description (See Appendix I - Exhibition Content Description on page 74). These stations are presented in detail below after the suggested exhibition structure and route are described.

5.3.1 Exhibition structure and route

The modules are placed in a certain way to create the feeling of several rooms in the exhibition. Siemens personnel guide the visitors through the exhibition and they walk a certain path. By having a set route, it is easier to tell a story throughout the exhibition to elicit emotions and to give the visitors a better experience.

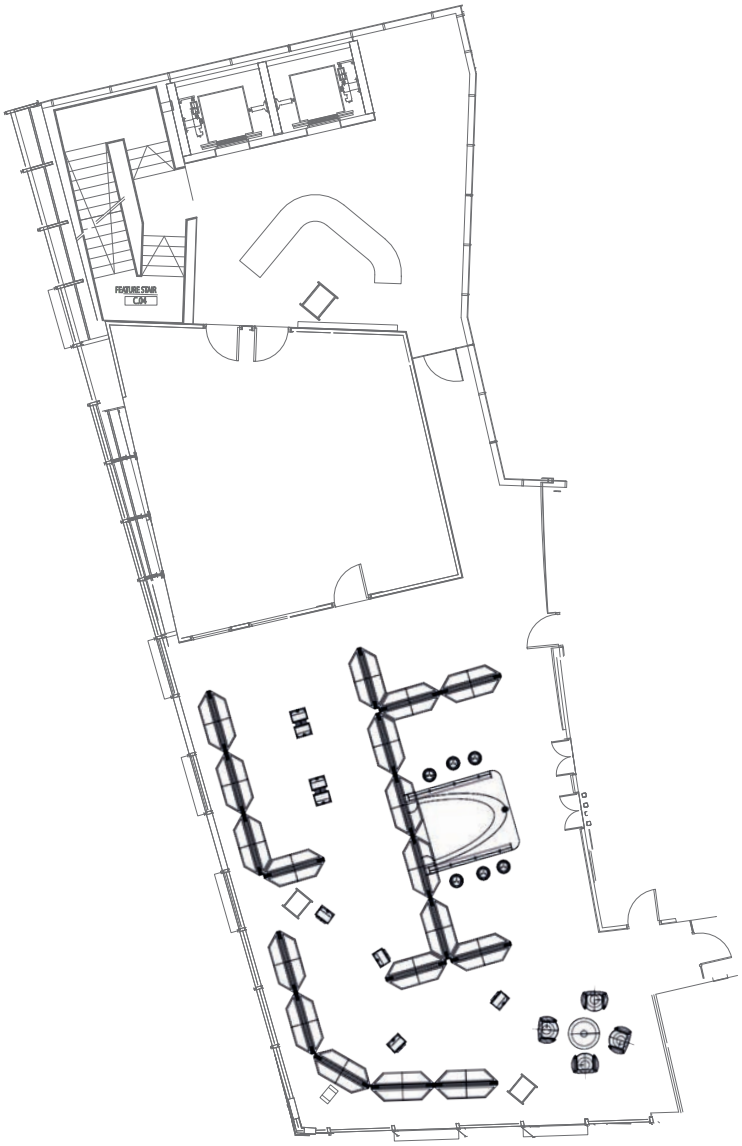


Figure 5.12 USC first floor office space - Exhibition layout

Figure 5.13 Station 1 - Smart grid background

5.3.2 Station 1 – Smart grid background

The introduction to the smart is presented on two screen modules at the start of the exhibition. A guide gives the presentation to a group of about 4-12 visitors at the same time. The presentation starts with the guide presenting the energy situation today. The message is that the global trends today are growing populations and higher demand for energy worldwide. At the same time, the world's energy mix needs to change from fossil to renewable sources, which puts a lot of pressure on the electricity grid. The need for a secure electricity supply, efficient use of energy, and a transition towards sustainable energy systems are the most important drivers for the smart grid. These drivers are introduced and the concept is described to make sure that the visitors all have the same basic level of understanding.

5.3.3 Station 2 – Historical timeline and definition

After the introducing presentation the group walks into the tunnel-like part of the exhibition. In the tunnel the group stops to watch a timeline-movie where a voice tells the story about how smart grid technology has evolved, from an historical perspective. The timeline consists of four different branches that each begins with a scientist that represents a certain technological development. These are Edison with his DC-technology and his branch emerges with the branch that starts with Tesla who developed AC-technology. On the other side there is a branch representing communication technology that starts with Bell and Siemens. This branch will emerge with the other side's branch and this meeting represents present time when smart grid technology links communication and electricity together. This timeline gives a historical perspective on smart grid development and compare Werner von Siemens with other scientific giants and thereby emphasizes Siemens's excellence.

After the historical introduction the visitors spread out in the tunnel and use individual interactive stations. The first module inside the tunnel has a set of electronic kitchen magnets with different words. These words can be used to form sentences and the visitors are encouraged to write their own definition of the smart grid concept in one sentence. These sentences are projected on the walls and ceiling of the tunnel and shown to visitors that come after. Through writing their definitions, the visitors are able to influence the exhibition and will start thinking about what a smart grid is and how it can be defined in different ways.

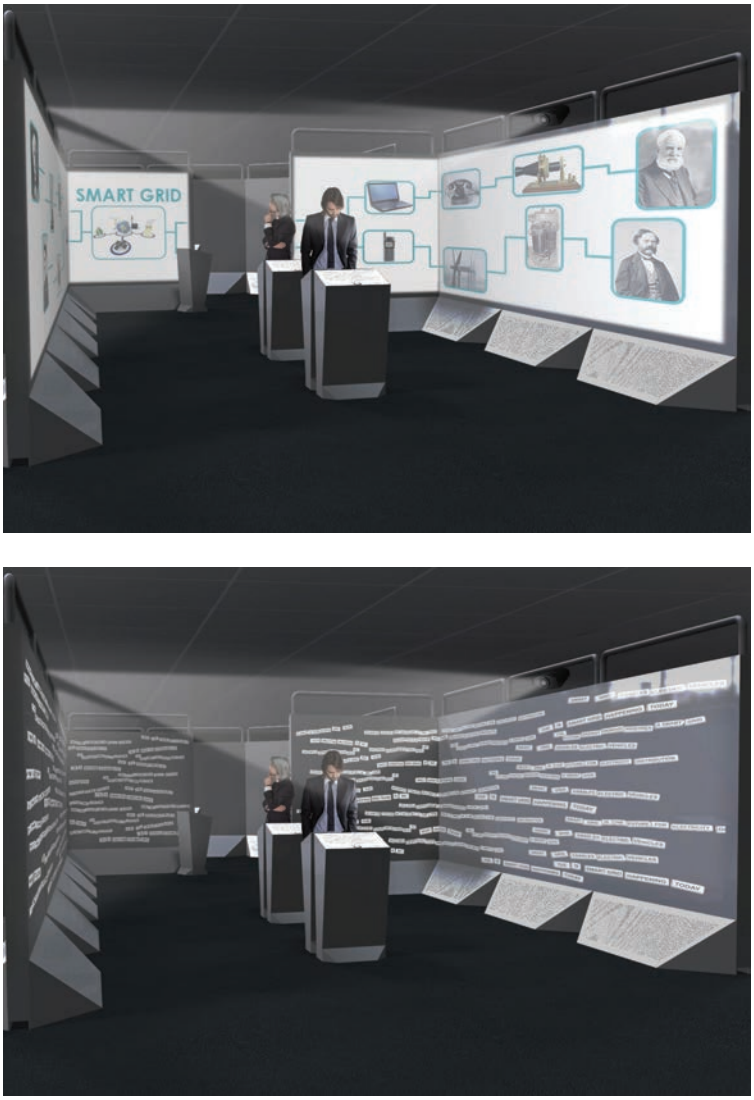


Figure 5.14 Station 2 - Timeline and smart grid definition

Figure 5.15 Station 3 - BOCI analysis

5.3.4 Station 3 – Benefits and challenges

The visitors continue in the tunnel into the next room to try out a new set of interactive control modules. These have three different content parts that compares today's electricity grid with the future smart grid.

One shows a graphical representation of the benefits, opportunities, challenges and issues (BOCI) with a smart grid. Each topic in the graph contains three layers of information and the user can touch a topic on the control module to reach the next layer or go back one layer. The BOCI-analysis mainly consists of benefits and opportunities and the challenges will be presented together with suggested solutions to increase the credibility of the exhibition.

The second possible use of the interactive modules presents films showing visions of possible future scenarios. In one film the whole world is connected with super grids that transport clean electricity (produced by e.g. solar power in desert areas) around the globe. A second film shows a decentralised future where local energy sources (e.g. from solar photovoltaic on rooftops) together with local storage capacity can supply electricity to self sufficient micro grids. These films give a promising picture of the future and a good feeling of anticipation.

Thirdly the user gets to participate by making own estimations of future population, energy need, and energy mix. For each set of estimations a future scenario is presented with movie cuts and supporting numbers and figures of new investments needed in the electricity grid. From all reasonable estimations the smart grid will be a necessity to all future scenarios and by letting the user participate, this conclusion becomes more trustworthy. The result is stored at the personal exhibition account and can also be compared to other user's results.

5.3.5 Station 4 – Actors and Markets, the SimGrid challenge

After the tunnel, the group gathers again to attend a round of SimGrid together with the guide as a moderator. SimGrid is a simulation game that combines digital screens with physical objects. The game module is a multi touch table with object recognition where the players can put models of different smart grid components. The mission is to construct a balanced energy system and a grid that can supply a city with electricity in a clean, reliable and efficient way.

Figure 5.16 SimGrid Challenge

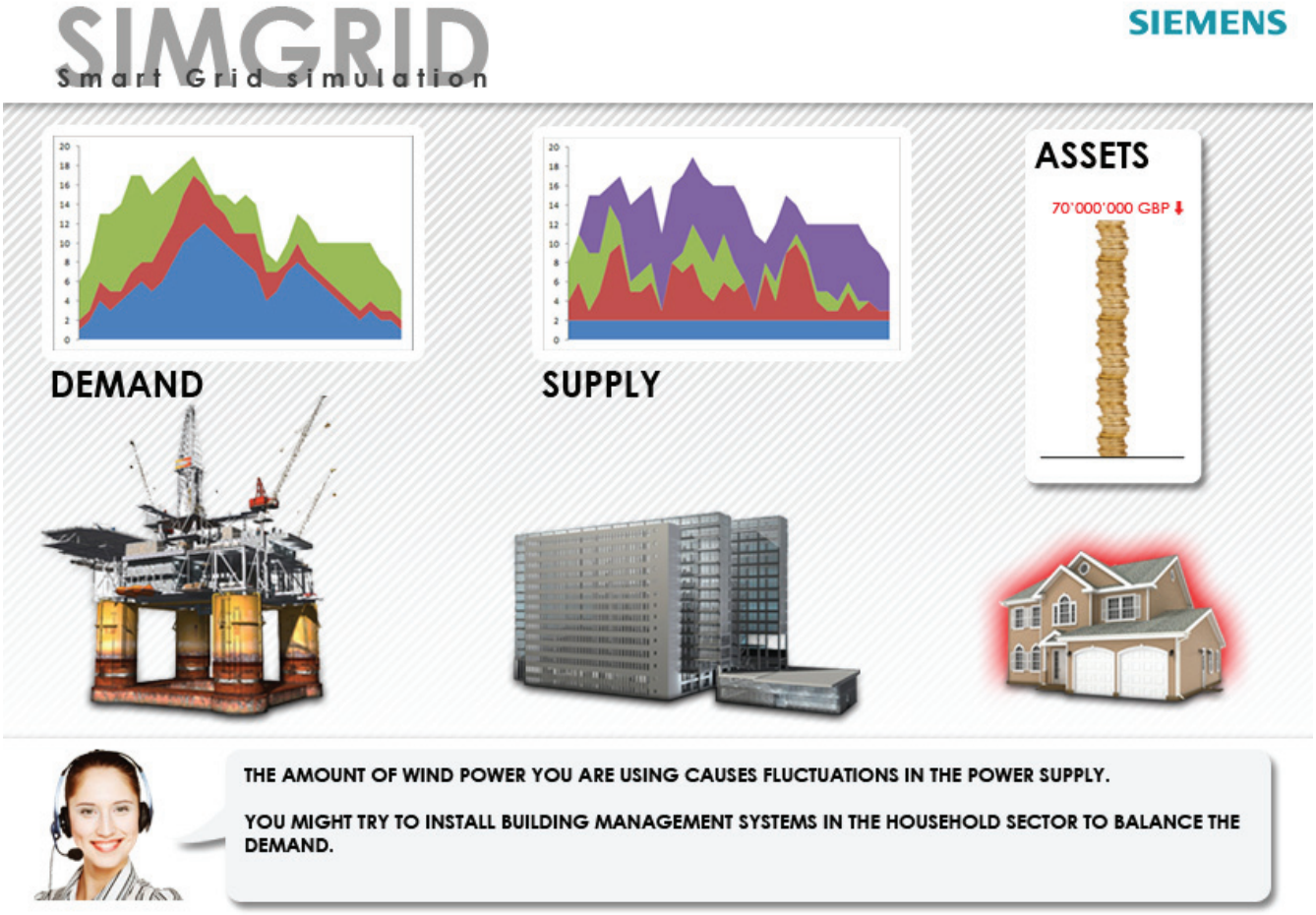


Figure 5.17 SimGrid - Screen view

Purpose of the game

The first purpose with SimGrid is to give the players a deeper understanding of how a smart grid is constructed and what the challenges are. Most visitors have a good knowledge about smart grid prior to the visit, but by having a real time experience of taking part in building one, they reach a new level of understanding.

Secondly, the users are able to take the role as another actor in the smart grid field than what they normally represent. This give them a better understanding of who the actors are, what their roles are, what challenges they face, and how different actors need to work together to enable the future smart grid.

Finally, the simulation game work as a meeting platform for different visitors to the exhibition. It is a game for four to six players who work together towards a common goal and therefore require cooperation between the visitors. The moderator can raise interesting questions that will induce discussion around the table.

Questions that may come up and be discussed during the simulation are:

-What is needed to build an electricity system?

-What are the main differences between the electricity grid today and the smart grid?

-What actors are involved and how should they co-operate to build the smart grid?

-How can a balanced situation between electricity supply and demand be managed?

-How does a demand response system work and why is it a crucial part for keeping balance in the grid?

Initial situation and game idea

On the game module there is a digital landscape with models of houses, industries, and office buildings on fixed positions from the start of the simulation. On the screen on the wall the status of the city's households, industries, and commercial buildings are shown, as well as the electricity supply and demand curves, and the money assets of the city. As long as the industries are producing and the households and offices are running without blackouts, the monetary assets will grow.

The initial situation is a stable city where the electricity supply is kept high to meet the demand peaks. The game starts with a movie on the screen showing that the city's energy supply is changing when the nearby coal-fired power plant is suddenly shut down. At the same time, more people are moving into the city which changes the demand for electricity in all three sectors. The players are given the challenge to adapt the electricity system to the new situation to make sure that the city's monetary assets are not running out.

The game moderator gives the rules and explains how the simulation works. Each player is in charge of some categories of products and has the possibility to put them on the table. Placing a model on the table means that the city is investing in this product which costs money. To cope with the changes in the energy situation the players have to co-operate to match the supply and demand curve without running out of money. All important parts of the electricity generation, transmission, distribution, and consumption must be in place and the players are only in charge of one category each. The products categories available will be those that Siemens has to offer in the smart grid field, e.g. wind turbines, HVDC cables, switch gears, smart meters, and building management systems.

Game flow

There are different game flows that can be used in the SimGrid. They can be divided into turn-based flows and chaos-based flows. In a turn-based flow, each player will have the option to either invest in a new product or to pass before it is the next player's turn. This type would probably be the best option if the users play against each other. In SimGrid however, the users play together towards a common goal which makes a chaos-based flow suitable. The players can choose to act whenever they want during the simulation time, but since co-operation is needed, the users will have to discuss the moves with each other. One option is to have short simulation intervals where the players can act and then have a break where the game moderator can address interesting questions that have come up before the simulation starts again.

Figure 5.18 SimGrid - Close-up

5.3.6 Station 5 – Cases and solutions

When the visitors have attended the round of SimGrid, the first part of the exhibition is finished and the group moves on towards the breakout space. In this area, there is a bar serving refreshments to the visitors who can settle down at the bar or in a comfortable chair around a coffee table. The relaxed atmosphere is well suited for presenting Siemens cases and products in the smart grid field, and this is done at the four solution display tables that are placed in the breakout space. Siemens personnel are present to help the visitors use the screens and to answer questions regarding Siemens smart grid solutions.

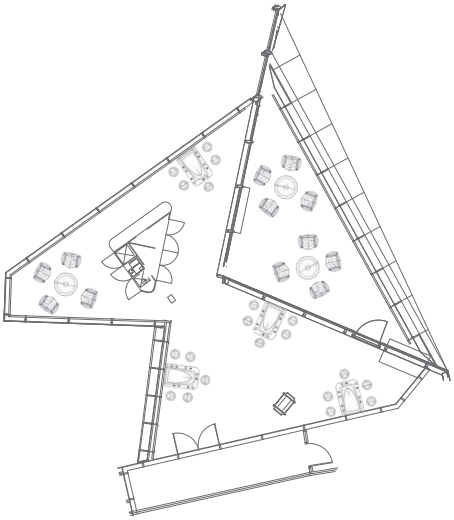


Figure 5.20 Breakout space - Exhibition layout

Figure 5.19 Breakout space setting with solution display module

The screens present either cases or products and organise them in different ways to make the information as accessible as possible. The user chooses to look at cases or solutions but they are also linked to each other.

When choosing to see cases the earth will appear on the screen with small dots representing Siemens presence around the world. The user can spin the globe around a vertical axis and touch any dot to get information about the different case studies. The visual information will be complemented with sound effects when the globe spins and when one location is zoomed in etc. By showing that Siemens has worked with smart grid projects around the world the visitors will feel that Siemens is the world leading company and the best partner in the smart grid field. The user can also choose to see the cases represented by icons and categorised according to geographical location, field of business, size of project, or alphabetically. Whenever the user sees something of interest the current page can be swept to the avatar on the screen to store the information on the user's personal Siemens account.

If choosing to look at products and solutions Siemens virtual city is shown with the smart grid products categorised according to technology and type of business. By using existing software the product presentation is easy to construct and update and the visitors recognise the specific Siemens environment. Similarly to the case presentation more information about each product is accessible by clicking on the screen and information of interest can be stored to the Siemens account. The products can also be shown as icons and organised in categories to get a good overview of Siemens smart grid portfolio.

Both cases and solutions are presented on the case and product templates that can be used for any type of technology and therefore in other temporary exhibitions. This makes the installation flexible and the content can easily be updated, which is necessary for a developing field of technology such as smart grid.

Figure 5.21 Solution display module with cases displayed on globe

Figure 5.22 Solution display module with Virtual City software

Figure 5.23 Icons representing cases and products

5.4 OUTDOOR EXHIBIT

The outdoor exhibit relates to smart grid and the temporary exhibition, but also to sustainable technology in general, and the content is flexible so that it can be adapted to other topics.

5.4.1 Outdoor requirements

Since the outdoor area is available for the public there are other requirements for an outdoor exhibit than for the temporary exhibition inside. It must be weather and vandal proof and should address all visitors, unlike the specific target audience for the temporary exhibition. A solution to the vandalism problem is to make use of the water around the centre and place the installation off shore. This way no one can reach it and it is thereby protected.

