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Assessing the functions and dimensions of visualizations in foresight

by

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Abstract

A central question in foresight exercises is how to communicate the derived results effectively, especially when relevant stakeholders cannot be part of the participatory foresight process itself. While visualizations appear to be a central means of communication and engagement, little is known in the context of foresight on the function and dimension of visualizations. By drawing on an empirical study this article presents a framework for using visualizations in foresight and illustrates its application by referring to a case study. The argument is made that by using a dimensional framework the effects of visualization can be leveraged for communicating foresight results and creating stronger buy-in.

Keywords: foresight, visualization, communication, scenarios

1. Introduction

Although Alfred North Whitehead coined the term “foresight” to describe the hallmark of the competent business mind in a celebrated lecture at the Harvard Business School in 1931 (Tsoukas & Shepherd, 2004a), only in the late 1980s was the term used to describe activities that inform decision makers by improving inputs about an organization’s long-term future (Miles et al., 2003). Even though methodologies used to develop foresight, such as Scenario Planning (Fahey & Randall, 1998; Wack, 1985a, b) or the Delphi technique (Helmer, 1983; Linstone & Turoff, 1975), have been applied for much longer and used in futures studies (Helmer, 1983; Masini, 1993; May, 1996; Schwarz, 2008), the notion of foresight has placed a stronger emphasis not on predicting the future, but rather on preparing for it (Tsoukas & Shepherd, 2004b).

The field of foresight appears not only to be proliferating (Rohrbeck & Schwarz, 2013; Schwarz, 2008) but also maturing. Shell has celebrated 40 years of application of Scenario Planning (Wilkinson & Kupers, 2013). Further, Rohrbeck and Schwarz (2013) have underlined in an empirical investigation of large European companies the value contribution of corporate foresight activities. Other empirical evidence about different types of foresight systems and the alignment of foresight activities within multinational companies has been published by Müller and Müller-Stewens (Müller & Müller-Stewens, 2012).

However, in the practice of foresight the question of how to communicate the results of foresight exercises appears relevant, and yet relatively underinvestigated. But, the importance of an effective communication seems to be evident, especially in cases in which relevant stakeholders can not be part of the participatory process itself (e.g. Hines & Bishop, 2013). In this article we focus on the question of how visualizations can be used systematically to support the communication and dissemination of foresight insights and results.

Visualizations have become a vital part of many foresight activities. But while they seem to have been widely accepted, in the realm of foresight little is known about the function and dimension of visualization. The function for foresight stems from a constructive perspective on the influence of visual images on human perception. Cognitive scientists have argued that humans are able to create a “memory of the future”, a repository of images of the future (Ingvar, 1985). As soon as the brain is confronted with new phenomena, it links them to a stored image of the future and reacts accordingly. This, however, implies that these stored images of the future can, for instance, deliberately be addressed with a product or service offering that pertains to such a visualization of the future. This speaks to the influence of these visualizations. With the dimension of visualizations we refer to a wide range of ways in which visualizations can be used in the realm of foresight. In particular we consider and differentiate in this discussion between the different purposes and forms of visualization.

In this article we present a systematic framework for foresight practitioners on how to develop and use visualizations effectively to transfer results and insights with the aim to increase creative stimulation, knowledge transfer and buy-in of stakeholders into the results of foresight exercises.

The article is structured as follows. In section 2 we start with a discussion on the relevance of knowledge visualization for foresight by referring to existing theories and concepts in foresight and knowledge management. This discussion lays the theoretical groundwork for providing empirical evidence in section 3 from the usage of visualizations in a practical foresight exercise conducted at Zurich University of the Arts (Müller & Müller, 2011). Furthermore, this empirical evidence is used to develop the framework for visualization strategies in the same chapter. Finally, the framework is applied to the case study “ZEMS” (Zukunftsstudie Elektromobilität Schweiz 2030) before the paper concludes with a discussion of the limitations of and future directions for research.

2. Foresight and visualization: a theoretical discussion

The main aim of this section is to answer the question of why visualization plays a crucial role in communicating the results of foresight exercises and why this issue needs further attention. The issue of visualization is not entirely new to foresight or strategy. While the implications, for instance, for knowledge management (Eppler & Burkhard, 2007) appear to be self-explanatory, the implications on strategy development are also of interest. Several authors (e.g. Eden & Ackermann, 1998; Eppler & Platts, 2009) have argued for the usefulness of visualizations in the process of strategy making. Eppler and Platts (2009), for instance, agree that visualizations can address cognitive (e.g. information overload), social (e.g. coordinating multiple groups and hierarchical levels) or emotional (e.g. achieving staff buy-in) challenges in the process of strategy formulation.

In particular in knowledge management visualizations can be perceived as a long-standing objective (Eppler & Burkhard, 2007).

Generally speaking, the field of knowledge visualization examines the use of visual representations to improve the creation and transfer of knowledge between at least two people. Knowledge visualization thus designates all graphic means that can be used to construct and convey complex insights. Beyond the mere transport of facts, knowledge visualization aims to transfer insights, experiences, attitudes, values, expectations, perspectives, opinions and predictions, and this in a way that enables someone else to re-construct, remember and apply these insights correctly (Eppler & Burkhard, 2004: 3).

Eppler and Burkhard (2007) suggest a framework for the use of visualization in knowledge management around the following dimensions:

- Knowledge type,
- Knowledge function,
- Target group,
- Situation, and
- Visualization format.

While it has been pointed out that there is little assistance to apply visualizations (Eppler & Burkhard, 2004), this appears to also be true for the domain of foresight. While in general such a framework can be applied for the visualization of foresight results, we want to explore in more detail what the specific requirements are for this domain. In reference to the above-mentioned framework, we want to explore how knowledge of the future (as a type of knowledge) can be created and transferred by means of visual communication.

But why is visualization in the context of foresight of such relevance? Clearly, foresight is about creating alternative pictures of the future and in this respect the means to create these futures need to be chosen carefully. Hiltunen (2007) has proposed “The Futures Window” with the aim to trigger futures thinking by visually displaying weak signals. Baerten (2007) argues that scenarios often remain more abstract and that visualizations can make futures actually experientiable.

However, if we take a broader perspective and consider the relevance of cultural products, such as visual images or literature, in foresight, we can not only gain a deeper understanding of the relevance of visualizations but also foster discussions on shortcomings.

In the context of foresight we can observe a growing interest in the use of cultural products.

There appear to be, broadly speaking, two areas of interest:

1. The development of foresight on the basis of cultural products, and
2. The communication of the results of foresight exercises by referring to principles of cultural products.

2.1. Using cultural products to develop foresight

The first area refers to the use of cultural products to develop foresight, based on narratives from contemporary literature (Liebl & Schwarz, 2012; Schwarz, 2011; Schwarz & Liebl, 2011).

More recently the usage of literature, especially science fiction literature, has been discussed in a special issue in *Futures* (Graham et al., 2013) to develop prototypes and foresight by envisioning the future, referred to as Science Fiction (SF) prototypes. According to Johnson (2011: v):

SF prototypes are short stories, movies and comics that are created based on real science and technology. This is not a new idea; for over 100 years artists have been creating fiction based on fact. What makes SF prototypes different is that they explicitly use these fictional creations as a step or input in the development process. Whether one is a designer, engineer, scientist, artist, student or strategic planner SF prototypes offer a way to imagine and envision the future in a whole new way.

Johnson (2011) elaborates that SF prototypes are narratives which are based on scientific fact and that the purpose of using SF prototypes is to explore the implications and/or effects of that science.

Graham et al. (2013) refer, in the same context, to creative fictional prototypes where storytelling imagery based on science fact is used as a design tool to explore future consequences of innovations, for instance in regard to how people will interact with technology.

Schwarz and Liebl (2013) have argued that SF prototypes taken from cultural products are not only valuable in terms of stimulating creativity in an organization, they are also valuable because of their potential for becoming part of the reality constructed by consumers through the processes of diffusion and normalization (Liebl & Schwarz, 2010), and thus eventually being embedded into their worlds. By emphasizing the addition of a socio-cultural perspective of SF prototypes, it is argued that socio-cultural innovation is relevant for the creation of innovative business models (Schwarz & Liebl, 2013).