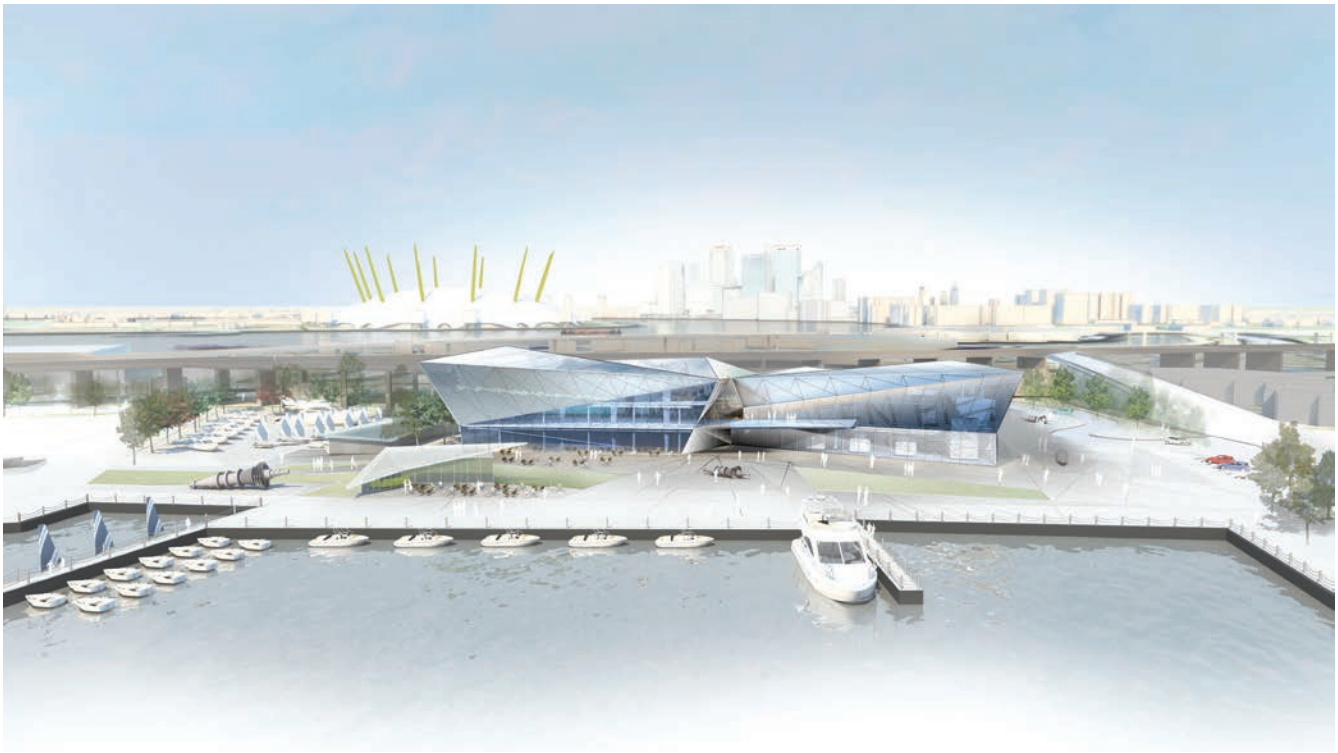


Figure 5.24 Urban sustainability centre with outdoor area

5.4.2 Concept description

The concept of the outdoor exhibit is based on the technology of augmented reality. Through augmented reality it is possible to project artificial images into a real environment. This could be done either by a smart phone app or with augmented reality goggles. The installation concept is a grass clad island on the water with a futuristic egg shaped house built on it. The house attracts attention and evokes curiosity with the visitors, and makes them excited to use the app or goggles to watch what happens on the island.

In the augmented reality picture a micro grid appears that balances supply and demand of electricity on the island. Small scale renewable power plants emerges, e.g. solar PVs on the roof, a vertical wind mill next to the house, and a wave power plant in the water around the island. Other sustainable technologies such as rain water harvesting, energy storage facilities and a spiral-shaped cultivation are shown in the garden around the house. Next a futuristic electric vehicle appears in the water and drive up on land to park next to the house. In the background large off shore wind power farms are visible as well as well as large scale solar power plants.

On shore there is a signpost explaining how to use the augmented reality technology and describing the different objects and solutions that appear in the picture.

Figure 5.25 Outdoor exhibit attractor

Figure 5.26 Outdoor exhibit with augmented reality visuals

The scenery is a vision of a clean and efficient future where new technology solutions help people to live in a sustainable way without having to lower their quality of life. It shows how an isolated area can become more self-sufficient on resources and how a household goes from being a consumer into becoming a “prosumer” and even a net producer of power to the grid. The vision shows that a sustainable future is possible and that people can live without affecting the environment or climate in a negative way. This is intriguing to experience and evokes a sense of hopefulness about the future and at the same time makes the visitors interested in learning more about sustainable solutions in the Urban Sustainability Centre.

6. DISCUSSION

This section considers the methods used throughout the project and the results they generated. Sources of error are discussed and a suggestion on how to proceed with the exhibition concepts is presented regarding what needs to be developed further and what the next steps could be.

6.1 METHOD DISCUSSION

This project has strived for a structured, scientific approach and several different methods and theories have been applied. In general, this has worked very well and the final results are proof of this. However, in a project of this size the parameters are many and their relationships very complex and to call attention to this, some methods and sources of error are discussed below.

The MECE analysis carried out at the start of the project didn't reach its full potential. This tool is mostly used in management related projects and was difficult to apply to the current scope. It did, however, present a useful overview of which data collection activities that were important to prioritise and which ones that could wait.

Regarding the data collection, a rather extensive one was carried out on the topic of smart grid, designing emotions, and experience design. Some research was done on exhibition design but this topic was arguably slightly overlooked. The time plan didn't allow a deep dive into the topic but the reason for down-prioritising it is mainly something else. One of the key instructions from the project owners in the early stages of the project was to provide fresh external input on Siemens exhibition strategies. Therefore, opinions and reflections on exhibition design were formed from observations and experiences rather than extensive literature studies.

The questionnaire that was distributed in the data collection phase of the project aimed to attain a better understanding of the knowledge level on the topic smart grid. The composition of the group that filled in the questionnaire aimed to represent the target audience for the actual exhibition and this may be of interest to discuss. The participants were on average slightly younger than the expected exhibition audience and, for obvious reasons, Swedish. A portion of them were also in the field of electricity installation which falls outside of the target audience's profile. In spite of this, it is argued that the result of the questionnaire is relevant for the project. This is based on the assumptions that knowledge level on smart grid is not heavily dependent on nationality (within Europe) or age. The rather high percentage of people from electricity installation could be assumed to lower the overall result but instead the result indicated a rather high knowledge level. To confirm this, a larger sample of people from a broader range of background could have been used.

The market studies done in the project aimed to give an overview of other similar exhibitions. None of these (except from the Siemens exhibit at CIRED) were actually visited. To be able to personally experience e.g. "The magic box" might have given a deeper understanding of the other actors' strategies for exhibition design and selecting content.

The data collection and analysis resulted in two lists of requirements, one for a temporary exhibition on smart grid and on for the outdoor exhibit. Instead of doing three; one for the temporary exhibition platform, one for the smart grid exhibition content, and one for the outdoor exhibit the two first ones were merged. This was considered better since the smart grid content part of the project followed a slightly different process than the others and could thus not be concluded into a classic list of requirements. It helped, however, to have a specific exhibition topic in mind when working with the temporary exhibition platform concepts, so this structure of the lists of requirements was preferred. Notable is that Elicit emotions is among the top three requirements in the first list of requirements. This might seem strange to some readers but the reason for it is quite straight forward. As stated in the design theory section (See 2.2 Design theory on page 10) emotions are an important part of our decision making process. Since the main objective of the exhibition is to encourage further engagement with Siemens, i.e. making certain decisions in favour of Siemens, emotions are crucial to consider. Most of the other requirements listed relate strongly to the top three ones and some of them can even be said to overlap slightly. But when working with somewhat intangible areas such as emotions and experience, some overlaps are hard to avoid. However, the total effect of the list is still a well-founded framework for the solution set.

Another quite important issue when working with emotions and experience is how to communicate it. The concept presentations given in this project were based on speech and visuals and did not include e.g. audible or tactile stimuli. As discussed in the theory section (See 2. Theory on page 5) a full aesthetical experience is essential to consider to make sure that the product-user experience elicit the desired emotions. It is assumed that this applies when giving presentations as well and it would therefore have been desirable to enhance the experience for the audience with music, sound effects, the right lighting conditions etc. to be able to communicate the concepts on a deeper level. However, such a presentation might have come across as a bit excessive, and to instead go with a concept that the audience was used to

was a good decision. All the aspects of the concepts were instead explained vividly and it is not necessarily need to personally be subjected to an experience to be able to assess its potential.

Since the scope of this project did not include any deeper studies in the usability of the products no empirical usability studies have been performed. Some non empirical usability studies such as Hierarchical task analysis, Cognitive walkthrough and/or Predictive Human Error Analysis is advised to consider for the continuation of the project to ensure a sufficient level of usability.

6.2 RESULT DISCUSSION

The final results are divided into three parts and each part is discussed separately below.

6.2.1 Temporary exhibition platform

The modular concept provides flexibility to the exhibition concept, which is a very important feature to a temporary exhibition platform. The use of digital information from projectors and screens enables the content to change without adding new equipment to the exhibition and the mobility of the modules makes it possible to adapt the furnishing and interior to different topics. The case and solution display module is also flexible and can be used for any type of products and topic. Both the case and product templates and the product display table are designed to have a standardised method for presenting Siemens solutions regardless of topic. The multi touch table with object recognition used for the SimGrid challenge in the smart grid exhibition concept is probably the least flexible part of the temporary exhibition platform. However, this table can be used in many different ways besides the proposed game concept. The object recognition technology enables human-product interaction in an innovative way and can be adapted to either explain the theory of a topic or to showcase products by using both physical models and digital information.

One possible problem that may occur when using projectors is that the lighting conditions are too bright for the projections to be clearly visible. The solution to this problem would be to shade out the sunlight and to use a low level of indoor lighting in the room. The screen modules are adapted to fit the ceiling height in the suggested office space of the Urban Sustainability Centre and will thus form walls and sub-spaces and shield the sunlight if placed in front of windows. Another possibility is to use blinds in the windows to control the amount of sunlight and thus create the desired lighting conditions. Another issue that needs to be solved is to find an optimal placement of the projectors to create the desired atmosphere, with pictures surrounding the visitors, without anyone blocking the projections. If this turns out to be a problem when letting projectors on one module projecting on an opposite one, a solution can be to project from below. A projector can be placed in the base module and project onto the screen above without anyone or anything in the way.

The choice of location in the centre was made after conferring with Siemens and the architect firm. There were other suggestions of possible placements for the temporary exhibition, e.g. the Street in between the Corporate and Exhibition crystals or one of the meeting rooms. The chosen office space and breakout space has many advantages, e.g. the reception and cafeteria is already planned for and the location is well separated from the permanent exhibition. However, the temporary exhibition concept can be used in other locations as well but the layout would then have to be redesigned.

6.2.2 Temporary exhibition on smart grid

The smart grid exhibition concept presented in this project is one possible solution out of many. The final concept design depends on both the messages that should be presented, and on the different ways to communicate this information. The content of the smart grid exhibition concept is meant to give the visitors the right background information and sufficient knowledge about the topic to be able to discuss it with the other visitors and with Siemens personnel. The topic of smart grid is presented in a broad way to reach all different visitor groups and the objective is to have the visitor to start thinking about new possibilities with smart grid development rather than learning about technical details. By creating a meeting platform in the exhibition, the visitors can learn from each other and gain a deeper understanding of the topic in other ways than by just reading information.

The areas of the Exhibition Content Description (See) that needs to be developed further are ones regarding Siemens cases and solutions, and the steps that different actors need to take in the smart grid development. The projects that Siemens participate in and the products they deliver will change over time and this part of the content will have to be updated throughout the exhibition period.

Therefore, it would have been a waste of effort to focus on that part of the content in this project. Regarding the steps in the smart grid development and the messages Siemens wants to communicate to the different actors; this has to be considered further. Siemens has recently done a re-organisation and the smart grid sector will be part of a new division which has led to changes in the messages. Once the new organisation is in place the message to different smart grid actors should be considered and then included into the exhibition.

One of the major requirements of the smart grid exhibition is to elicit emotions within the visitor to inspire action. To achieve this it is important to tell a story throughout the exhibition and this has been attempted in the concept presented in this report. By first welcoming the visitors and handing out the Smart Passes, they will feel special and selected and thus be more receptive to the messages presented. The background presentation will give the visitors sufficient information to be able to take part in the rest of the exhibition and also create more interest in the topic. The historical background gives a multi-sensory experience and by placing Werner von Siemens as one of the founders of smart grid technology the visitors will gain more faith in Siemens as a competent company. When the visitors write their own definitions of smart grid they will start thinking about the topic and open their minds to other's opinions on the smart grid concept which will further enhance interest and curiosity. By showing possible benefits, opportunities, and challenges with smart grid compared to the electricity grid today, the visitors will feel the importance of the smart grid development. By then moving to the SimGrid-station where the visitors will work together to actually create a smart grid they will also feel excitement of being part of this development. The last part of the exhibition is in the relaxed and comfortable environment of the breakout space where the visitors will get to learn more about what solutions Siemens can provide in the smart grid field. This will elicit a feeling of confidence that Siemens has all the tools and knowledge to be the best provider of smart grid technology. Throughout the exhibition the visitors will thus both learn more about the topic and also be exposed to emotional experiences which lead to discussions and possibly also to decisions on further engagement. However, all of these installations need to be constructed and tested before the exhibition begins, to make sure that the right usability is achieved and that the desired emotional sequence is elicited.

The concept works well for group visits, where part of the exhibition is presented by a Siemens guide. This requires that there are well educated personnel present to make sure that the visitors get a friendly and professional reception and that questions that comes up throughout the exhibition can be answered. The amount of interactive installations in the concept also requires staff on site to help out and instruct when needed. Especially, the SimGrid-station will need a Siemens moderator to initiate the game procedure and to induce discussion among the users.

6.2.3 Outdoor exhibit

The outdoor exhibit is based on augmented reality technology, which is new and still quite innovative but may be problematic. The camera must recognise patterns in the picture to be able to add digital images that look real. This technology should be tested before the exhibit is being built to make sure that the installation will work as planned. If the picture doesn't look real or the digital images won't follow the cameras picture when it moves, the installation will not be perceived as sufficiently innovative or interesting.

6.3 NEXT STEP FOR SIEMENS

The suggested way to continue with the temporary exhibition and outdoor exhibit is to make a cost analysis and see what fits into budget, choosing case studies and products to showcase in the smart grid and other temporary exhibitions, start developing this content, and finding suppliers of the technical equipment.

6.3.1 Budget

If deciding on proceeding with these concepts, the first thing to do will be to make a detailed budget and see what solutions are economically feasible. Things to consider are cost for technical equipment (e.g. projectors and touch screens), software development (e.g. for the SimGrid concept), and how much the extra staff would cost.

If the whole concept for the smart grid exhibition does not fit into the budget, parts of it can be cancelled. The case and solution presentation is the easiest part to separate from the rest since it is placed in a different location and works well on its own. Other options can be to cut down cost by using existing screens instead of the modules developed in this project or to use simpler solutions for

product presentation, but this would put the sense of excellence, efficiency and innovation in jeopardy.

The cost for the outdoor concept can vary a lot depending on how large the island is and what kind of attractor that is put on it. The island can be constructed on floating pontoons and the design can be more simplistic to keep the price down, as long as it is a good attractor that catches the attention of the people outside the centre. The augmented reality allows a lot of innovative features without any extra cost (except for the software development).

6.3.2 Case studies and products

As motivated earlier, what cases and solutions to present in the smart grid exhibition has not been defined. Siemens is a very large company and smart grid is a quite wide topic which means that there are a lot of projects that can be considered for display. When finding an interesting Siemens project, this can be described on the developed template and complemented by e.g. movie clips and interviews with participants. After finding a case, the Siemens products that were provided should be included in the solution display and linked to the case.

6.3.3 Software development

Since there are lots of digital, interactive installations in the concepts, there is much software development that needs to be done. Especially the SimGrid game will take a lot of concept development and testing before it can be finalised and put into use. The object recognition technology must work with the software to get the complete simulation experience. The game idea must also be defined before the programmers can start working with the software development.

6.4 CONCLUSION

In this project, the three-fold scope was fulfilled and presented in both text and visualisations. A temporary exhibition platform was developed, together with a suggestion on a location in the Urban Sustainability Centre, suitable to host the temporary exhibitions. The concept was made flexible so that the information content of the exhibition can be changed to fit any topic. As a complement to the temporary exhibition platform concept, to be used as a guideline when designing an exhibition, a document with strategies for successful communication was developed.

An exhibition concept on the topic of smart grid was produced regarding both the information content about smart grid and exhibition design solutions to communicate the message to the right target audience. The exhibition concept was made to fit the temporary exhibition platform and can be used to present and motivate why a temporary exhibition is a good complement to the permanent exhibition in the Urban Sustainability Centre.

Besides the temporary exhibition concept, an idea for an outdoor exhibit was developed. This exhibit makes use of the water area outside the centre, targets the broad public, and aims is to make people interested in sustainable technology and the Urban Sustainability Centre.

In all parts of the project, a product development process was applied and numerous methods and tools were used. The installations in the exhibition focus on interaction and visitor participation to increase user engagement. The project has a clear sustainability perspective and the smart grid exhibition will help the visitors to see the necessity of a sustainable development and what role a smart grid will play in the future.

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Conceptual Design of Temporary Exhibition Platform
and Smart Grid Exhibition
for Siemens Urban Sustainability Centre

APPENDIX

APPENDIX I - EXHIBITION CONTENT DESCRIPTION

This document describes the messages and content of the temporary exhibition on smart grid. The exhibition description sheet is divided into a background part that introduces the topic, a part regarding benefits and challenges compared to today's electricity grid, a section on actors and markets and finally a part on cases and solutions that Siemens provides in the smart grid field.

Background

The world's energy demand is increasing rapidly with a higher standard of living and an increasing world population. The total energy demand is expected to grow at an annual rate of 2.2 percent from 20,300 terawatt-hours today up to 33,000 terawatt-hours by 2030.

There is also a need to change the energy mix in the systems towards a more sustainable use of energy. The energy and transport sector emits greenhouse gases causing climate change and the fossil resources that today stand for about 90% of the world's total energy supply will eventually run out.

Great transitions need to be done, to change the energy mix towards renewable sources and to use energy more efficiently. The most clean and sophisticated way of utilising energy is to use electricity, a high quality energy source that can be transformed into all other sources in a very controlled way. This will bring a great challenge to energy systems worldwide and especially put the electricity grids under large pressure.

The world stands before a paradigm shift in electricity generation and an electrification of our societies. This is not possible with today's electrical grids that are often aging and outdated. Today's grid is characterized by centralized, large scale production and hierarchical distribution from the power generator to the consumer through high voltage transmission networks and low voltage distribution networks. In the future, the grid will be transporting electricity in two directions and both the supply and demand side will be more complex. The electric grid has to develop into a smart grid that can both secure the balance between production and consumption and guarantee the availability of high quality electricity.

Historical perspective

The smart grid is evolving from technologies that originate back to three scientific giants;

- T.A. Edison who developed DC and battery technology,
- N. Tesla, who further developed Edison's concept for electricity distribution by inventing AC technology,
- A.G. Bell who invented the telephone and therefore set the ground for today's communication technology.

Alongside with these great scientists was Werner Von Siemens who started the company that would become one of the biggest and most successful players in both electricity generation and distribution and communication technology. When the fields of electricity and communication come together in the smart grid, a unique combination of knowledge and competence is required to meet the new demands. Siemens has this competence.

Drivers for a smarter grid

The drivers for developing a smart grid are many and vary a lot for different locations and situations. Most important drivers are the integration of renewable energy into the electricity mix and the reliability and efficiency of the electricity grid.

Sustainability and integration of renewable energy

To reduce the carbon footprint from electricity generation more renewable energy sources will be used in power production. The problem when integrating more renewable power generation into the energy system is that power that comes from solar and wind is highly fluctuating. Today, the electricity supply is adapted to the demand and needs to be more reliable than the renewable intermittent energy sources are. This relationship will change so that load follows generation which calls for a flexible electricity price in combination with a grid that can communicate with smart home products.

The integration of renewable energy sources will change the energy mix but there will still be a need for traditional power supply as base load to keep the supply stable. However, even fossil power generation can be made more efficient to minimize the carbon footprint by using better turbines in the power plants and combining heat and power production.

Security of supply and efficiency

In many places around the world there is already a problem with old grids not being able to supply the electricity according to demand. Blackouts and brownouts are costly and this problem becomes larger as the world's energy demand increases and the fossil sources are running out. Keeping the right power quality also becomes more problematic when more disturbing objects are connected to the grid and more sensitive equipment is being used. This gives a need for a smarter control of the electricity system to assure a safe and reliable supply of the right quality.

Today's electricity infrastructure is designed to meet the highest level of demand and during non-peak hours the system is under-utilised. If the demand was evened out, this excess power capacity would not be needed. Smart grid technology can manage this by providing incentives for consumers to shift consumption from peak hours to off peak hours. This is done by providing information about supply and electricity price as well as smart automated solutions that helps the consumers make the most profitable choices.

Smart grid technology can also help improving transmission and distribution to have less loss from friction and to optimise investments in the system.

Different development and drivers in different regions

The most prominent driver for developing the smart grid varies around the world. In EU the main driver is the political will to change the energy mix into more renewable. The smart grid is needed to enable large scale integration of renewable electricity generation. USA on the other hand has an old and unreliable grid and their smart grid driver is mainly to secure the electricity supply to avoid costly blackouts. China is the region that grows the fastest at the moment and needs to build a lot of new grid to supply the energy demanding east from the sources in the west. To optimise the investments needed the new grid will include smart technology.

Definitions of smart grid:

Smart grid is a concept without one true definition and different actors will have different approaches to defining what it is.

To define the smart grid there are two different approaches that can be used. One way is to use a technological approach on the topic and define the concept based on the technology and products that builds up a smart grid. The other approach is to start at the challenges that the electric grid has to face and define the smart grid as the power network that has the solution to these challenges.

Smart grid from a technological perspective; a smart grid consists of:

- An electricity system with two-way distribution and communication
- Smart metering to control supply and demand
- Optimisation tools to improve energy efficiency
- Storage devices that works with the grid to match the supply and demand

Smart grid from the challenge perspective; a smart grid must enable:

- Integration of more renewable electricity production
- Efficient long and short transmission and distribution electricity
- Load shifting in a way that gives incentives for efficient consumption
- An integration of electric vehicles in the vehicle fleet

Benefits and challenges

The existing grid infrastructure in many developed countries is aging and needs new investments. Smart grid technology provides the opportunity to maximise the use of existing infrastructure through improved monitoring and management and new infrastructure can be more strategically built to complement the existing. This means that smart grid technology will have effects throughout the energy chain as well as affect the whole world's energy systems.

The effect of a smart grid on a society can be divided into benefits compared to the old grid, new opportunities that evolve, challenges that have to be met, and issues to consider.

The benefits compared with today's grid can be directly linked to the drivers for the smart grid. The challenges that have to be met can be of technological nature as well as society and market related.

Allowing integration of renewable energy

- Large scale renewable energy plants

- Expansion of the small scale electricity generation market

Through a smart demand response system in combination with storage possibilities the supply and demand for electricity can be matched, even when intermittent power sources are used in a large scale. This in combination with better transmission and distribution technology will allow larger wind farms or large solar power plants to be included in the energy system which enables power production in more remote areas of the world such as off shore and dessert areas.

The smart grid will also allow bidirectional flow of electricity which will make it possible for e.g. households to produce its own electricity. Smart technology is needed to optimize this small scale production and to integrate it with the grid.

A more reliable electricity supply

- Effective disturbance management

- Manage and supply different energy quality to different users

- Self healing network

Smart grid will make it possible to include more variability into the generation but keep the quality and secure the supply. Thanks to real time system information the operators can manage and balance generation and demand and keep the right quality. Automatic detection of error in the grid can be included and the errors can ideally be fixed without the customer noticing.

By using metering and sensor equipment, a smart grid can anticipate a fault in the system before it occurs and allow for necessary actions to be taken. If there is an outage, the smart grid can identify the source of the error and reduce the spread of the interruption and respond more quickly than today's grid. A smart grid could also be made self healing through artificial intelligence so that it could analyze and learn strategies to avoid future errors. The higher degree of automation and self-healing applications reduce operational and maintenance efforts and, therefore, enhance the profitability of electrical networks.

A more efficient energy use

- Optimises grid operation and grid infrastructure

- Reducing losses in the grid

Distributed generation from many small producers gives production close to consumption. This means less losses and less load on large transmission grid. Necessary investment in the transmission network can be postponed if the electricity is transferred smarter and used closer to the generation.

With smart metering interruptions in the grid will be easier to detect and correct. Weak areas with poor power quality can be identified and necessary measures taken more easily than today. This will make investments more cost efficient since the DSO knows where in the network the money will give the best outcome.

Enabling a change of the vehicle fleet into electrical vehicles

One of the major benefits with having a smart grid is that it enables a large scale expansion of electric vehicles in the vehicle fleet.

- It is better for the environment and climate as well as the local city environment
    - If the electricity is produced from renewable sources no greenhouse gases are emitted.
    - An electric vehicle is cleaner and does not emit particles, CO, NOx or other harmful compounds.
    - An electric engine is quieter and runs more smoothly than a combustion engine.
- An electric engine is more and efficient than the combustion engines.
    - It can use the brakeage power to recharge the battery.
    - The electric drives have fewer moving parts and are more controllable than combustion engines which give less friction losses.
    - No idle running when the car stands still.

Smart grid technology can enable charging of EVs when the demand, and price, is low or when there is a large supply from renewable generation. If charged during off peak hours, the effect on the grid is small when changing the vehicle fleet into an electric one. Smart charging can be included to make sure that cars are charged during night rather than when people get home from work. This is called Grid to Vehicle control (G2V).

A future possibility is to not only see the electric vehicle as a load in the electricity grid but to include it as an active player by using the batteries as storage devices. A first step towards using the electric vehicle for storage is to connect it to a smart communicating home EMS, so called Vehicle to home (V2H). By doing this it is possible to use electricity from the car battery at peak demand when the price is high or to use it to avoid blackouts. The next step is to use the electric vehicle fleet for large scale storage and send electricity from the batteries back to the grid when the car is not used and the demand is high, so called Vehicle to grid (V2G). This has great potential for solving both transportation and storage issues at the same time and E-cars become more than environmentally compatible vehicles. They are an important element of an intelligent energy infrastructure and contribute to the grid's ability to compensate for fluctuating power production from renewable sources and distributed generation units.

Enabling active consumer participation and demand response

- Increase the customer awareness of their energy consumption
- Clear price signals which gives incentives for changing the demand

Smart grid technology will allow the customers to be more involved in the energy system and make active choices on electricity usage depending on the supply. Through a variable electricity price and smart products, the consumer can change the demand to cheaper off-peak hours and therefore getting a lower electricity bill. This so called demand response system is one of the main advantages that come with smart grid development. Demand response enables a large scale expansion of intermittent power generation, by shifting and balancing the load and decreasing peak demand. A demand response system will need to be developed from several technology areas and includes advanced metering infrastructure and distribution management as well as smart customer products and interfaces. The first customer group that will have a large effect on the demand response development is the industry, since it is more concerned about the electricity price.

Storage is the biggest technological challenge

Energy storage is an important part of a smart grid and brings a challenge for technology development. However, storage is not a bottle neck for smart grid development; there are solutions today that works but the technology can be improved.

Solution for energy storage is needed in the future grid of several reasons:

- To even out the supply from intermittent sources and thus enabling more renewable power production in the energy mix.
- For time-shifting which means buying cheap electricity and use it when the demand is high or sell when the electricity is expensive.
- Good storage equipment gives decreased need to expand the grid today and thus postponing expensive investments and saving money.

Different storage technologies are needed for different applications.

- Pump power plant
    - Matches wind power well but dependant on geographical situation
- Batteries
    - Many different kinds are being developed
    - Used in electric vehicles
- Air cages
    - Efficiency under 80% but environmentally friendly
- Flywheels
    - Suitable for frequency control, short time usage and can be recharged many times
- Super-condensers

  - Has large potential but needs development

- Fuel Cells
  - Promising but needs hydrogen infrastructure

- Thermal storage

Prosumers and virtual powerplants

- Consumers may also be producers of electricity
- A prosumer can either use the electricity or sell it back to the grid in a bidirectional grid
- Small producers can get together and form a Virtual power plant to optimize the production

Consumers can also generate electricity and use it, store it or sell it to the grid and thus acting as so called “prosumers”. Many small electricity generators can get together to produce electricity as a virtual power plant. A virtual utility is a cluster of power plants and storage facilities controlled by one Energy Management System, EMS. The EMS checks demands and production in each part of the cluster and decides what to distribute and where. Coming together in a virtual power plant can also be a way for small producers to get market shares.

Cyber security

- Becomes more and more important when more things are connected. If our energy supply depends on ICT, the security issue is of great importance.
- Already an issue in banks, mobile phones etc. We still use credit cards.

Personal integrity

More details on our habits are registered, metered and stored, and can be used in advertising etc. This can mean both new business opportunities but also raise new questions as “How much information do we want to give out?” and “Who owns the information?”

New legislation will be needed to make sure that the information is not misused and to protect the personal integrity of the user.

Future scenario: Self sustaining micro grids

Micro grids, like “Islands”, that are self supplying with local power sources in combination with power storage is a possible future scenario. For developing countries smart grid technology can provide the means to electrify remote located rural areas by creating a micro grid. These local grids can later on be added to the electricity system when the national grid is growing and covering larger areas. A smart micro grid makes it possible for isolated regions to be completely self-sustaining on electricity which enables a clean and sustainable development all over the world.

Future scenario: Connect the world with a supergrid

The larger a grid is the more reliable and secure it can be. Renewable electricity can be produced where the sun shines or wind blows and then distributed to where the demand is largest at the moment. This leads to the scenario for the future where all continents are connected with the same so called “supergrid”. It could be possible to supply the worlds need for electricity solely by harvesting solar energy in the dessert areas around the world and this energy could be distributed through a world-wide smart supergrid. HVDC technology is used for long distance low loss transmission and smart energy management systems are needed to solve the complex task of bringing electricity to the users in the most efficient way.

Actors & Markets

The development of the smart grid will affect the whole energy system and markets involved. Investments are needed along the whole chain of electricity generation and consumption and new business opportunities will emerge as not only the rules, but the whole game plan changes. It is therefore important for an actor to know the roles in the smart grid development, and be prepared for the new conditions in the market.

Important actors are:

- Transmission System Operators
- Distribution System Operators
- Power generators
- City planners
- Aggregators
- Consultants (for power generation, building construction etc.)

Customers can be divided into three different categories:

- Industry – driven by logic and considers energy as an input.
- Commercial buildings – considers energy a cost to be rationalized to make profit.
- Households – wants to decrease cost and might be intrigued by cool equipment. Harder to adapt to changes than the industry has.

New business opportunities

The smart grid development will bring new business opportunities for companies in the energy market. New products and services that will emerge are:

- Electric vehicles
    - Cars and batteries
    - Charging infrastructure
    - Vehicle to grid communication

- PVs for small and large scale production
- Smart household equipment
    - Smart Meters
    - Smart home appliances
    - Interfaces towards customers
- Energy management and optimisation systems
    - Software to optimise and control power production and consumption
    - Home energy management systems
    - Virtual power plants
- Storage
    - Selling energy storage equipment or providing storage capacity to power producers

Investments, cost and benefits

The cost/benefit balance is easier at the beginning and at the end of the line.

- Production investments and benefits can easily be calculated on short term or long term; however you need to consider future subsidy systems.
- Energy efficiency measures including smart technology within the metering in industry and houses are possible to calculate and make profitable.
- Transmission investments are of distinct infrastructure type and are usually done with public money. Can also be financed together with other countries and regions.
- Distribution investments are the hardest to analyze and most problematic from a company perspective. The profits can be made by the ones who find the best solutions on the market today. New regulation may be necessary.

Problems appear when investments and profits don't appear at the same place in the electricity chain. Nobody wants to make investments in the grid that don't pay back. However, large investments are necessary both on the production side to meet the new demands and on the transmission and distribution side to improve the grids. There are high risks involved in new investments and the cost must be divided between different actors. Political mechanisms are usually needed for the investments to get going.

The road to the smart grid

The steps that need to be taken towards a smart grid differ a lot between regions depending on the situation today and what drives the smart grid development.

Regional characteristic to take into account:

- Energy mix, current and planned
- Demand, current and future from different sectors e.g. industry, transport, households
- Status of existing grid and planned transmission and distribution networks
- Neighbouring regions and possible connections
- Market structure and regulations

Demonstration projects

Commercial scale demonstration projects are needed to capture real-world data and see how the technology works with the market and regulation systems as well as with the end-user. Large scale demonstrations will give shared learning among the participating actors, decreased risk when investing in new technology and finding best practice methods for smart grid deployment.

Setting new standards

Smart grid technology will bring together many industry sectors that have not previously worked with each other and combine different products into one solution. At the same time, large investments are necessary to speed up the smart grid development. This gives a need for good interoperability between companies and products to decreases the risks with the investments. Standards are therefore crucial for a variety of products and services in the smart grid field.

Case studies and products

Siemens is a global company and has presence all over the world with knowledge within a broad range of disciplines. It is the only company with integrated energy and infrastructure knowledge and products to supply solutions throughout the entire energy chain. This is needed to meet the new challenges that come with an increasingly complex and changing energy situation in the world. The new smart grid technology needed for the different steps in generation, transmission, distribution, and consumption can all be found in Siemens' portfolio.

The approach for presenting products is to have a customer's perspective and start with a challenge that relates to smart grid development.

Product categories:

Siemens smart grid products can be divided into the categories E-mobility, smart distribution, smart consumption, and efficient network. On top of these categories Siemens' smart grid compass can guide the costumers into the right investments within the smart grid field. Siemens can supply consultancy expertise that helps actors in the industrial and public sector to find their path in the smart grid development.

E-mobility

The vehicle fleet in the world is transforming into an electrical one and the number of electric vehicles worldwide is expected to rise to 12 million by the year 2020. This transformation will lead to great challenges but also bear great potential. Siemens solution is a

self-integrating network and EV infrastructure that makes sure energy is available to supply mobility at any time and in a sustainable way.

Siemens can provide an integrated approach for the entire e-car infrastructure including various charging solutions, information and communication technologies, and billing solutions that make possible the seamless interaction of e-cars, operation centres, and power grid.

Examples of products:

Charge CP700A

This is a charging point with built in safety that is prepared for communication with future smart grid infrastructure.

Smart distribution

The Smart Grid is developing into a decentralized energy network and the distribution of electricity must be as efficient as possible without failing in reliability. To cope with this an intelligent infrastructure is needed which can be observed and controlled in a smart way, and which is prepared for tomorrows energy mix.

The higher degree of automation and self-healing applications reduce operational and maintenance efforts and, therefore, enhance the profitability of electrical networks. Consequently, telecontrol and online monitoring of substations improve operational safety.

Smart metering solutions from Siemens combine sophisticated metering functions, the management of distribution networks, and the integration of back-end IT systems. These solutions were specially developed to suit the new challenges the liberalised energy market poses on distribution network operators and energy retailers and ensures maximum transparency for end customers. This allows network distribution operators to optimize essential key processes and offer new services like flexible billing to their energy suppliers and customers.

Examples of products:

SIPLINK/SIHARBOR

Shoreside power supply for ships to power the boat when in harbour.

Smart buildings

Buildings are one of the major energy consuming sectors with a great potential for efficiency measures. Smart building solutions help optimising interactivity with the Smart Grid for maximum energy savings in buildings.

Siemens' smart building solutions make it possible for buildings to take advantage of automated demand response programs that immediately shift electricity demand from the least critical functions to where power is most needed.

Furthermore, they automatically store energy for later use when prices are most favourable. The building can go from being an energy consuming player into being a prosumer that re-feeds energy to the grid when the production is higher than the consumption. This process can be optimised with the smart buildings solutions which give the customer the possibility to making money on energy instead of spending it.

Examples of products:

BMS – Building Management System

Control and optimise the energy usage in a building by regulating when to buy, sell, store, and use the electricity and heat. Can also include the e-car into the building system and use that as a storage device.

Smart Meter

Measure and communicate the energy usage in a building.

Efficient network

An efficient network means both a grid that transports electricity with small losses and a network that is operated and controlled in an efficient way.

Technologies from Siemens such as high-voltage direct current (HVDC) transmission and flexible AC transmission systems (FACTS) help connect large-scale wind, hydro, and solar power generation to the grid – even when generation takes place hundreds, or even thousands, of kilometres away from the of consumption.

Siemens communications solutions enable online monitoring and control of all grid assets, which in turn means fastest possible reaction to faults and minimized downtimes. In many cases intelligent substation automation and protection solutions in combination with the Energy Management System (EMS) will even enable the Smart Grid to react autonomously. Advanced condition monitoring solutions from Siemens help optimize grid usage through continuous information about the state of the devices in operation and high-quality evaluation for minimized downtimes, reduced life cycle costs, and an extended service life of the assets.

Examples of products:

HVDC plus

High voltage direct current electricity transportation with high efficiency in long range applications.

PSS®SINCAL

Planning software for electricity and pipe networks. Optimise existing networks, identify hot spots, forecast problems, and plan and optimise new investments. Targets larger industries, power companies and cities.

DEMS – Decentralised Energy Management System

DEMS is the intelligent way to manage decentralised generation and virtual power plants. It is a software to put on top of the building management system and link supply and demand sides. The software can be used to control virtual power plants so that small scale generators can be optimised. It can also forecast and optimise the demand side to create demand response.

8DJH Gas insulated medium voltage switchgear

Communicative substations that provide information within the network. The gas insulation allows compact design for use in cities. Used for monitoring and load-flow controlling through remote controlling.

NXAIR Air insulated medium voltage switchgear

Safe to operate.

NXPLUS C Wind

Innovative feed in technology for wind power. Maintenance free equipment.