2.2. Applying the principles of cultural products

While we have already described the potential of using cultural products to develop foresight, the second area of interest, described now, refers to using the underlying principles of cultural products to communicate the results of foresight exercises.

For instance, design thinking emphasizes the use of stories to put ideas into context, thereby giving them meaning and hence addressing the human capacity for storytelling (Brown, 2009).

Boje (1991) refers to the “storytelling organization“ and to the perception of stories as an essential vehicle for sense making among external and internal stakeholders.

Narrative principles have been of interest in scenario planning for describing scenario details (Denning, 2006; Gaßner & Steinmüller, 2006; Nordfors, 2007; Rasmussen, 2005; Ringland, 2002; van der Heijden et al., 2002). The rationale for this approach is that a narrative format enables a reader both to better imagine and memorize the communicated scenarios.

However, we will focus on visualization, referring here to another group of cultural products. In principle, the relevance of visualization can be underlined by the notion that reality is socially constructed to a large extent on the basis of cultural products such as literature and movies (Czarniawska, 2006) (Crotty, 2003). Kirby (2010) has described the ways in which film makers have created cinematic representations of technological possibilities with the effect of stimulating the audience's desire for these technologies.

The relevance of visualizing pictures of the future becomes even more apparent when referring to the “memory of the future”, developed by neurobiologist David Ingvar (1985). Ingvar (1985) claims that humans have a well-developed capacity for narrative memory, for instance when creating expectations about the future. He argues that humans can memorize a variety of pictures of the future and then relate these pictures to an experience or an event.

This concept has received attention in regard to foresight driven scenario planning (Schoemaker, 1995; Schoemaker & Heijden, 1992; van der Heijden, 1996; van der Heijden et al., 2002; Wack, 1985a, b). “We visit these futures and remember our visits. We have, in other words, a ‘memory of the future’, continually being formed and optimized in our imaginations and revisited time and time again” (de Geus, 1997: 35). The argument is that the more memories of a future an individual or an organization is able to store, the more flexibly it reacts to new circumstances. The relevance of the “memory of the future” has been underlined in more recent research (Gilbert & Wilson, 2007; Schacter et al., 2007).

3. Usage of visualizations in foresight: empirical evidence

Visualizations have become a vital part of foresight activities, but there is little empirical evidence about the usage of visualizations. However, the study *Visual Futures* published in German (Müller & Müller, 2011) assessed how trend and futures researchers use visualizations in their foresight work. After presenting relevant evidence the authors recall the study to develop the framework for visualization strategies.

3.1. Methodological background of the Visual Futures Study

The study aimed to find out how visualizations are used by foresight practitioners, which types of visualizations they use, for which purposes and under what conditions. For this, 24 semi-structured interviews with European trend- and futures-researchers were conducted. The sampling criteria were: (i) foresight practitioner (ii) with more than 3 years of experience in foresight work, and (ii) accessible within Europe. While not trying to distinguish trend researchers from futures researchers, the participants came from a variety of backgrounds working as foresight professionals, self-employed innovation, design managers or strategists, think tanks, and small to large multinational companies. The questionnaire included mainly open questions in four sections: (i) the recent professional or corporate context of the practitioner, (ii) the type and style of his foresight activities, (iii) the usage of visualizations (how, when, why, types), and (iv) the sources and routines for the generation of visualizations.

The interviews, ranging from 30 minutes to two hours in length, were transcribed and qualitatively analyzed using the coding software program HyperRESEARCH.

3.2. Relevance of visualizations

Among the interviewees there was a pronounced consensus that the visualization of foresight results is of high significance. Of the 24 interviews, 23 participants stated that they not only

apply visualization on a regular basis, but that they also perceive visualization as a relevant tool for their foresight work.

Visualizations are applied in different contexts that can be linked to different phases of a foresight exercise. The interviewees mentioned the following contexts:

- Presentations,
- Workshops,
- Reports, and
- Archives.

The use of visualizations in presentations is common. It was emphasized by the interviewees that in presentations, visualizations are entertaining and hold the attention of the audience. In presentations the emotional impact of pictures was described as being higher than it was, for instance, in reports.