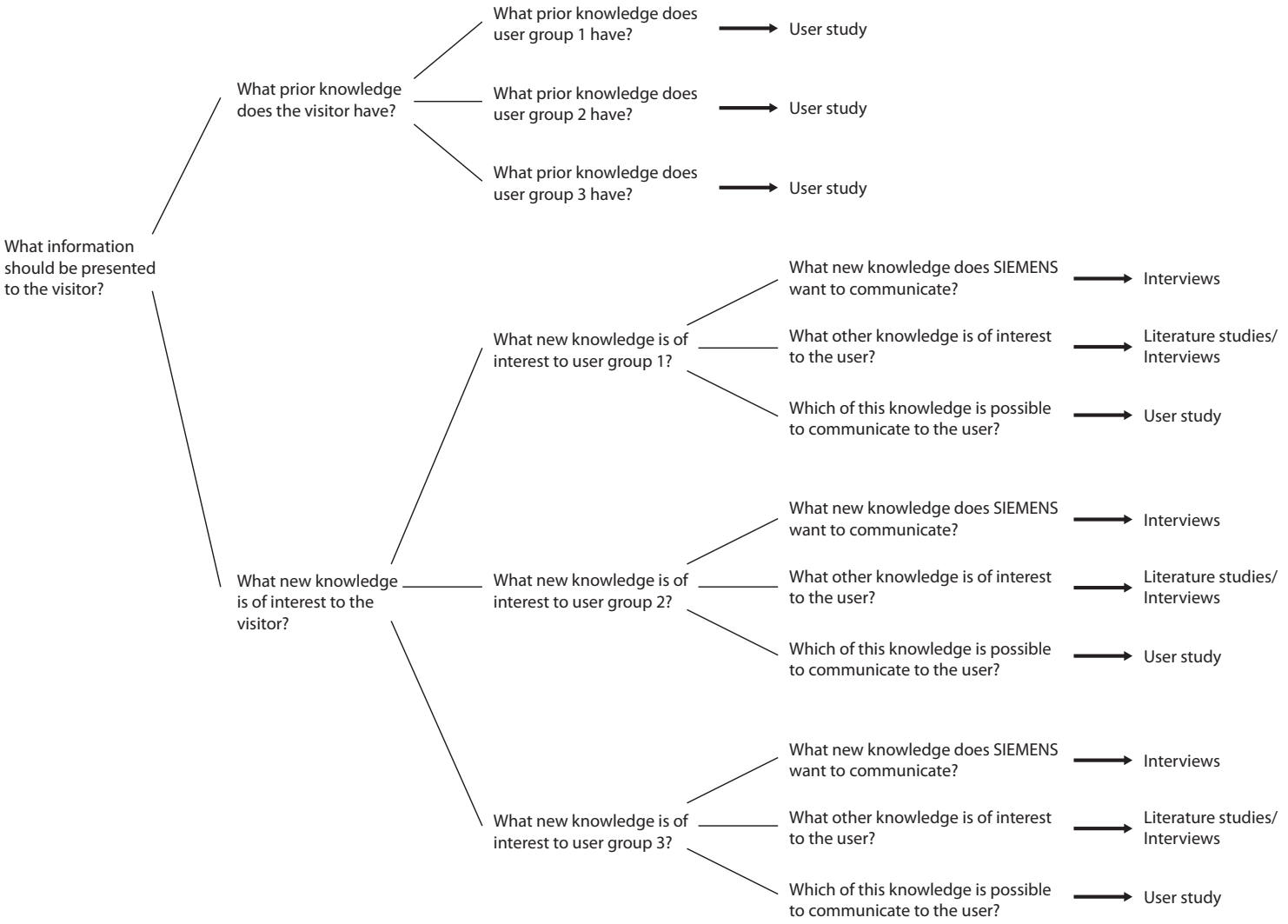
SIPROTEC 4

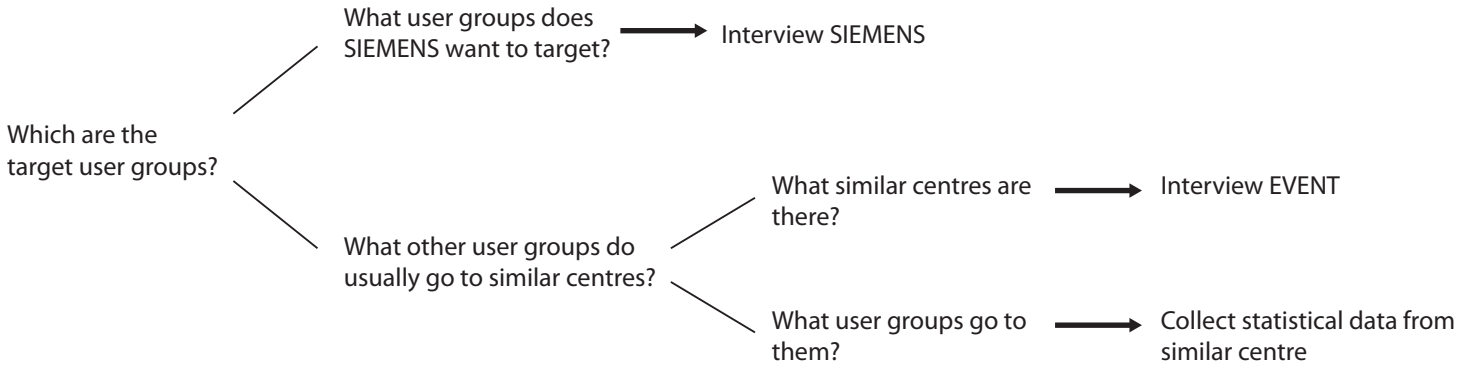
Future-proof seamless communication device to be placed in e.g.switchgears to protect, control, measure, and automate. Digital protection technology in all fields of application.

OVCB – Outdoor Vacuum Circuit Breaker

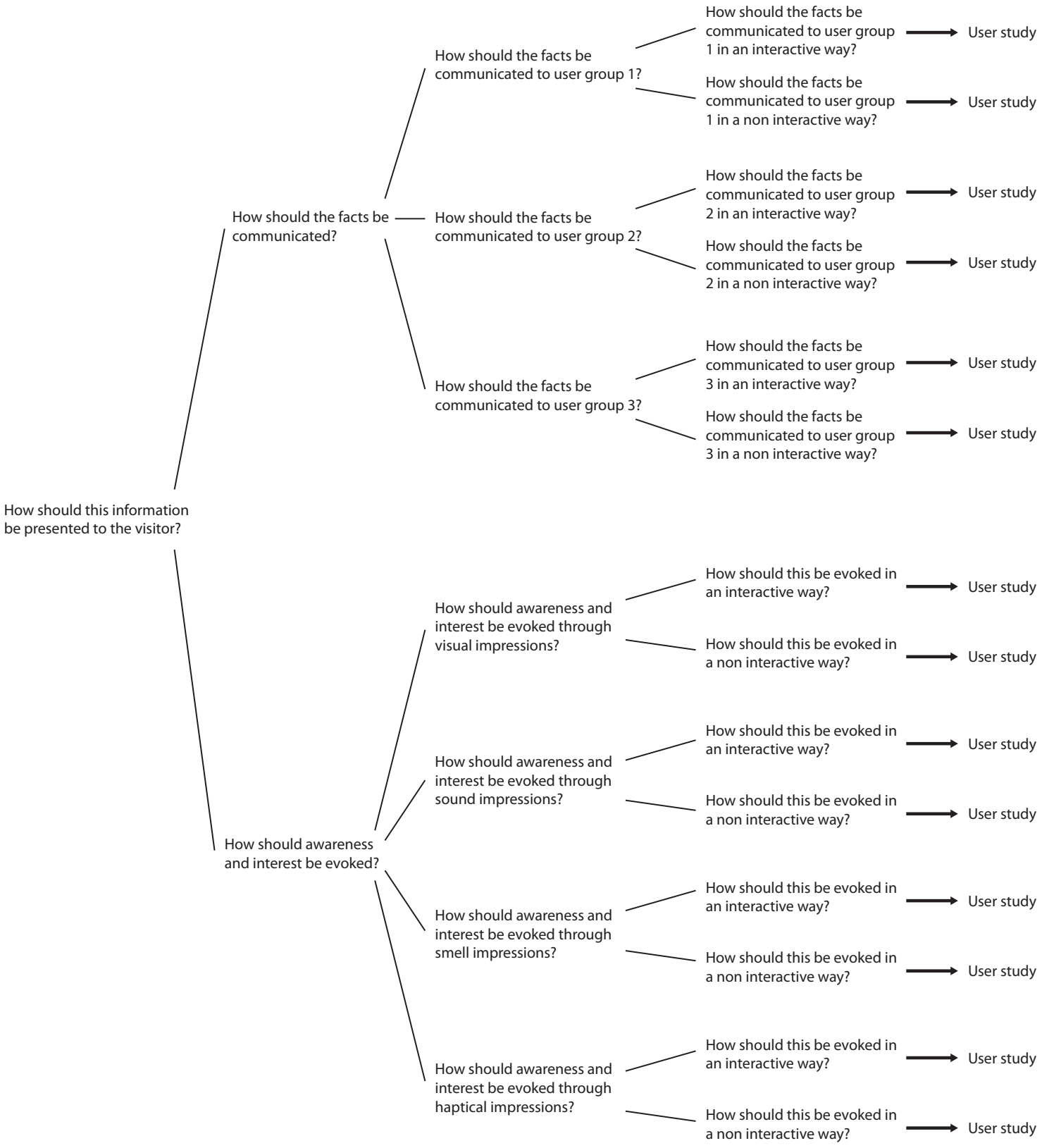
Circuit braking and reclosing medium-voltage device that can stand outdoor weather condition.

APPENDIX II - MECE ANALYSIS - FACTS & TARGET USER





APPENDIX III - MECE ANALYSIS - PRESENTATION



WEEKLY REPORT

TEMPORARY EXHIBITION ON SMART GRIDS FOR SIEMENS URBAN SUSTAINABILITY CENTRE

OSKAR KARLSSON & PETTER POLSON

PROJECT OUTLINE

The project aims to produce a concept for a temporary exhibition on the topic of Smart Grids in the Siemens Urban Sustainability Centre. The temporary exhibition will be on a deep dive customer specific level aiming to encourage discussion and aid in decision making and investment. The target audience groups for the exhibition are a Public Political Body and Siemens related Commercial Actors.

RECENT ACTIVITIES

- Produced a pedagogy and technology overview.
- Market and observation user studies and seminars at Visual Forum in Göteborg.
- Produced a draft for an Exhibition Impact sheet (what impact the exhibition should have on the visitors).
- Worked with a questionnaire to the Elfack fair next week.

RESULTS

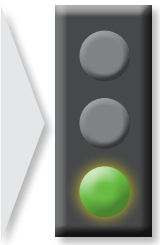
- Clearer picture of what pedagogical and technological tools we can utilize in the exhibition.
- Gained information on interactive learning.

THE NEXT STEP

- Attend seminars and perform observation studies and questionnaires at Elfack.
- Coordinate a visit to Siemens Germany offices.
- Meeting with Lina Bertling from Chalmers.
- Summarize data collection.

IDENTIFIED PROBLEMS

- The Germany trip is not yet fully organized, meeting in Berlin is not set up.
- We need a better knowledge of Siemens Smart Grid products.

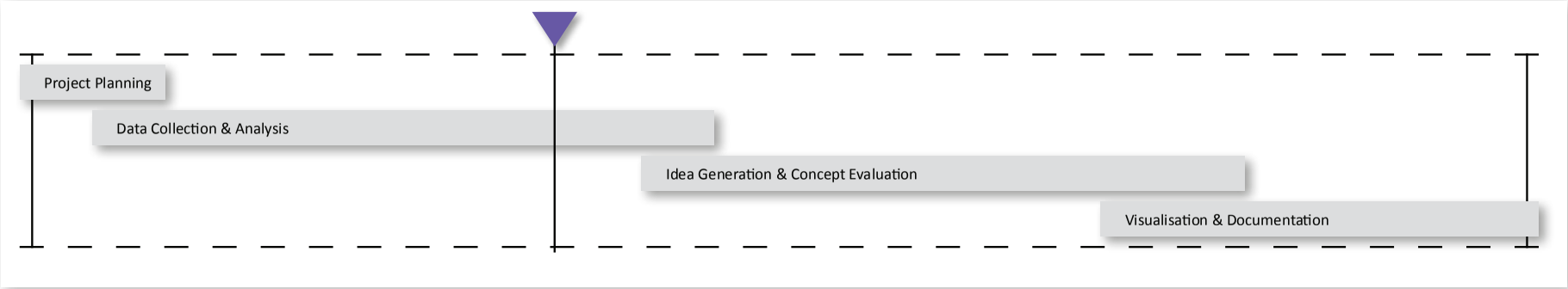


SOLUTIONS

- We hope to gain deeper knowledge on Siemens' smart grid products and services from our Germany trip.

ASSISTANCE NEEDED

- Organizing the Germany trip and setting up the meetings. Carol Gelder is already working on this.



APPENDIX V - SEMINAR TRANSCRIPTS

Seminars at Visual Forum

Göteborg 2011-05-03

The visit included lectures and seminars on the topic of visualization and learning, and observation studies and market studies on the exhibits.

About Visual Forum

VISUAL FORUM is the leading Scandinavian visualization conference and was held for the seventh consecutive year in Göteborg. It focuses on visualization technology for businesses, researchers, academia and public sector.

Speakers:

Hans Willehader, architect firm BIG, Denmark.

Karl Alfredsson, Centre of Pedagogy & Didactics, Gothenburg.

Odd Tullberg, Deputy of Visualisation & VR, WSP, Stockholm.

Pontus Jakobsson, CEO Sightline AB, Stockholm.

Andreas Lykke-Olsen, architect firm Kollision, Denmark.

Results from the Seminars

- BIG used a “comic book styled” publication to tell the story about their company and core values.
- BIG urged the value of “Hedonistic Sustainability” i.e. People need to be informed that living a comfortable and enjoyable life isn’t in conflict with a sustainable future.
- BIG often use art in their architecture. It adds value to the building and its surroundings.
- KA emphasised the importance of active participation and emotional engagement in the learning process (model Accenture, 2000).
- KA argued that the best way to gain a deeper understanding of complex systems is performing real projects and simulating real projects by a game is the second best.
- When using technology in learning you need to consider the content, the available technology and the pedagogical aspect (model by Ruben Puentedura eller Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A new framework for teacher knowledge. Teachers College Record. 108(6), 1017-1054.).
- To teach sustainability in urban planning you need to:
    - Create common knowledge for all target groups
    - Make them talk to each other and understand each other.
    - Consider who’s leading the discussions and holding the presentation.
- KA argued that games work on adults as well as on kids when it comes to learning. You just have to use vocabulary and a setup that fits the target group.

- OT & PJ argued that VR models are good to store and present large amounts of data. It speeds up the discussion and learning process.
- Actors become more engaged and involved in the discussions if they felt that they contributed to the VR model.
- ALO emphasised the importance of getting the public involved in city planning ("the involvement process").
- "There is no single perception of the common good".
- "Everyone has different emotions and want different things".
- ALO introduced the AELIA model (Attention, Experience, Learning, Influence, Action) as a way to engage the public.

Discussion

Incorporate a game aspect to the exhibit will make the user participate more actively and be more emotionally engaged in thus learning more about the topic. It is important to be aware of what pedagogical setup and vocabulary that is used so that it targets the right audience. Just like the content and the technology, the pedagogical perspective plays a big role in every exhibition. To actually induce "action" is an important part of communication that needs to be considered in the concept for the exhibition.

Using historical persons can be a good way to put things in historical perspective. To look at people instead of technology can illustrate how things have evolved. Paradoxical ways of presenting information (i.e. comic book style graphics to show science) attracts attention.

It is important to induce positive emotions and avoid hopelessness when communicating and educating. The use of non-logical (aesthetical) visual, audible or tactile elements can be used to enhance messages and create the right atmosphere. Involvement and the possibility to change and affect content make people more engaged, especially if combined with the "recognition-factor" i.e. being able to affect your own city.

Seminars, Elfack fair 2011

Professor Lina Bertling – Head of Division Electric Power Engineering, Chalmers University of Technology

- Her focus was on renewable electricity production from wind power and on transport, which are important issues in Sweden and globally.
- EU's 20-20-20 goals are the drivers.
- There are two important international cooperation; ENARD – bottom up approach based on technical requirements and ISGAN – top down approach based on political targets.
- Main questions for developing a smart grid are to have a balance between production and consumption and to control a higher capacity from renewable sources.

Stig Göthe – SEK, Chairman of the board at Powercircle

- Wind and solar power grows fastest in EU together with electricity from gas power plants.
- Small producers can get together in a virtual power plant with smart technology.
- Net owners have to adapt to changes that are coming into both producer and consumer side of the electricity system. They need to handle problems that occur without making any profit of their own.

- Actors
    - Generators
    - Network companies
    - Researchers
    - Energy service providers
    - Technology providers
    - Traders
    - Users
    - Regulators
    - Government agencies
- There was a political awakening in 2008-2009 when IEA started the network ISGAN on a political initiative.
- This is a new pioneer age for electric power technology. New standards are needed to control IT, disturbances, security etc. and new innovations are needed to cope with technological challenges.
- Smart grid has become the brand name for the change that is happening and is needed in the electricity grid.
- In China and India new cities and electricity grids are being built. This is where technology leaps will be taken when new grids are built from scratch. In the Western world there will be more upgrading of the existing grids.

Håkan Johansson – ABB, head of smart grid market Northern Europe

- The technology itself is not the biggest issue, the problem is how to get people using the technology.
- New business models need to be created, perhaps more regulation and other political instruments (e.g. taxes) are needed.
- Energy efficiency measures can give 30% higher efficiency in electricity usage.
- Most parts of the transmission grid are already automated today. This is not the case for the distribution grid.
- Defining a smart grid:
    - Start with the technologies and products that are part of the system.
    - Start with the problems and challenges that need to be solved.
- Smart grid is a growing area of technology that demands global standardisation.
- It is the consumer that expedites development of standards but the consumer has not participated in the electricity market before.

Discussion

Smart grid has become a fast growing area for research, technology development, and political discussions the last couple of years. It has become the brand name for the change that is happening and is needed in the electricity grid to maintain a balance between production and consumption when a higher capacity from renewable sources will be incorporated.

The biggest focus today is on integrating more wind power in the energy mix and to start the transition towards electric cars in the vehicle fleet. At the same time, lots of investments are needed to upgrade the electricity grids worldwide to cover a higher demand. The investments are different for different parts of the world due to the energy situation and the existing grid.

Smart grid technology will enable new actors to enter the electricity market e.g. small scale producers and new energy service providers. New market solutions are needed to cope with the changes and to make sure the necessary investments in the grid happen.

The smart grid technology itself is not an issue, the problem is how to get people using the technology. Other bottlenecks are lack of standards in the industry which slows down development and integration of the new technology, and unclear political steering.

APPENDIX VI - INTERVIEW TRANSCRIPTS

Interviews with Siemens personnel

The following persons were interviewed:

Werner Kruckow

Bettina Peck

David Kitching

Jo Hencher

Phil Skipper

Wilfried Lammers

Ina Nieroda

Robert Schlamminger

Heike Onken

Michaela Stolz-Schmitz

Dietmar Staack

Monika Lischka

Ralf Christian

Siemens in general

- Siemens is an honest, trustworthy and practical company. They only show real data and does not give promises that they cannot keep.

- Siemens core values are:

    - Employees – brain power

    - Excellence - technology

    - Innovation - technology

    - Efficiency

- “Tomorrow is today” – slogan at Siemens exhibition at Masdar. Not promising things for the future but supplying the tools today.

- Siemens is not a “good provider”, Siemens is “the company” for SG products.

Smart grid message

- Smart grid is not a player in the system, it is a concept.
- No smart grid is the same, it depends on the situation.
- We are not going to preach right and wrong about smart grid, instead give Siemens' view on the topic.
- Paradigm shift in electricity generation between the 20th century and the 21st.
    - More complex than the chain model for distribution.
    - Renewables instead of fossil.
    - Load follows generation instead of the other way around.
- Drivers for a smart grid
    - Balancing the grid.
    - Load-shifting.
    - Reliability – important in the US.
    - Efficiency – EU 202020 target.
    - Decreasing carbon footprint.
- Time frame: 1st step has already been taken; houses are being equipped with smart meters to prepare for the SG development. Next step is electric vehicles.
- Bottlenecks in smart grid development:
    - People's mindset has to change.
    - Countries need to agree and cooperate (standards etc.).
    - New infrastructure is needed.

  - Control of renewable production.

- Storage is a big problem, however not a bottleneck for building a SG. The technology today works but can be improved.

- The near future is not fossil free; there will still be 50% fossil sources in the energy systems worldwide 2030.

Regarding the exhibition in general

- The building itself is used as part of the exhibition as an example of sustainable building technology with solar panels, rain water harvesting, geothermal heating, natural ventilation and energy efficient lighting. The building is all electric.

- The temporary exhibition (TE) should be moveable because it can be placed at other locations after it has been displayed at the CUS.

- Make the content adaptable/flexible so that it can be change later on. The latest products or case studies may not be the same when the exhibition is in place.

- The TE is more business oriented than the PE. It will be placed in a higher security area and target a more specific group of visitors such as decision makers and buyers of Siemens products. However, the broad public should not be fully excluded from the temporary exhibition.

- The Temporary exhibition will be part of a bigger package with conferences, performances etc.

- A story is needed to evoke emotions.

- Create a wow-effect and then communicate the content instead of the other way around. You have only 20 seconds to communicate the message.

- There is no age limit in playing games, it is inspiring and captivating.

- Use competitiveness for making the users more engaged in the learning process.

- Interactive installations work well, even with business-visitors, and are of importance to the exhibition.

- When using interactive functionalities, it is important that correct feedback is given to the user. He/she needs to understand what consequences his/her actions have.

Smart grid specific exhibition

- Important actors in the smart grid field:

  - Transmission System Operators

  - Distribution System Operators

  - Power generators

- City planners
- Aggregators
- Consultants (for power generation, building construction etc.)

- When presenting products:
  - Start from customer perspective, what is the challenge?
  - Present Siemens' solutions, if possible related to a case study.
  - Show the solution as a product portfolio and then specific products.
  - Make the product presentation flexible.
  - Important products:
    - DEMS
      - Decentralized Energy Management System software.
      - DEMS optimizes virtual power plants by forecasting winds etc and regulating energy mix depending on electricity price and load distribution.
      - DEMS is used in the USD.
      - Utilities are typical customers.
      - Can also be used in whole cities, e.g. London.
      - Positioned between the small scale electricity generation (from e.g. solar cells) and the Building Management System that controls the loads.
      - DEMS optimized the system to minimize external (expensive) input.
      - Target is to have DEMS in the Low Carbon London project.

        - Smart grid compass:

            - Siemens offers consultancy to tailor-make steps for smart grid development.

            - Uses workshops and the tool smart grid compass.

- Steps in smart grid development:

    - Focus on regional strategy instead of a time strategy since each situation is unique.

    - Cover the world with challenges, drivers and cases. Siemens is a global company and the centre for urban sustainability is a global centre.

    - Focus on regions and drivers and relate to case studies.

- Possible case study is the “Low Carbon Network” in London.

Interviews with non Siemens personnel

Results from interviews with others than Siemens personnel during the project are listed below.

Regarding exhibition techniques

- Interaction is important to attract and maintain attention from the visitors. People stay longer at the exhibit or installation and get more involved and engaged when they can influence the content.

- Interaction is important regardless of the target group. It works for all ages, professions etc.

- It is very important to “tell a story” with an exhibition to create interest. The different exhibits need to be connected and relate to each other in a relevant way.

- Avoid too complex mechanical technology in an installation. Moving parts tend to break and need more maintenance.

- Innovative technologies for interactive exhibits:

    - **Multi touch tables –** A large touch screen oriented as a table that the users can gather around and interact with. It is a suitable tool for discussion where all users are equal in the sense that they all can participate in the interaction.

    - **Object recognition –** The multi touch tables described above can be used together with physical objects that are placed on it. The table can recognize predefined objects and identify where the object is placed and in what direction it is oriented.

    - **Motion control system –** These types of systems use cameras or hand held devices to register movements from the user and enables touch free interaction. The technology can be found in different gaming consoles and uses cameras, accelerometers and sensors to detect motion.

    - **3D video –** By using 3D video spectators can get a thorough understanding of the spatial aspects of a concept presented and complex problems can be better communicated and discussed. A 3D movie also effectively catches the attention of the viewer.

- **Projection mapping –** This technology allows projection of images or movies onto irregular surfaces. This can be used to create a 3D environment.

Regarding smart grid

- Actors in the smart grid development:
  - Producers – can be large and small, global and local.
  - Venture capitalists – new actors that invests in projects.
  - Equipment constructors – building e.g. wind mills. Find new niches or adapt existing.
  - Producers of smart home equipment
  - Aggregators – gathers information from different electricity generators to distribute.
  - Users – can be prosumers, i.e. both producing and consuming electricity.
- Bottlenecks in the smart grid development:
  - Standards – the government should step in at large infrastructure investments. In this case, standards are needed to get technology development instead of the other way around.
  - Technology lock-in – people are locked into old ways of thinking, fresh ideas are needed. Smart grid is a new technology area and can be a way to get new ideas into an old business.
- The distribution net will be more like the transmission net is today, but who pays for the necessary investments?

APPENDIX VII - QUALITATIVE OBSERVATION STUDIES

Universeum, Gothenburg, 2011-03-30

- All the decoration, furniture, lighting and music etc. worked together and created a sense of a whole. This added to the experience.
- In an exhibit where the task was to solve a crime the feedback was very confusing. It was hard to understand if anything happened when the buttons were pressed and if it gave the correct result. This generated at disappointed and embarrassed feeling since I didn't manage to solve the task.
- The part of the exhibition where you got to act as a TV reporter and record a weather forecast was very appreciated and engaging. It was fun to get to act as a famous person and then see oneself on TV. You automatically wanted to look and talk exactly like the TV reporters which triggered competition.
- The exhibit where you got to act as a handball goalkeeper was very fun and engaging. It was very entertaining to use your whole body and try to catch as many balls as you could. This triggered competition between the participants.
- The exhibit that showed that pain can be controlled didn't really work. This caused frustration and scepticism.
- The "memory floor" triggered competition and was very addictive for the user although it was a bit unclear what you actually learned from it.
- The idea to be able to create your own music from your pulse and hear what your body sounds like caught the participant's attention. The use of both lights and sounds was fascinating.
- Enclosed environments around installations made it easier to focus on the exhibits.
- The "creepy" interior and framing at one of the installations created a lot of anticipation and excitement. It was very obvious that something scary was going to happen but it wasn't clear exactly what.
- It wasn't clear how to use the "frog sound installation". You were supposed to press two buttons at the same time which was very problematic. This caused frustration and annoyance.

The Gothenburg museum of Natural History, 2011-04-20

- Hard to follow the "story" and focus on items if there is no clear "red thread".
- Annoying not to have a clear heading of what an exhibit is about. Too much information on a small space feels cluttered.
- The wooden cabinets the exhibits were displayed in and the old fashioned interior design gave a sense of "Carl von Linné" and the categorisation of the species.
- Exhibitions placed with one big exhibit in the middle and smaller ones around it.
- Very few interactive exhibits. No sound. No haptic experiences.
- Big, macabre, scary, disgusting or in other ways bizarre exhibits fascinated, attracted attention and got more viewing time.
- 3D-objects enhanced the spatial experience and gave depth to the exhibits.
- Touching the sharkskin was interesting and the feel of the texture on your fingertips gave a more vivid experience.
- The huge model of the killer whale attracted interest. Its big sculptural forms fascinated and were beautiful to look at.
- The many drawers with different butterflies in them were fun to investigate.
- Some of them didn't come out smoothly which was annoying.
- There were so many of them that you couldn't look in them all. This was a bit frustrating. "Where is the prettiest one?"
- There was no overview of them. You just opened them randomly.

- Good that signs and text looked as old as the rest of the visual elements. Looked like they matched each other.
- The Japanese Spider Crab's size and spectacular appearance fascinated and caught attention.
- To see the animals in their context was interesting and added to the understanding.
- The use of colours and fonts in the exhibit about Caribbean fish enhanced the display.
- The exhibit about mushrooms was unclear. The text was too small and difficult to read.
- The section on how amoebas reproduce was explained in a clear way with a clear chronology. There was no need for text to understand.
- The big "tree" that showed how different species are related to each other was very informative. "Man's" branch was coloured red which made it easy to spot and follow. Interesting to see which other species are closely or remotely related to us.
- The many tiny handwritten signs were hard to read.
- The exhibit about smaller birds was perceived as very cluttered. They had jammed very many birds in the same cabinet which made it hard to focus on a single one. This was a shame since they were all very interesting and unique.
- Putting an image or a painting behind an exhibit created a sense of depth which made you feel as if "you were actually there yourself".
- The section about how lighthouses can affect birds flight trails and ultimately lead to that birds die gave a very sad feeling. Felt guilty.
- Some displays were situated very high up on the wall in narrow corridors. Most of the time you didn't notice them at all. To look at them you had to bend your neck in an unpleasant way.
- In the main hall there were goat's horns on the wall to symbolise variation. This was perceived better than the exhibit with all the little birds.
- In the exhibits on animal phenomena's models of the animal was combined with photos, graphics and text. This was a different approach than the exhibits about the animals themselves.
- The exhibit about mites in houses caused a slightly disgusted feeling. This caused longer viewing time however.
- The wooden floor and the rest of the interior harmonised with the exhibits of skeletons of whales and dinosaurs. Felt like a "typical museum".
- An exhibit where you could listen to whale sounds didn't function properly. No sound could be heard which caused frustration and confusion. "Did I do it wrong?"

Visualisation Centre, 2011-04-28

From interacting with the installations and observing other visitors during the tour in the centre following observations were made.

- **Lego city**

  This installation visualizes the city of Norrköping in white Lego. By projecting different colours on houses, rivers and the streets, different messages could be communicated. This enables several "layers" of information in the same model which makes it more space efficient.

  Since the visitors recognized the city, they became more engaged in the exhibit and listened to the information presented by the guide more carefully. It would be possible to use something similar with London in the USC.

  Not all messages they tried to communicate with this technique came across as intended. Different messages require different communications to reach the receiver.

- **Virtual autopsy table**

This exhibit uses a multi touch table to display a virtual autopsy. The installation encouraged interaction and was one of the most popular installations in the exhibition. All users around the table could participate in the interaction but some problems were experienced when moving around the “body”.

- **The food on the table**

  This was another multi touch table installation that showed what climate effect different types of food have. The user got information about the food by placing paper discs with illustrations which represented a certain food types on the table.

  By combining the digital screen with physical objects the users got more involved in the interaction process. To physically pick up and place the paper disc on the table happened by intuition and at the same time encouraged action from the user.

  The exhibit was easy to understand and use for first time users and worked smoothly. Other types of objects could have been used instead of the paper discs, such as models of buildings or power plants etc.

- **Mind ball**

  This exhibit was a game where the two contestants competed in relaxing the mind and not thinking. By measuring the brain activity of the two competitors a ball was moved back and forth on a table and the person who relaxed the most could eventually score a goal.

  The installation was very popular among the teenagers visiting the exhibition who queued up to compete against each other.

  Competition can play an important role in an exhibition, especially if done in a new and innovative way.

- **Molecule construction**

  In this exhibit the user were supposed to construct molecules from atoms by using 3D goggles and haptic controllers.

  Getting both visual and tactile feedback enhanced the experience of this installation. To give the user a challenge is a good way of creating interest, but it needs to be on the right level.

- **Electronic book and the animal display**

  These two exhibits utilized cameras and motion control sensors so that the user could interact with it with his/her body. Even though the actual content of the exhibits were not very interesting the way of interacting with them still encouraged the visitors to use them.

- **Snake box**

  This exhibit mainly consisted of a black box with a viewing hole. Inside the user could experience how snakes perceive their environment.

  The mystery of the black box appealed to the user’s curiosity and was therefore intriguing.

- **Archaeology game**

  In this computer game the users were encouraged to dig for fossils. If the user managed to find three fossils before the time ran out the player then got to answer some question about the animal he/she just found the remains of and then earned a medal.

  The game targeted children but highlights the fact that playfulness and challenges can be a powerful tool when presenting information.

- **Face recognition**

By sitting in front of a computer screen and a camera, the user's facial expression was registered and transferred to a digital model on the screen. This exhibit mainly showed, in a playful way, that face recognition technology is available today.

- **Fish sensor**

In this exhibit the user got to experience how a fish orientates through tactile sensing instead of vision. The user had to wear a blindfold and had to rely on a hand held sonar device to orientate which was exciting.

Visual Forum, 2011-05-03

- Yrkeshögskolan Göteborg: No attractor or walls around the installation, only roll-ups, a computer and some brochures. Popularity: 4.

- Lindholmen Science Park: Had attractor but a bit unclear what it does. Computer screen showing film. No walls around the installation. Popularity: 2.

- VIC Stockholm: Roll-ups without little information. No screens and no real attractor. Very few visitors.

- Projectiondesign: Large projection screen showing the visitors in 3d when using goggles. Also other screens and interactive installations. Popularity: 5.

- BARCO Sverige AB: Not very effective or useful attractor, they couldn't show anything with it. It was used in medical applications but none of them could be shown. Nice posters and complementary chocolate. Popularity: 3.

- ATS AB: Showed a cool movie of a laser scanned square in Gothenburg. The actual laser was the attractor of the installation which also consisted of some roll-ups. Popularity: 6.

- SIMBAL: Interactive precision controller as the main object of the exhibit. Interactive challenge for the visitors to try the instrument. Popularity: 5.

- Visualiseringscenter C & Sectra: Large model of a virtual autopsy table as the main attraction. Interactive and popular among the visitors. Popularity: 5.

- EON Development AB: Large screen with CAD model of scoter and kinect camera to interact with it. Also a laptop with a 3D screen with face recognition so that visitors could control the object on the screen with their eyes. The exhibits were impressive but the functionality was not perfect. Popularity: 5.

- jDome: Situated in the lecture hall instead of the main hall. The actual product, a half spherical projection screen with interactive functionalities, was the attractor in the installation. Visitors could step inside the half sphere and move around in a virtual landscape by moving their body. Popularity: 3.

APPENDIX VIII - QUANTITATIVE OBSERVATION STUDY

Quantitative observation study at Elfack

The observations from the Elfack fair were summarized into a 13 by 16 matrix with the different companies/exhibits on the one axis and the different aspects that were observed on the other. Features like size, popularity, interactive objects, colour scheme, personnel, giveaways etc. were studied. The different cells were then colour-coded with respect to the degree of impact it was judged to have on the exhibitions popularity.

Company	Esylux	Ahlsell	Cetec	Schneider Electric	ABB	Elektroscandia	Elma instruments	Milwaukee
Size [m]	10x10	15x15	7x12	30x15	30x30	20x20	7x12	8x8
Popularity [1-5]	5	5	5	5	4	4	3	
Installations	Four product shelves	Four installations with a product and a screen at each.	Two cabinets in the corners. One installation with a screen in the corner.	About ten large installation with arc shaped covers.	About forty installations showing products and some separate screens.	About six. One car and some screens on tables.	About seven. Mostly shelves with products. Two heat cameras.	Two workben Shelves with p the walls.
Interactive objects	Lightswitches	Competitions	No	Touchscreen showing Schneiders business. Dollhouse with buttons showing home appliances.	Competition	Heat camera. Car.	Heat cameras. Products to try.	Usable drills at stations.
Colour	Grey/white/red. Same type as their logo.	White and blue as in logo. Blue lighting.	Colourful in beach style.	Green and white all over. Green texts on white background.	Grey, white and black. Not very distinct but the logo is visible everywhere.	Mostly white surfaces and black floor.	Black and the logo, products in different colours.	Red and white the interiors a products.
Interior design	Bar table and regular tables with chairs. Bar with food service.	A bar, some bar tables and an arm wrestling table in the centre.	Large bar on sand. A wooden deck with chairs.	Large exhibition, round bar in the middle, same covered installations in shiny white plastic.	Large bar with food service in the centre, somewhat enclosed. Shiny exhibits in straight rows.	Bar and a separate café which was popular. Screens and installations frames the area.	One small table, otherwise mostly steel shelves with products. Cluttered.	Small bar but f the benches. L end hardware
Give aways	Hamburgers, drinks, water bottles.	Drinks at the bar.	Sausage and drinks in the bar. Also sweets, pens etc.	Nuts and drinks in the bar.	Fruit and sanwiches in the bar and waterbottles.	Cinamon buns in the café, drinks in the bar.	Soft drinks and bags with brochures.	Coffee in the b
Personnel	Dressed in red branded shirts. Ladies in tights to attracts visitors.	Blue company polos.	Mostly in the bar wearing hawaii-shirts.	Lots of personnel, dressed in green.	At most of the installations, dressed in black with blue or green ties.	Well dressed in suits and bowties.	A few dressed in black.	All dressed in
Screens	No screens	One for each installation and four above the bar.	One at the corner installation.	At most installations, some larger, one touch screen, also in the ceiling.	Computers at most installations for showing product systems.	At most installations. One connected to the heat camera.	At the heat cameras and one computer.	No
Posters	Large poster behind the tables.	One behind each exhibit.	No	Only prints on the walls.	Large at the bar and smaller at many exhibits.	Some in the café.	In the ceiling and at the side.	Some pictures corner shelf.
Attractor	Poster in the ceiling. Large arc shape with picture over the bar.	Arc with logo over the arm wrestling table.	The bar itself.	Large screen in ceiling and all the arc shaped installations.	Some larger installations and products.	The car and a large round installation.	The poster in the ceiling.	-
Other	-	Arm wrestling compatition and sledge hammer competition.	Music and party mode.	Answer some questions about Schnieder and win an iPad.	Competition; hit blinking lights.	-	-	-

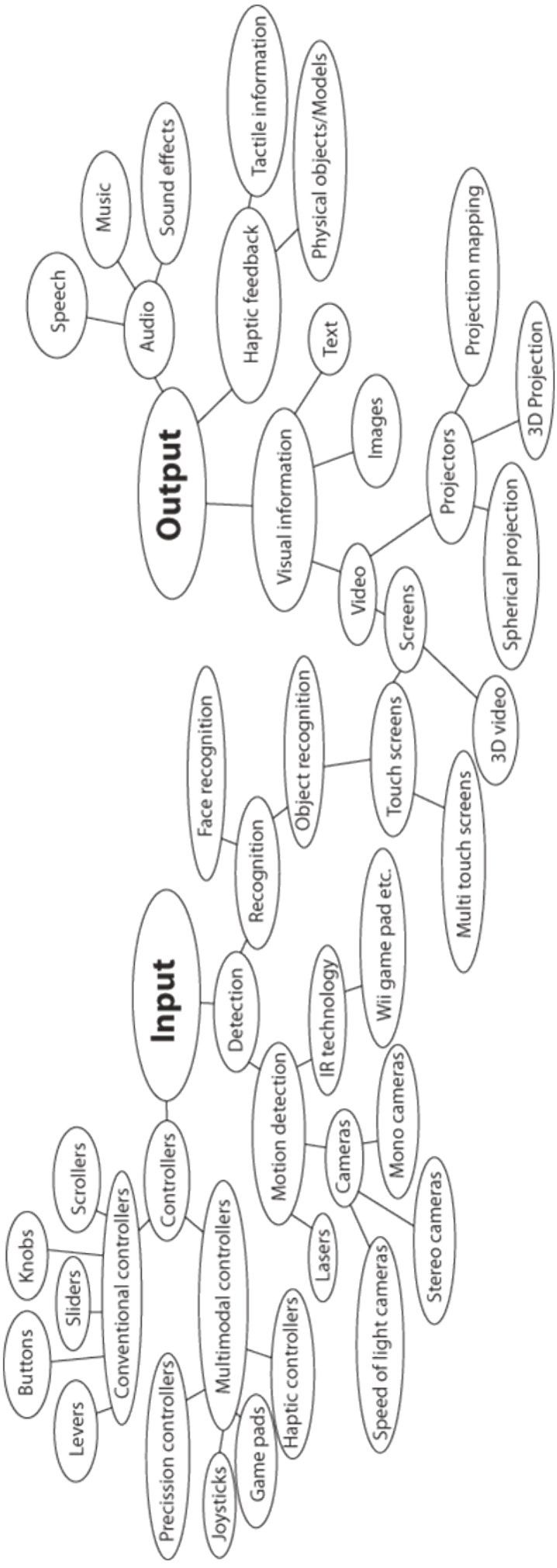
Green cells=big positive impact on exhibition popularity