In workshops, visualizations are most frequently designed by the participants in order to stimulate their creativity. In the iterative process of constructing or de-constructing pictures, consistent visualizations of the future can be created. The interviewees mentioned that only seldom does visualization take place at the end of a workshop.

In reports, visualizations are intended primarily to illustrate and to explain the results of a study to a wider audience typically not involved in the foresight exercise. Visualization consists of adding images to the text or underlining arguments. The interviewees insisted that the purpose of visualizing, for instance, the scenarios is to create alternative images of the future. Further, they noted that the visualization of foresight results also enables quicker comprehension of the content than does reading an entire report. This finding also applies when complex issues are visualized in order to display causalities or interdependencies. According to the interviewees,

the potential reaction of the recipients to visualization needs to be taken into consideration. As one interviewee stated, "Pictures make you inspiring, diagrams make you credible".

3.3. Types of visualizations used

While several types of visualizations exist, only a few appear to have been applied in the organizations of the interviewees. The majority of the study participants tend to use only diagrams and schemata in their reports or newsletters; photographs are found more often in presentations and often come from image databases or instead visual metaphors or abstract pictures are used to complement the development of a future vision. However, the use of images runs the risk of being perceived as randomly selected or meaningless. Other types of visualizations used are cartoons or maps, and rarely video clips or interactive animations.

3.4. Functions of visualizations

A central question in the creation or selection of visualizations is their function. Based on the interviews three core functions of visualizations could be identified:

1. Stimulation,
2. Knowledge transfer, and
3. Insight generation.

In terms of simulation, visualizations have an aesthetic function: for example as part of corporate identity to create a certain atmosphere, or to inspire or surprise the viewer.

Knowledge transfer is the distillation of knowledge so that it can be communicated in a clear, understandable and memorable manner. The visualization becomes a reference point and point of departure for shared conversations and visioning.

In contrast to these other functions, in the context of insight generation, visualizations do not reduce complexity. Instead, they make implicit knowledge available and allow the identification of patterns and relationships. In this sense, visualizations become analytical and creative instruments at the same time: producing new perspectives, uncovering hidden options, or completing existing knowledge.

3.5. A dimensional framework for visual strategies

As the *Visual Futures* study showed, the generation and usage of visualizations by foresight practitioners is rather unfocused and mostly without any inherent visualization strategy. The communication and transfer of foresight insights and results could especially profit from a more systematic approach.

Therefore, the empirical data of the *Visual Futures* interviews has been used to develop a dimensional framework which shall be presented and described in the following section. The framework has been developed by an open coding process of the interview transcriptions. The 305 different codes that have been generated in a first coding cycle were semantically consolidated and reduced to six main codes, also called dimensions, on four levels. Finally, we operationalized the six dimensions by transferring them into six specific questions to guide foresight practitioners in their visual strategy development process (see also figure 1).

According to the final framework the usage of visualizations for the purpose of the insight transfer and results communication is most effective by considering the following set of dimension questions.

Figure 1: Dimensional Framework for visualization in foresight

3.4.1. Why?

“Why?” refers to the strategic intention underlying the use of the visualizations: For what purpose and objectives shall they be used? How can this purpose be most efficiently fulfilled? The importance to know why visualizations shall be used in a certain foresight context seems to be self-evident. However, the empirical evidence suggests (Müller & Müller, 2011) that this is rare. The reasons for the use of visualizations tend to be diffuse or inconsistent, and as such are not inherently strategic.

However, the use of visualizations might be clearly aligned with the objectives of the foresight activity: to foster creativity in a participatory process, to structure communication in a single working session, or to communicate the results of a foresight study. As soon as the relevant objectives are identified, a visual strategy can be developed. It describes how visualizations shall be structured and used to meet designated objectives. As such, each visual strategy needs to consider the basic conditions and challenges related to the specific foresight context and it should explain why the usage of visualizations is more successful than other forms of insight generation, structuring, or communication (e.g. text, speeches...).

Finally, strategies can be specified by visual architectures. A visual architecture represents a structural operationalization of the strategy and provides guiding principles for the elaboration of the other dimensions of the framework. Types of architectures might be “hierarchical structuring” (see chapter 4.1.2), “modular structuring”, “cascades”, or “network structures”.

3.4.2. Wherefore?

“Wherefore?” refers to the purpose of the visualization, whether stimulation, knowledge transfer or insight generation. We have discussed this aspect in the chapter on the functions of visualizations (3.3.).

3.4.3. Who?, Where, What?

Two factors need to be taken into account when considering the recipients (“Who?”) of visualization: the visual literacy and the visual background of the recipients. *Visual literacy* is the competence of the recipients to grasp the information that is communicated through a particular visualization. The visual background is the context of the recipients' organization. Are the organizations accustomed to visualizations? What kind of image or color scheme is used? This visual background can depend on a country's industry and on the organization.

We have elaborated above on the possible contexts (e.g. presentations, workshops, reports, archives) of visualizations and their implications for selecting a type of visualization (“Where?”).

Regardless to the content (“What?”) that is addressed by visualization, future-oriented content can be clustered in two groups and that have implications for the visualization:

- Phenomenological types: is the content to be visualized a status, event, or development?
Depending on this assessment, different types of visualizations appear to be more suitable.
- Degree of concretization: is an abstract idea or a specific concept to be visualized?
While a detailed visualization might be best suited for a sophisticated prototype, the opposite might be the case for idea generation or creativity.

3.4.4. How?

Three components determine how to visualize the results of foresight exercises: design, medium and semantics.

Design consists of the following aspects:

- Perspective on the visualization: from the top, frontal, side etc.,
- Composition: image detail, form, arrangement of images, ratio and distribution of images,
- Coloring,
- Lighting, and
- Style.

Medium refers to the following:

- 2D: Diagram, drawing, photography, etc.
- 3D: Model, object, prototype, etc.
- 4D: Animated image, movie, etc.

In addition to and independent from the design of visualization, three means of *semantic* relationships between content and visualization can be differentiated; these are not exclusive and can be combined:

- Representation: a situation, a scene or a fact is illustrated. The visual image has foremost a descriptive character and the focus is on representation in a sense that there is some observable similarity between the image and the represented object.
- Symbol: the visualization can be perceived as being a proxy for an abstract or complex idea. In many cases the visual image can be understood only in light of the underlying content (e.g. through a title or a brief description)

- Schema: along with a schema a high degree of abstraction is connected. In many cases this form of visual representation is used to display the relationships or causalities between components or to illustrate data and combinations of data.

4. Application of the framework in context of the ZEMS foresight study

To illustrate the application of this framework, we refer to the ZEMS foresight study. *ZEMS* is an acronym for the description of the German study: Zukunftsstudie Elektromobilität Schweiz 2030 (Study on the Future of eMobility in Switzerland in 2030) (Müller et al., 2013) which was conducted from 2012 to 2013 at the Zurich University of Applied Sciences.

4.4.1. The ZEMS foresight study

While the e-mobility market in Switzerland is still in its infancy, it is starting to establish itself. For the time being, the long-term prognosis of the market and its underlying business ecosystem are rather unclear, which is still a problem for all the stakeholders.

The study focused on the following key questions:

- What will e-mobility in Switzerland be like in 2030? What will its significance be for urban mobility?
- What will drive and inhibit electro-mobile development in Switzerland?
- What will Switzerland's commercial e-mobility ecosystem look like in 2030?

During the study a participatory and scenario based approach was adopted, integrating 19 external industry experts and corporate partners (automobile industry, ICT, energy business), as well as academics from different disciplines. They supported the research process through the five stages of the scenario building and interpretation, by workshop participation, expert interviews or reviewing intermediate data and draft scenarios.

Published in April 2013, the core results of the final ZEMS study comprised four qualitative scenarios for urban e-mobility in Switzerland in 2030, each of which has its own focus:

- Scenario 1: e-mobility as “light mobility”. Electric vehicles are very small and light and used for short distances and light duty transport in city centers. They have a variety of types, shapes and colors and are easy to use.
- Scenario 2: e-mobility as “connected mobility”. Electric vehicles are closely connected to urban mobility systems. According to the idea of intermodal mobility, travelers use a range of smoothly integrated mobility services and products in spontaneous and situational ways.
- Scenario 3: e-mobility as “niche mobility”. The commercial breakthrough of electric vehicles in the mass market did not happen. They are just used by different niche user segments in Switzerland, such as high society, green avant-gardists or tourism.
- Scenario 4: e-mobility as “commuter mobility”. Caused by different technological and economic drivers electric vehicles become very cost efficient, which is why regular drivers such as private commuters, smaller commercial and bigger corporate fleets use them more often.