Yellow cells=some positive impact on exhibition popularity

Red cells=negative impact on exhibition popularity

	Ensto	Siemens	Sevvodan/Niko	Novum	Delta	Brennenstuhl	Helakabel
	20x10	10x30	15x5	15x10	15x5	15x5	15x3
3	3	3	3	3	2	1	1
ches. roduct at	About eight. Some products on tables and on unusual looking shelves.	About eight exhibits, one small wind power plant and one large product on the floor.	Two screenwalls with information, one table with products and a ball throwing game.	Four product shelves and one armwrestling game. Very open.	Three installations showing products on benches.	Two brochure stands and three product shelves.	One shelf with brochures.
t the work	No, but products you can touch and hold.	Touchscreen showing Siemens business.	Throwing competition.	The armwrestling game.	No	No	No
, both on nd on the	Green on floors and on signs, otherwise clean white surfaces. Nice graphics in the same colour palette and good lighting.	Turquoise	Mostly white and grey.	Yellow and black on installations, posters and floors.	Blue, white and green, both on floor and posters.	Not very distinct. Red chairs.	Black walls, grey floor. Colourful cabel-wall.
focus on ike a high store.	Geometrical shapes and good quality plastic installations. One large arc shaped in the centre and a food service at the edge. Good lighting	Nice sofas, tables and plants creating livingroom feeling. Two-sided bar and installations. White passage in the middle and black floor under the installations.	Spinnable information signs and a bar table.	Large bar in the centre. Black passage in the floor that leads to the bar. Installations on the sides.	One bar table, otherwize just their products.	One bar table and one regular. Looks like a hardware store. Strong lights.	Room surrounded by cable walls. Two bar tables.
ar.	Pens, sausages and drinks.	Coffee and cookies in the bar.	Chocolate, fruit and coffee.	Ice-cream and drinks in the bar.	No	Brochures	Coffee
red.	Green and white striped shirts with grey pants.	Mostly men in black.	Young model girls and some workers. All dressed in black polos.	Men in black.	Not dressed the same way.	Two persons showing products. Dressed in jackets.	Few, dressed in black.
	One at the food service desk and one in a corner showing nice movies.	At the installations and one large at the bar.	One computer.	No	Large screen showing nice case study movie.	No screens	No
at a	Pictures at the walls.	Large cubicle shaped in the ceiling.	In the ceiling.	Large with logo behind the bar.	On the walls.	Some on the wall.	Only some prints at the walls.
	The arc shape with logos and signboards on top.	Large posters above the bar. Nice tree poster at the "livingroom" and large Siemens products.	The spinnable information signs and the ceiling poster.	Large poster above the bar.	Signboard in ceiling.	One large poster with logo in ceiling. No attractor on the floor.	The cable walls.
	-	-	Throw balls in holes to score points and win an iPod.	-	-	-	-

APPENDIX IX - MEDIA TECHNOLOGY TOOLBOX



APPENDIX X - QUESTIONNAIRE

Smarta Elnät

Tack för att du tar dig tid att fylla i denna enkät. Resultatet kommer användas i ett examensarbete vid Chalmers tekniska högskola som kommer mynna ut i en utställning om Smarta Elnät.
Din medverkan är helt anonym och mycket betydelsefull för vårt fortsatta arbete.

Jag är...

- ○ Under 25 år
- ○ 25-40 år
- ○ Över 40 år

Utbildning

Välj den senast avslutade eller pågående utbildningsnivån!

- ○ Högskoleutbildning inom teknik
- ○ Annan högskoleutbildning
- ○ Gymnasieutbildning inom teknik
- ○ Annan gymnasieutbildning
- ○ Övrigt: _____

Bransch

- ○ Student
- ○ Politiker
- ○ Statsplanerare
- ○ Elproduktion
- ○ Eldistribution
- ○ Elinstallation
- ○ Övrigt: _____

Smarta Elnät

Frågor

Fråga 1. Vad anser du ingår i begreppet Smart Elnät?
Kryssa i en eller flera rutor!

- [ ] Elbilar
- [ ] Solceller
- [ ] Nya elmätare
- [ ] En ny slags elektricitet
- [ ] Nytt sätt att transportera ström
- [ ] Kommunikation
- [ ] Infrastruktur
- [ ] Förnybar energi
- [ ] Elsäkerhet
- [ ] Övrigt: _____

Fråga 2. Hur kommer det Smarta Elnätet uppstå? Vilken av nedanstående beskrivningar anser du vara korrekt?
Välj ett alternativ!

- ( ) Det smarta elnätet bygger på nya upptäckter som möjliggör en revolution av elnätet.
- ( ) Det smarta elnätet är en evolution av de existerande el- och kommunikationsnäten.

Fråga 3. Fördelarna med det smarta elnätet anses vara många. Vilka anser du vara viktigast?
Rangordna fördelarna nedan i förhållande till varandra! 1 är viktigast, 5 är minst viktig. Använd varje siffra endast en gång.

	1	2	3	4	5
Ger en säkrare elförsörjning	( )	( )	( )	( )	( )
Möjliggör en elektrifiering av fordonssektorn	( )	( )	( )	( )	( )
Förbättrar energikvaliteten	( )	( )	( )	( )	( )
Gör elanvändningen mer effektiv	( )	( )	( )	( )	( )
Möjliggör utbyggnad av förnyelsebara energikällor	( )	( )	( )	( )	( )

Smarta Elnät

Fråga 4. Vilka tror du är de främsta flaskhalsarna vid utbyggnad av ett smart elnät?
Rangordna alternativen nedan i förhållande till varandra. 1 är främsta flaskhalsen och 5 är den minst viktiga. Använd varje siffra endast en gång.

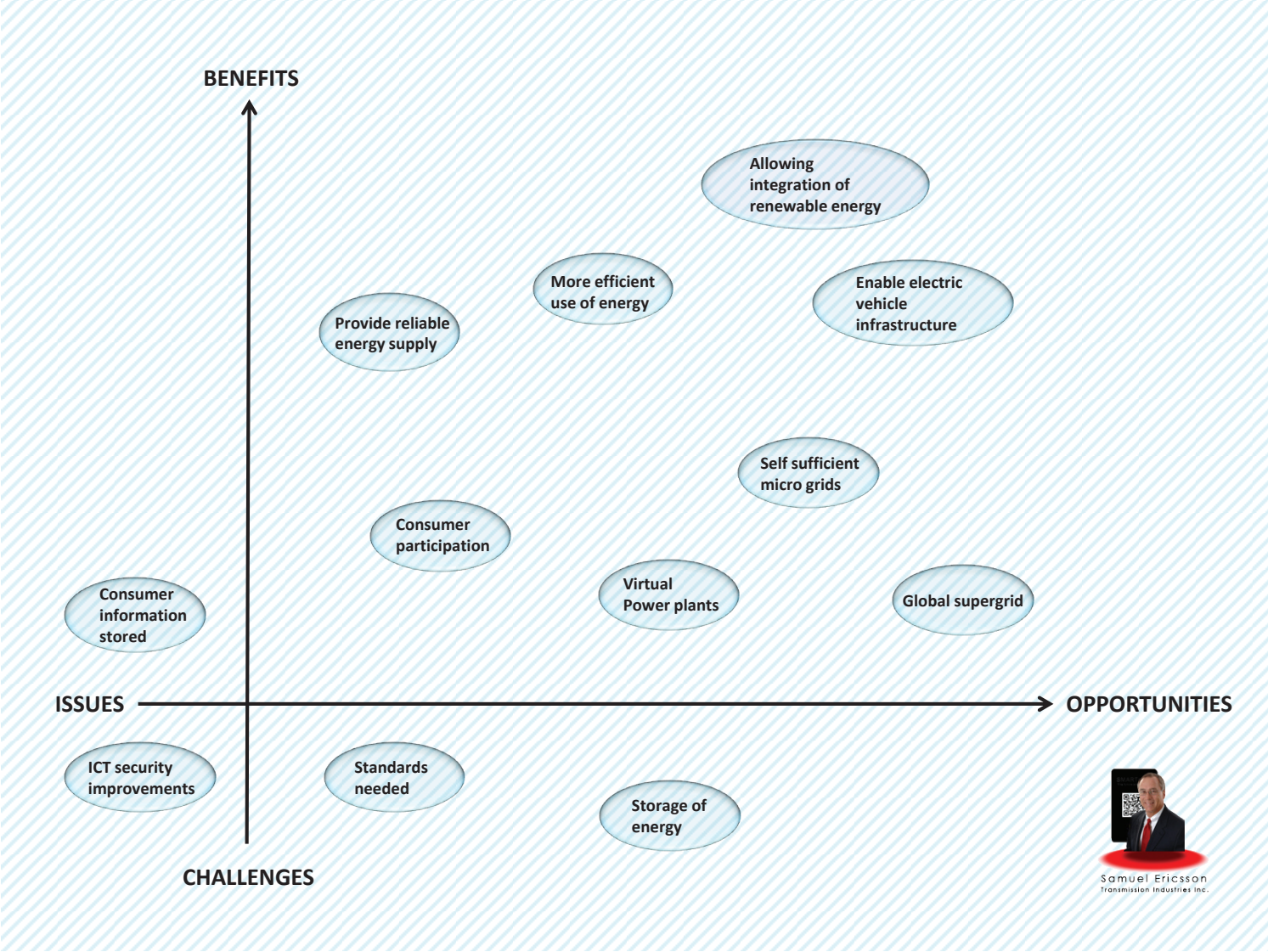
	1	2	3	4	5
Nya marknadslösningar måste komma fram för att investeringarna ska ta fart	○	○	○	○	○
Tekniken och produkterna som behövs behöver utvecklas/förbättras	○	○	○	○	○
Det saknas politiska styrmedel för att reglera utbyggnaden	○	○	○	○	○
Privatkonsumenter saknar vilja att påverka sin elanvändning	○	○	○	○	○
Standarder behöver tas fram för att den nya tekniken ska få genomslag	○	○	○	○	○

Fråga 5. Vad skulle du helst lära dig mer om inom smarta elnät?
Välj ett eller flera alternativ!

- ☐ Nya marknadsförutsättningar
- ☐ Affärsmöjligheter och hur man kan tjäna pengar
- ☐ Ny kommunikationsteknik
- ☐ Nya produkter
- ☐ Tidsram för utvecklingen
- ☐ Hur elbilar kan passa in i ett smart elnät
- ☐ Vilka aktörer som finns idag och vilka nya som kan tillkomma
- ☐ Specifika fallstudier/exempel på vad som händer på området
- ☐ Övrigt: _____

Fråga 6. Vilka effekter tror du att utbyggnaden av ett smart elnät kommer ha på din branch?

APPENDIX XI - BOCI ANALYSIS



APPENDIX XII - KR-MATRICES

KR-matrix

Temporary exhibition

		x	Technology & construction					Visitor impact						Content	Usability		Context			Aesthetical appearance			Communication & Learning				Max score:	23		
			Reliable operation	Feasable design	Allow mobility	Fascilitate maintenace	Be percieved as innovative	Inform about SG	Present Siemens Solutions	Tell story	Provide interaction	Induce discussions	Elicit emotions	Fascilitate content flexibility	Intuitive understanding for first time users	Deepend functionalities for experienced users	Relate information content to context	Relate design to context	Allow flexible placement	Express Siemens core values	Express innovation/futurism	Fit into Siemens fascilities	Catch attention	Maintain attention	Engage visitor	Adapt content	Score y	Score x	Total Score	Weighting
	y																													
Technology & construction	Reliable operation		0																								0	9	9	**3**
	Feasable design		y	0																							1	13	14	**3**
	Allow mobility		y	x	0																						1	10	11	**3**
	Fascilitate maintenace		x	x	x	0																					0	1	1	**1**
	Be percieved as innovative		y	y	y	y	0																				4	13	17	**4**
Visitor impact	Inform about SG		y	y	y	y	y	0																			5	17	22	**5**
	Present Siemens Solutions		y	y	y	y	y	x	0																		5	16	21	**5**
	Tell story		y	y	y	y	y	x	x	0																	5	14	19	**4**
	Provide interaction		y	y	y	y	x	x	x	x	0																4	8	12	**3**
	Induce discussions		y	y	y	y	y	x	x	y	y	0															7	12	19	**4**
	Elicit emotions		y	y	y	y	y	y	y	y	y	y	0														10	13	23	**5**
Content	Fascilitate content flexibility		y	x	y	y	x	x	x	x	y	x	x	0													4	9	13	**3**
Usability	Intuitive understanding for first time users		y	x	y	y	x	x	x	x	y	x	x	y	0												5	9	14	**3**
	Deepend functionalities for experienced users		x	x	x	y	x	x	x	x	x	x	x	x	x	0											1	1	2	**1**
Context	Relate information content to context		y	x	x	y	x	x	x	x	y	x	x	x	x	y	0										4	5	9	**3**
	Relate design to context		x	x	x	y	x	x	x	x	x	x	x	x	x	y	x	0									2	1	3	**2**
	Allow flexible placement		x	x	x	y	x	x	x	x	x	x	x	x	x	y	x	y	0								3	2	5	**2**
Aesthetical appearance	Express Siemens core values		x	x	x	y	x	x	x	x	x	x	x	x	x	y	x	y	x	0							3	1	4	**2**
	Express innovation/futurism		x	x	x	y	x	x	x	x	x	x	x	x	x	x	x	y	y	y	0						4	2	6	**2**
	Fit into Siemens fascilities		x	x	x	x	x	x	x	x	x	x	x	x	x	y	x	x	y	x	x	0					2	0	2	**1**
Communication & Learning	Catch attention		x	x	x	y	x	x	x	x	x	x	x	x	x	y	y	y	y	y	y	y	0				8	1	9	**3**
	Maintain attention		y	y	y	y	x	x	x	x	y	x	x	y	y	y	y	y	y	y	y	y	y	0			15	1	16	**4**
	Engage visitor		y	y	y	y	y	x	x	x	y	y	x	y	y	y	y	y	y	y	y	y	y	y	0		18	1	19	**4**
	Adapt content		x	x	x	y	x	x	x	x	x	x	x	x	x	y	y	y	x	y	x	y	x	x	x	0	6	0	6	**2**
	Score x		9	13	10	1	13	17	16	14	8	12	13	9	9	1	5	1	2	1	2	0	1	1	1	0				

KR-matrix

Outdoor exhibit

		Attention	Context			Max score:	3	Max weight:	2
		Evoke interest	Withstand weather	Withstand vandalism	Relate to context	Score y	Score x	Total Score	Weighting
Attention	Evoke interest	0				0	3	3	**3**
Context	Withstand weather	x	0			0	1	1	**2**
	Withstand vandalism	x	x	0		0	0	0	**1**
	Relate to context	x	y	y	0	2	0	2	**2**
	Score x	3	1	0	0				

APPENDIX XIII - LIST OF REQUIREMENTS

List of requirements

Temporary exhibition

	Function denomination	**Notes/Limits**	**Weighting**
Technology & construction	Reliable operation	Robust and simple technology and construction	3
	Feasable design	Realisable with modern technology, cost comparable with similar fair installations.	3
	Allow mobility	Few loose parts, few connections, fascillitate assembly/disassembly, allow transportation.	3
	Fascilitate maintenace		1
	Be percieved as innovative	By stakeholders and visitors.	4
Visitor impact	Inform about SG	See EDS	5
	Present Siemens Solutions	As THE partner and provider of products, solutions and services for the SG development. Siemens is an honest, trustworthy and practical company. They don't make promises they cannot keep.	5
	Tell story	Not only presenting data. Dramaturgical finesse needed.	4
	Provide interaction	To engage and enhance learning.	3
	Induce discussions	That ultimately lead to actions and decisions	4
	Elicit emotions	According to Emotional profile.	5
Content	Fascilitate content flexibility	Content will change often and needs to be updated.	3
Usability	Intuitive understanding for first time users	Target group: Industry & Authority	3
	Deepend functionalities for experienced users	Siemens employees	1
Context	Relate information content to context	Relate to the permanent exhibition when placed in the USC and function independently when placed in other contexts.	3
	Relate design to context	USC: part of bigger concept; conferences, performances etc.	2
	Allow flexible placement	In conference rooms, office spaces and similar.	2
Aesthetical appearance	Express Siemens core values	Employees, Excellence, Innovation, Efficiency.	2
	Express innovation/futurism		2
	Fit into Siemens fascilities	The USC, other Siemens offices, conference fascilities, trade shows etc.	1
Communication & Learning	Catch attention	Eg. Attractor	3
	Maintain attention		4
	Engage visitor		4
	Adapt content	To target group	2

List of requirements

Outdoor exhibit

	Function denomination	Notes/Limits	Weighting
Attention	Evoke interest	Arround the USC and/or Smart Grid. Target audience: Broad Public. People walking by and/or driving by and/or flying over.	3
Context	Withstand weather		2
	Withstand vandalism		1
	Relate to context	Building, garden and other outdoor elements.	2

STAKE HOLDER REQUIREMENTS

Project owners

Deep-dive, customer specific exhibition
Targeting industry, authority (and public to some extent).
Innovative, futuristic exhibition.
Global perspective.
Fresh input, not siemens view.
Encourage discussion.
Exhibition should be mobile.
Outdoor exhibit should be vandal proof.

Siemens Office Nottingham

Present and create interest in Siemens products.
Send different messages to different actors.
"There should be SIEMENS all over the place in the corporate crystal".
"We don't want people to wait for smart grid".
"Land owners are key decision makers".
Target housing associations.

Siemens Office Erlangen

Siemens is not a good provider, it's THE Smart Grid company!
We're not aiming at a fossil free future, but more renewable.
Present only the challenges Siemens can solve.
Use Siemens core values and express that it's a "German realistic company". "The future starts today".
No Smart Grid is the same. It depends on the situation and location.

Siemens Office Nürnberg

Present Siemens view on Smart Grid. "We're not a religion".
Smart Grid development has already started.
Focus on the areas that are not covered in the PE; actors, markets and product solutions.
TE needs to be flexibel and easy to update.
Avoid mentioning specific countries.
Show regional strategies rather than time strategies.

Siemens Tech. Akademie

Decreasing our carbon footprint is the main driver for a Smart Grid.
Siemens should be presented as THE green company!
Focus on cities and urban contexts.

Architect

Exhibition must fit into the USC context aesthetically.
Flexible location depending on the scope of the exhibits.
Spacious location, possibly conference rooms or offices.

EVENT

"80% public visitors, 10-20% schools and higher education and 1-2% Siemens customers".
Exhibits should have two layers of levels.
Event has ideas for the outdoor as well.
The TE must relate to the PE regarding style and content.

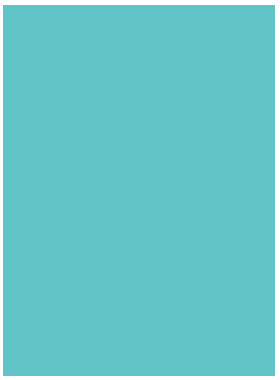
Siemens Sweden

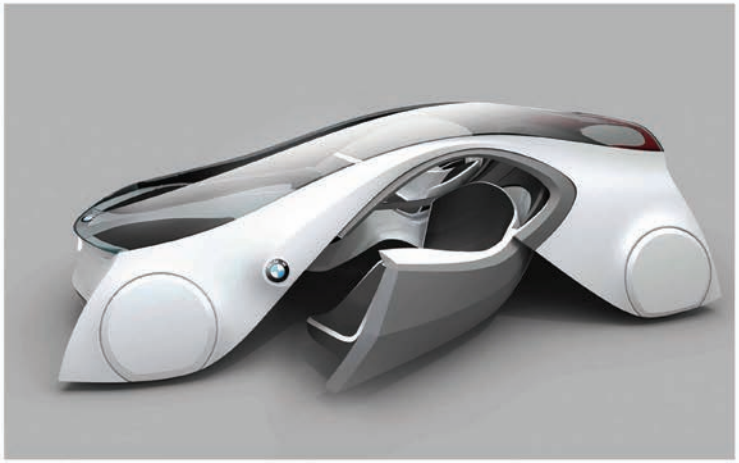
Look into the possibility of incorporating Swedish case studies.

Chalmers University

New, fresh ideas are needed. People in the business tend to think too conventional.
Exhibition needs to incorporate interactive objects.

APPENDIX XV - IMAGE BOARD





APPENDIX XVI - PERSONA

HEINZ-RUDY MERKEL

PERSONA

"People who produce good results feel good about themselves."

Age: 48

Born: Erlangen, Germany.

Education: M.Sc. In electro technology at Nürnberg Technische Universität.

Work experience: Siemens Erlangen, E.On Berlin, E.On London

Job description: Strategic purchaser for the distribution division

Family: Wife Carol and daughter Lucy

Interests: Fly-fishing

Heinz-Rudy grew up in the south of Germany but after valued achievements and advancement in the company E.On Germany he got the opportunity to transfer to England. He now works in E.On UK's London office on Pall Mall and lives with his family in Kingston Upon Thames outside of London,

He met his wife Carol on a company team building trip only three weeks after he had moved to England. She was one of the team building facilitators and was in charge of Heinz-Rudy's group. He likes to look back at their first glances on each other and their awkward first conversations as some of his fondest memories. They are now happily married since 17 years and are blessed with a 13 year old daughter, Lucy.

Even though Heinz-Rudy doesn't say so himself, Carol is clearly the one in charge in their home. This would definitely surprise the people that Heinz-Rudy works with who perceive him as quite demanding and resolute. Some people might even describe Heinz-Rudy as stubborn and arrogant but he himself prefers persistent and progress-driven.

Outside of work Heinz-Rudy is surprisingly quite active. He golfs as often as he can and swims laps a couple of times a month in the winter. But more than anything Heinz-Rudy is an avid fisherman. He enjoys fly fishing in the watercourses outside of Kingston and has a very impressive collection of flies.

APPENDIX XVII - BRAINSTORMING WORKSHOP RESULTS

2011-05-24

10:00-12:30

Participants: 8 students from industrial design engineering and engineering physics.

Results

The workshop was divided into four brainstorming sessions concerning the exhibition, how to communicate the topic of smart grid, how to use gaming as a method for learning and what to do with the outdoor space.

Session 1 – General exhibition ideas

- Use labyrinths to force meetings.
- Encourage a certain moving direction.
- Give more questions instead of clear answers to a question.
- Make it possible for one visitor to impact on other visitors or parts of the exhibition when interacting at one spot.
- Include installations or experiments that demand cooperation between different visitors.
- Encourage visitors to teach others.
- Make it possible to ”login” as yourself or as somebody else to get a feeling of what roles there are.
- Use “rich emotions”, thing you do that you don’t like but gives a richer experience, e.g. fascination over car accidents.
- Surprise the visitors without humiliate them.
- Induce hope and engagement instead of bad conscience.
- Use competitions and challenges.
- Use as little text as possible but still be informative.
- Make the visitors feel like children, use playfulness, but without making it childish.
- Build several floors and create rooms that the visitors can enter. Relate to the story that is told.
- Let the visitor decide over the future vision and create scenarios from decisions he/she makes along the way in the exhibition.
- An exhibition can either be like a one-way street where the visitors are led in a certain direction or it can be open for visitors to walk freely and “mingle”.
- Use personal stories, the anecdotes are remembered afterwards.
- It can be nicer to hearing information than to read.
- Create a lounge area on a higher level to get an overview of the exhibition.
- The exhibition should be easy to understand and engage with.
    - Individually adapted, you should not have to understand the technology to be interested.
    - Clear overview over the exhibition or being guided through the exhibition.

  - Clear examples of actual products presented in an interesting way.
  - Use audio.
  - Use physical models to encourage playfulness but keep it on a serious level.
  - Give the user possibility to affect the content.

- Read QR-code to gain deeper knowledge. iPhone app?
- Show calculations that show your own city's possible energy savings etc.
- Address the person and not only the worker to make him/her feel involved.
- Create stories and scenarios for the world where you can guess how the story continues.
- Create your own future city. Get print outs that you can bring back to your company.
- Use different height levels for different installations to promote and group certain things.
- Create the right experience by using lights that matches the message (Götatunneln).
- Present all parts of a system in the same way to make them comparable.
- Make the whole exhibition self sustained and transparent to show the technology.
- Not too much selective information at one time.

Session 2 – Visualizing smart grid

- Use the body and blood circulation as an analogy for the smart grid.
- Show the smart grid on different levels; world, country, city, household to make it easier to relate to this complex topic.
- Let the visitor create a grid in a city on a large screen by using physical models of components e.g. houses, wind power plants, and electric cars.
- Place a big city in the middle of the exhibition and give the message that smart grid is the core of the city. Let visitors gather around the city and participate in adapting it to future needs.
- Use lights in the floor that turns on when someone walks on them, like the "sustainable dance floor".
- Let the visitors contribute to the electricity generation needed in the exhibition.
- Have a large board/screen that shows all energy flows in a city, e.g. London. Let the visitors include new parameters/solutions and see how the flows are changing.
- Follow an electron's way in the grid.
- Visualize why smart grid is needed to enable more renewable power generation and also why it is good for me as a person.
- Make it clear what the benefits are with certain investments.
- Give scenarios, what happens if we don't do the necessary investments?
- Use Google earth so that the visitor can use his/her own city when building a virtual smart grid. One result can then be compared to other cities.

- Visualise the smart grid by connecting the wind, water, and solar panel parts etc. with a pulsating grid under a glass floor.
- Let the visitors act as the electricity! When they reach an installation it lights up as if supplied with energy.
- Smart grid on the floor: Follow it to different stations and learn about different aspects. Follow the electrons journey.
- Keep a tracker on each visitor so that the exhibition senses that someone is near. This device can also provide deeper information about the installation.
- Use real technology to power the exhibition. With transparency so that you see what powers what.
- Create miniature of a city by combining a multi touch table with physical objects. Wind farms, batteries, housing etc. Use Google earth as underlay.
- Merlin railway analogy: The target group is appealed by creating miniaturised versions of city systems.
- Incorporate workshop where the visitors are encouraged to build their own city. Collaboration.
- Ability to see how other parties interacted with the exhibition. “How did Belgium solve this?”
- Use physical model of the earth to illustrate the whole system with day and night consequences.

Session 3 - Use gaming for learning

- Not all people are of the same competitive nature. There can be more than one station that can stimulate different competitive personalities.
- It can be an intellectual challenge e.g. a riddle that you cannot stop thinking about.
- Have the visitors come up with solutions to smart grid related problems.
- The visitor can bring a challenge into the exhibition or having to answer a question/make a decision at each station.
- Perhaps a challenge must be solved before the visitor may enter the exhibition.
- The visitor could have a personal credit that increases when succeeding at a challenge.
- You should not be able to lose a game or finish last.
- Make it more of a game than a competition.
- The visitor could receive a receipt or price to bring home.
- Create a relaxed environment to attract visitors to a game.
- Have a mini game at the virtual city. Give the user 5 minutes to build a smart grid as large as possible.
- Let companies compete and put the winner’s logo on a price board.
- Keep it on the right level. Cannot be perceived as silly.
- Have a quiz at every station. Not too hard and completely voluntary.
- Present a challenge at every station. You don’t have to do all of them, you can choose the ones you’re interested in. Your results are then summarised at the end.
- A game where you are assigned a certain amount of money to start with and then try to reduce energy consumption and emissions. You then get feedback on how you did and why things happened like they did and what services, solutions or strategies that may have helped.

- The participants need to be able to communicate this to their company when they come back! They receive a give-away to take home that communicates their results in the game. A certificate, a trophy, a MIG-game, a video of your game, screenshot?

Session 4 – Outdoor space

- Make the installation big to attract interest and make it visible from above.
- Relate to the green/sustainable theme by using plants, trees etc.
- Make it sculptural, something to climb at or walk into.
- Create a globe that symbolized the green house effect.
- Make an inverted globe that you can enter and see the worlds energy use inside.
- Have fewer impressions outside to make it a more relaxing place.
- Use “jumping water” to get a feeling of life and action.
- A garden that communicates “greenness” and that a smart grid will not reduce life quality.
- A “legoland” city with a smart grid in it.
- Sculptural installation with different levels to walk up into. You are directed to different viewpoints that look out over London’s different “sustainable sights”.
- Something (model of the earth) where you can see the different in energy usage in the western world compared to the rest.
- Show a challenge/task/question. Solution inside.
- Create something spectacular that you can see from the air (airplane). E.g. huge pond with islands in the shape of a world map. At night LED lights will show how the population is spread over the world and how the cities can be connected with a smart grid.
- Create a harmonic place to go out into and reflect on the content inside. Nice to come out for a break.

APPENDIX XVIII - PUGH-MATRICES

PUGH-Matrix

Temporary exhibition concepts

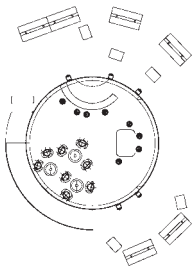
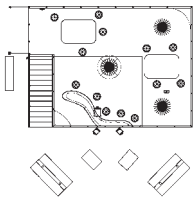
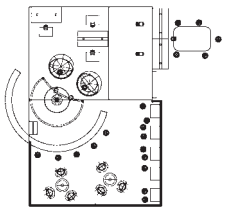
		Reference	Concept 1, Circle		Concept 2, Tunnel		Concept 3, Mingle	
Function denomination	**Weighting**	**Siemens exibition CIRED**	**Score**	**Weighted score**	**Score**	**Weighted score**	**Score**	**Weighted score**
Reliable operation	3	0	-	-3	-	-3	-	-3
Feasable design	3	0	-	-3	-	-3	-	-3
Allow mobility	3	0	0	0	-	-3	0	0
Fascilitate maintenace	1	0	-	-1	-	-1	-	-1
Be percieved as innovative	4	0	+	4	+	4	+	4
Inform about SG	5	0	+	5	+	5	+	5
Present Siemens Solutions	5	0	+	5	+	5	+	5
Tell story	4	0	+	4	+	4	+	4
Provide interaction	3	0	+	3	+	3	+	3
Induce discussions	4	0	+	4	+	4	+	4
Elicit emotions	5	0	+	5	+	5	+	5
Fascilitate content flexibility	3	0	+	3	+	3	+	3
Intuitive understanding for first time users	3	0	0	0	0	0	0	0
Deepend functionalities for experienced users	1	0	-	-1	-	-1	0	0
Relate information content to context	3	0	0	0	0	0	0	0
Relate design to context	2	0	0	0	0	0	0	0
Allow flexible placement	2	0	-	-2	-	-2	0	0
Express Siemens core values	2	0	+	2	+	2	+	2
Express innovation/futurism	2	0	+	2	+	2	+	2
Fit into Siemens fascilities	1	0	-	-1	-	-1	-	-1
Catch attention	3	0	+	3	+	3	+	3
Maintain attention	4	0	+	4	+	4	+	4
Engage visitor	4	0	+	4	+	4	+	4
Adapt content	2	0	+	2	+	2	+	2
			Total score:	**38**	**Total score:**	**35**	**Total score:**	**41**

PUGH-Matrix

Concept 1: **5** **Concept 2:** **14** **Concept 3:** **-19**

Temporary exhibition concepts

		Concept 1 vs Concept 2		Concept 2 vs Concept 3		Concept 3 vs Concept 1	
Function denomination	**Weighting**	**Score**	**Weighted score**	**Score**	**Weighted score**	**Score**	**Weighted score**
Reliable operation	3	+	3	0	0	-	-3
Feasable design	3	0	0	-	-3	+	3
Allow mobility	3	0	0	-	-3	+	3
Fascilitate maintenace	1	0	0	-	-1	0	0
Be percieved as innovative	4	-	-4	+	4	-	-4
Inform about SG	5	0	0	0	0	0	0
Present Siemens Solutions	5	0	0	0	0	0	0
Tell story	4	-	-4	+	4	-	-4
Provide interaction	3	-	-3	0	0	0	0
Induce discussions	4	0	0	+	4	-	-4
Elicit emotions	5	0	0	+	5	-	-5
Fascilitate content flexibility	3	+	3	-	-3	+	3
Intuitive understanding for first time users	3	+	3	-	-3	0	0
Deepend functionalities for experienced users	1	0	0	0	0	0	0
Relate information content to context	3	0	0	0	0	0	0
Relate design to context	2	0	0	0	0	0	0
Allow flexible placement	2	+	2	-	-2	+	2
Express Siemens core values	2	0	0	0	0	0	0
Express innovation/futurism	2	0	0	+	2	-	-2
Fit into Siemens fascilities	1	0	0	0	0	0	0
Catch attention	3	+	3	+	3	-	-3
Maintain attention	4	-	-4	+	4	-	-4
Engage visitor	4	-	-4	0	0	+	4
Adapt content	2	0	0	-	-2	+	2
		Total score:	**-6**	**Total score:**	**8**	**Total score:**	**-11**

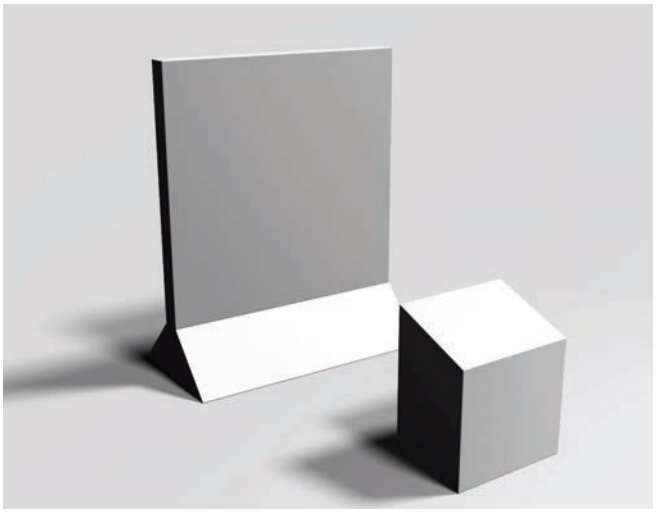
CONCEPT SURVEY

TEMPORARY EXHIBITION ON SMART GRID & OUTDOOR EXHIBIT FOR THE USC

Oskar Karlsson & Petter Polson
2011-07-11

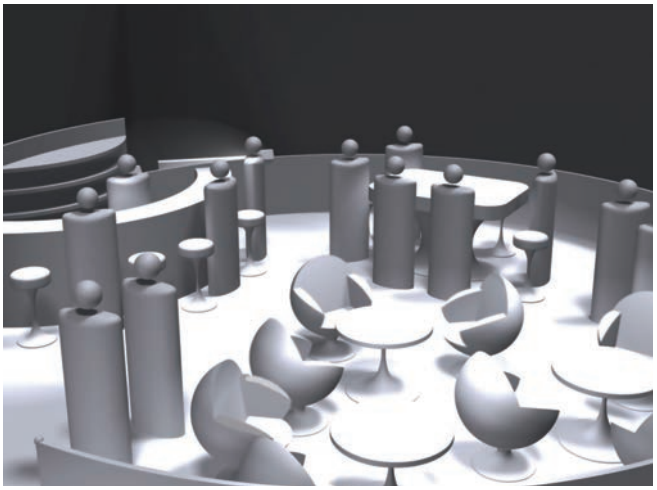
YOUR NAME:

GENERAL CONCEPTS



CONCEPT 0.1

- Use modules and projectors for flexibility.
- Enable mobility for the entire exhibition.
- Maintain flexibility in content and make it easy to update.



CONCEPT 0.2

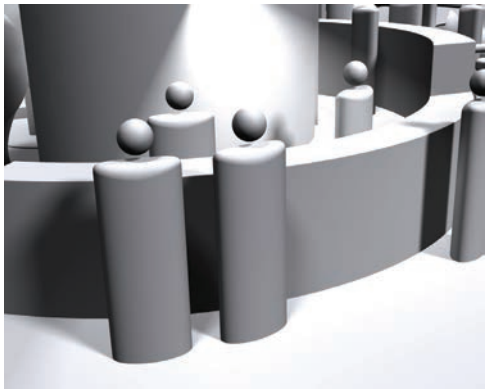
- Include a lounge area at the end of the exhibition.
- Visitors can sit down, have a drink and discuss solutions and/or cases in a relaxed atmosphere.
- Emphasizes that Siemens take care of their customers and is a safe and reliable collaboration partner in the Smart Grid field.

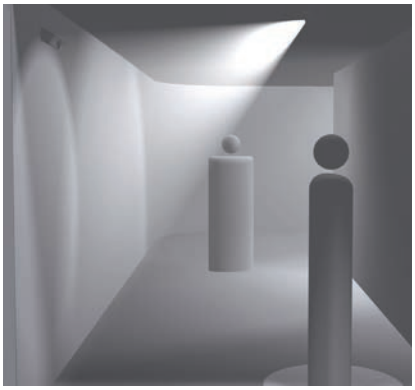
WRITE YOUR COMMENTS HERE:

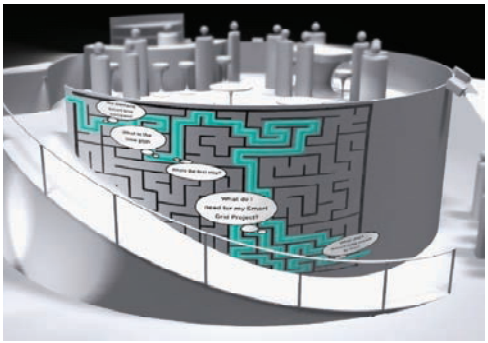
GENERAL CONCEPTS

CONCEPT 0.3 - SMART-PASS

- Check-in counter where visitors are registered.
- Visitor information is stored to a Siemens account and linked to a SMART-pass.
- Information e.g. product descriptions and case studies etc. is stored in the Siemens account and can be accessed via the web after the visit.
- Through face recognition technology a visitor's picture can be linked to his/her SMART-pass and Siemens account.







CONCEPT 0.4 - THE PATH TO THE SMART GRID

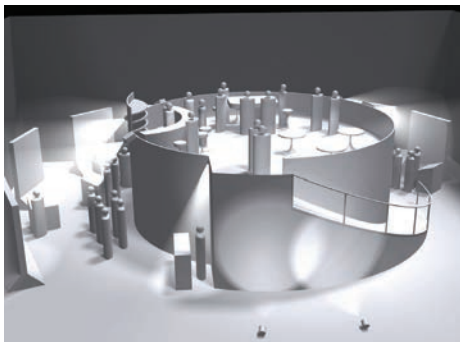
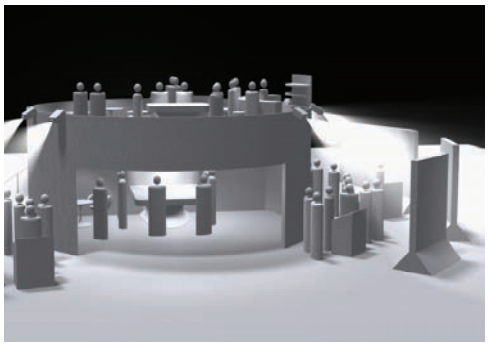
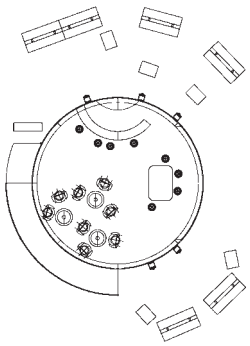
- Maze on the wall by the staircase as a metaphor for the different challenges in finding the right path towards the smart grid.
- Every project is different but Siemens offers consultation and tailor made solutions for customers all over the world.
- Siemens enlightens the path when climbing the stairs towards the smart grid solutions.

WRITE YOUR COMMENTS HERE:

STRUCTURE

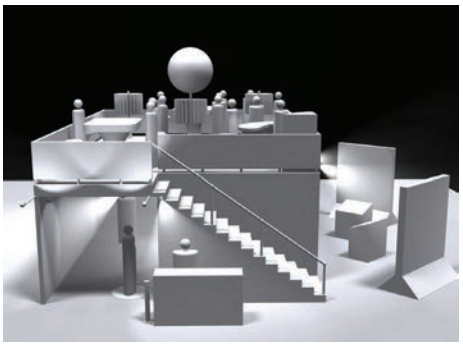
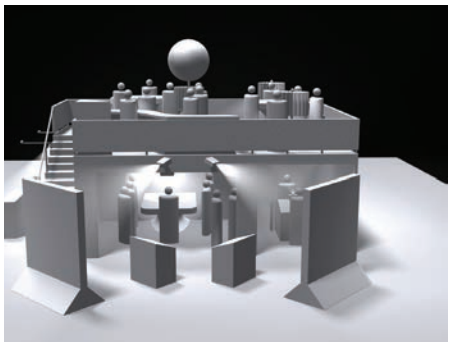
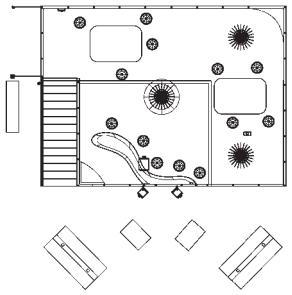
CONCEPT 0.5

- Two story, round structure with lounge on 2nd floor.
- Room underneath the lounge and hidden room for storage under the staircase.

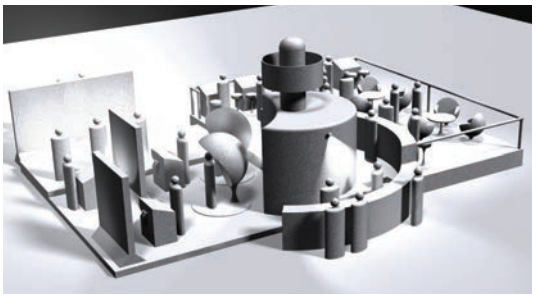
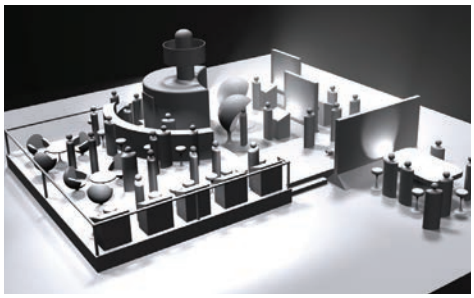
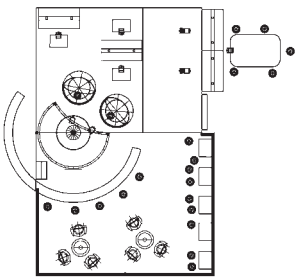
CONCEPT 0.6

- Two story, square structure with lounge on 2nd floor.
- Tunnel at entrance that leads to a room underneath the lounge.

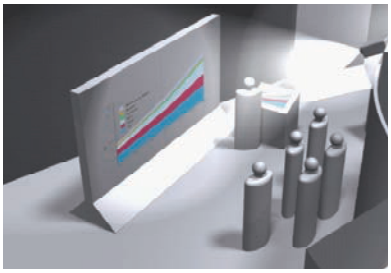
CONCEPT 0.7

- One story construction with three levels.
- Module based exhibition on the two first levels and lounge on third level.

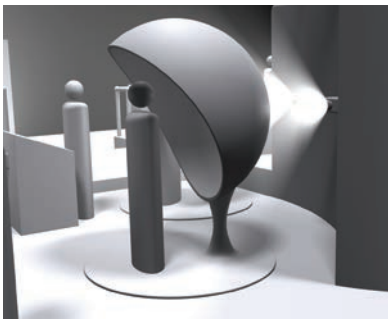
WHICH CONCEPT DO YOU PREFER? WRITE YOUR COMMENTS HERE:

STATION 1 - SMART GRID INTRODUCTION



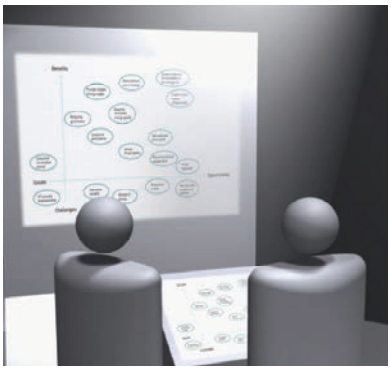
CONCEPT 1.1

- Guide presenting background information.
- Shows that the drivers for a smart grid are many.



CONCEPT 1.2

- Back projected dome modules showing background movie.

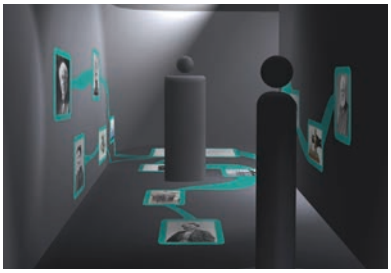


CONCEPT 1.3

- Interactive module with BOCI-analysis.

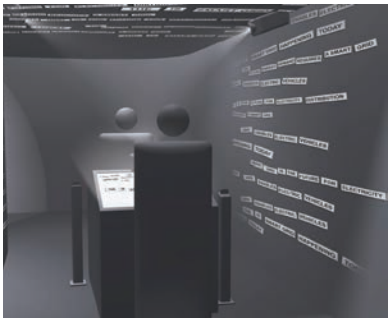
CONCEPT 1.4

- Movie showing futuristic vision of world connected with super grids.



CONCEPT 1.5

- Timeline on tunnel walls giving historical background.
- Putting Siemens among famous scientists.



CONCEPT 1.6

- Digital kitchen magnets for user to write their definition of a smart grid.
- Sentences are projected on walls and ceiling.

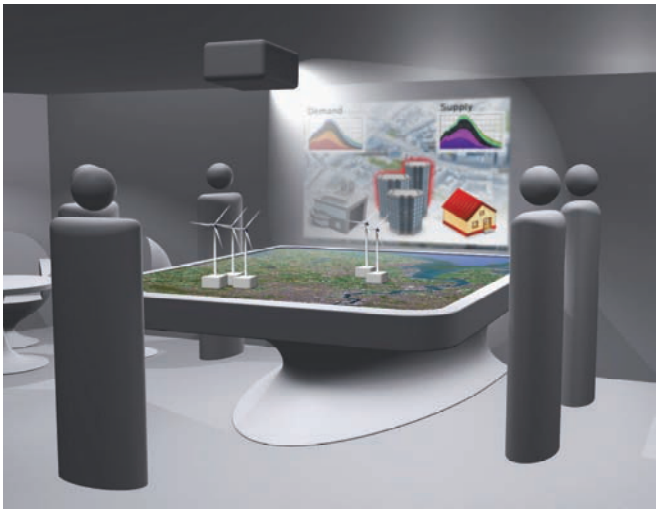
CONCEPT 1.7

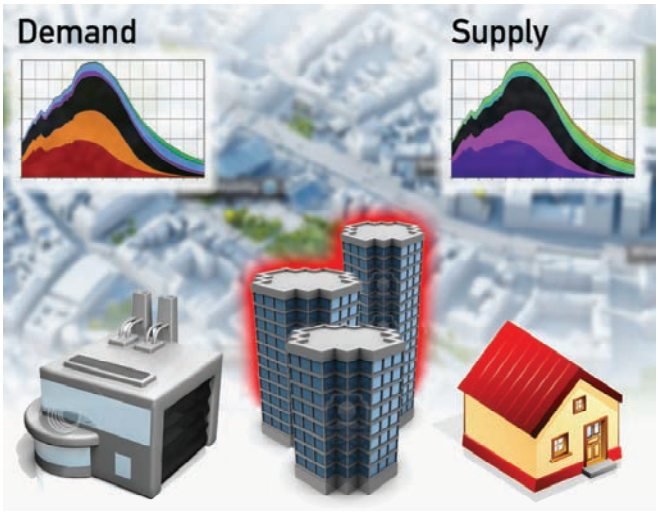
- Interactive module where the user can estimate numbers and create future scenario.

WHICH CONCEPTS DO YOU PREFER? WRITE YOUR COMMENTS HERE:

STATION 2 - ACTORS AND MARKETS

CONCEPT 2.1 - SMART GRID SIMULATION GAME





Purpose

- Induce learning by giving a real time experience.
- Gain a deeper understanding how smart grid works and what challenges there are.
- Meeting platform for different actors to discuss smart grid matters.
- Raise important questions.

Game design

- Four players participate at the same time, playing with each other.
- Screen showing status for the sectors, electricity balance and monetary assets.
- Players interact by putting physical models on screen with object recognition.

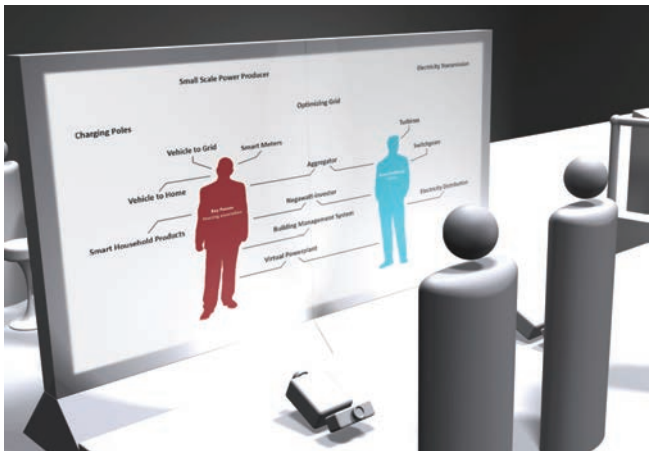
Game idea

- Create and maintain balance between supply and demand.
- Earn as much money as possible by supplying electricity as efficient as possible.
- Work together to build the smart grid.

Game flow

- Movie gives the background situation and challenge.
- Moderator introduces rules for simulation.
- Chaos-based flow with possible breaks where moderator induces discussions.

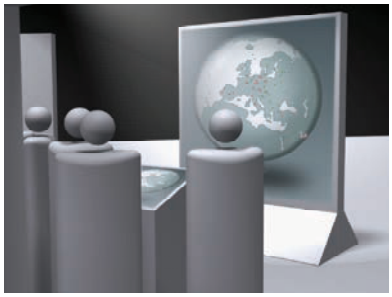
CONCEPT 2.2 - INTERACTIVE MOTION DETECTION SCREEN



- Interactive module showing new and old market opportunities as bubbles around a silhouette of the user.
- Possibility to compare with other businesses and users.

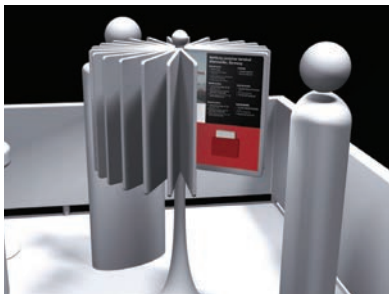
WRITE YOUR COMMENTS HERE:

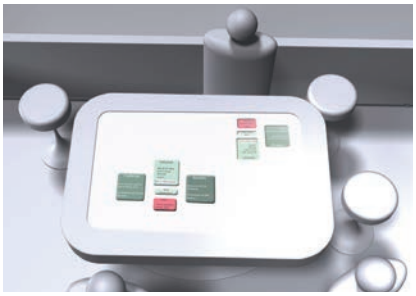
STATION 3 - CASES AND SOLUTIONS



CONCEPT 3.1

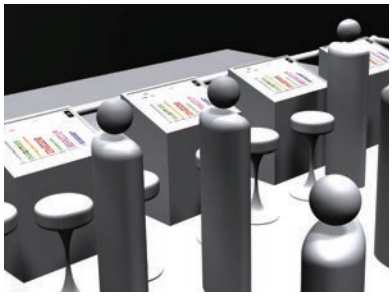
- World map with dots representing Siemens's presence.
- Interactive touch screen with moreinformation about each case.
- Make use of Siemens virtual city software for product presentation.
- Siemens personnel presenting around a large touch screen table.





CONCEPT 3.2

- Posters showing Siemens cases in colour coded categories.
- Case cards to pick up at each case poster to use and bring home.
- Object recognition tables to place case cards on and get case and product information.
- Interesting information can be stored on the exhibition account and accessed from home.

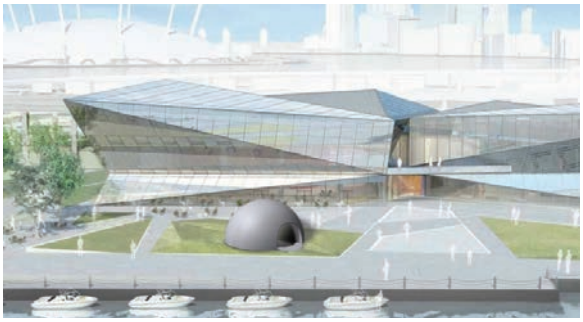


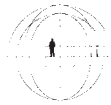
CONCEPT 3.3

- Interactive modules with cases and products represented by icons.
- Icons can be categorized in different ways for intuitive information access.
- Possibility to store information on exhibition account by swiping the icon to the SMART-pass symbol.

WHICH CONCEPT DO YOU PREFER? WRITE YOUR COMMENTS HERE:

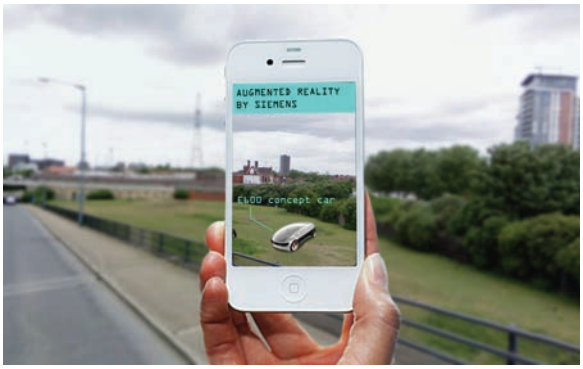
OUTDOOR CONCEPTS





CONCEPT 4.1 – INVERTED GLOBE

- Grass covered half sphere above ground, half sphere below.
- Visitors go inside the sphere in small groups to a platform in the centre.
- Earth projected on the inside wall to illustrate sustainability issues.
  - -Earth by night – electricity use worldwide.
  - -Countries size proportional to resource use.
  - -World energy supply from the desert areas.



CONCEPT 4.2 – AUGMENTED REALITY

- For smart phone users or by having special goggles in place.
- Put virtual objects in a real environment.
- Show pictures of visionary sustainable future.

CONCEPT 4.3 –

RENEWABLE ELECTRICITY

- Use water area for wind, wave and solar power production.
- Generate electricity to supply e.g. a plasma ball onshore.
- Attract attention to the fluctuation of renewable energy.

CONCEPT 4.4 – THE EGG

- Large oval shaped installation with inner and outer surface.
- Download an app for your smart phone and answer today's question.
- See your face and answer floating around on the inner surface.

WHICH CONCEPT DO YOU PREFER? WRITE YOUR COMMENTS HERE:

APPENDIX XX - CONCEPT SURVEY RESULTS

Name	General Concepts	General	Structure
	Modules & Lounge	**Smart Pass & Maze**	
Werner Kruckow	both concepts are right and important - let's see what we can physically implement	a) the smart pass is a given to me as this is basically the same concept as in the main exhibition hall with the RFID tags. b) I have my doubts about the practicality of the path to the smart grid as this wil mostly happen in the corporate crystal which means we need to have a simple and cost effective temporary solution or any sophisticated permanent updatable solution.	From a practcal point of view I would eliminate concept 5 and 6 and I am still sceptical about concept 7. Let's see ...
Jo Hensher	The flexibility and updatability are very important	Concept 0.3 - it may be too much to have a separate check in counter for this exhibition. I would suggest exploring the option of linking with the main exhibition check-in as it will also use smart cards/RFID tagging Concept 0.4 - A two-storey exhibition may reduce its ability to be placed elsewhere. In addition we would need to check that it would comply with the UK's disability discrimination act	
Bettina Peck	concept needs to be flexible to make updates easy. Achieved with concept 1. Idea of lounge area also good as it gives us the opportunity to have a conversation within a more relaxed atmosphere	smart card idea very good. could be linked with the general exhibition idea. concept 0.4. in general interesting but needs to be checked if we have enough space for this.	concept 5 or 6 depends on how much space we have and where. preferred option is 6 concept 8 too "busy".
Annette Diziol, PB	Concept 1: Flexible, easy to transport and relocate. Can be incorporated into almost any roof shape. very suitable for the building. Concept 2: Idea to conclude a visit of the temporary exhibition at a cafe/lounge area is very good. Use of cafe/ break out space at level 1 over the shop advisable. Additional cafe/lounge spaces will be cost intensive and not easy to incorporate at this stage.	Concept 3: Smart pass. Very appropriate for a high tech company such as Siemens. Concept 4: Double storey temporary arrangements are difficult to include into the building.	Unfortunately 2 storey elements are difficult to incorporate into the building height and space wise. A level arrangement that is coordinated with teh layout of the spaces in the pavilion would work best

Name	STATION 1 - SMART GRID INTRODUCTION	STATION 2 - Actors and Markets
Werner Kruckow	I like 1.1, 1.4, 1.6 and 1.7	My favourite is 2.1 - cost?
Jo Hensher	Most prefer - 1.1, 1.3, 1,4	Prefer 2.1
Bettina Peck	except 1.2. I think all concepts are interesting. It will depend what we will exhibit we then should decide which concept to apply.	concept 2.1. preferred option
Annette Diziol, PB	Concept 1.5 / 1.6/1.7 are my favorite. Especially the tunnel with the time line and the kitchen magnets is powerful, play full and intelligent. It will be remembered by visitors. Further it is an element which is not included in the Event exhibition design	Concept 2.1. It may be beneficial to discuss with Event the set and content of their city game in order to expand the content and not to provide repeat experiences.

Name	STATION 3 - Cases and Solutions	Outoor concepts
Werner Kruckow	3.1 is attractive to me	you convinced me about 4.4 in our call 4.1 won't be feasible as we cn't go underground I was told 4.2 I don't see a big impact 4.3 please investigate further what is feasible as we don't use the water at all yet
Jo Hensher	Like 3.2 and 3.3 as visitor can take home the information	There are many things to consider when designing the outdoor exhibits. - the majority of the land surrounding the building is not the responsibility of Siemens, but the local authority - security could be a problem. Our cameras will mainly focus on the building and the immediate land outside it. As the rest of the land is public land, we cannot prevent members of the public from viewing and possibility destroying these in the middle of the night This is why I really like Augmented reality - its really innovative, only a handful of attractions do this in the UK. Also it has the ability to be applied not just for the temporary exhibition but also for the main exhibition
Bettina Peck	concept 3.1 and 3.2. are the preferred options as they allow good common interaction with the customer	
Annette Diziol, PB	Concept 3.3 is my favourite	Concept 4.2 is my clear favourite