Finally, next to the general study introduction each of the scenarios was presented in a dual structure. In the first part of the “scenario description”, the analytical-descriptive concept (core idea, key factors, macro environment, e-mobility ecosystem) of the scenario was presented. In the second step of “scenario illustration” a comprehensive narrative about the e-mobility future in Switzerland 2030 was developed. For this, a specific editorial format has been chosen: a special magazine issue about the Geneva Motor Show 2030, in which fictional expert talks, product testing reports and background information about e-mobility in Switzerland 2030 can be found. The scenario illustrations are very creative; however, they are consistent with the scenario descriptions as well as the scenario conditions and contents.

4.4.2. Visualization strategy of ZEMS

During the scenario development and interpretation process different sorts of visualizations and visual instruments were used. One of the biggest challenges was the comprehensible and convincing communication of the final scenarios and their implications for the final target groups of the study. In the final phase of communication the project team faced the following challenges:

- The e-mobility market is based on a complex ecosystem, which is provided by companies of different industries and public institutions. Furthermore, a broad set of social, technological and economic factors will influence its future structure and dynamics. Therefore, communication had to enable the team to present integrated and comprehensive, yet still simple and sound, scenarios to the audience.
- The ZEMS study addresses a broad and heterogeneous target group, starting with the public media and stakeholders to e-mobility experts of different industries and institutions. There is a high variation in their body of knowledge about the core topic e-mobility and the ecosystem-related questions. A balanced scenario communication would meet the expectations and needs of all the target groups.
- The ZEMS study has a long-term time horizon. In effect, it became harder for the study's target group to understand the main ideas, concepts and inter-linkages of the scenarios because they still might be too abstract and too "far away" from today's mobility contexts. Therefore, communication had to integrate a chronological translation: illustrating visionary ideas and future concepts while connecting them to today's understanding of mobility.
- As a result of the participatory scenario process of 18 months, the information density of the scenarios is very high. The project team had to find a way for scenario

communication not to tax the readers or to cause them to lose interest in reading lengthy scenario descriptions.

The project team therefore designed a visualization strategy that would support the communication of the scenarios and their implications.

As the core of the strategy was a visual architecture. It had to provide visual guidance to the reader for the purpose of a better orientation and understanding of the complicated and detailed information. The architecture consisted of a 5 level structural concept, reflecting the (hierarchical) structure of the entire foresight study (see figure 2).

On the top level of the study a dual icon was defined, reflecting the core topic of the research project: the future shift from “gas-powered to electric mobility”. On level 2, each scenario (descriptive part) had its own icon, which followed the same design direction as the level 1 icon. Variations in design styles were introduced on level 3 where each scenario was illustrated according to its own layout and visual aesthetics. In each scenario additional editorial illustrations and fictional ads (level 4), as well as street and vehicle sketches (level 5), were added.

Figure 2: Visual architecture of the foresight study

Following this architecture the most abstract and reduced visualization is on level 1. The lower the level, the more specific, differentiated, and situational the visualizations are. This was exactly how the study text was structured.

Finally, this allows the reader to follow his own choice. He can start to read the fictional and narrative scenario illustrations with the vehicle and street sketches, fictional ads and catchy editorial illustrations, or he may want to start top-down, by reading the study introduction and scenario descriptions thereby gaining an overview of the most important scenario information and facts.

4.4.3. Visualizations and their dimensions

After defining the visual strategy and architecture, the other dimensions of the proposed dimensional framework are applied to levels 1 through 5 (see figure 2).

Level 1: Visualization of the overall study

The main functional focus of the level 1 visualization was on stimulation: to provoke thought, to attract attention, to arouse interest and to form a recognizable identity for the project and study (Wherefore). As visual core content (What) the metaphoric shapes of a liquid drop (for gas) and a battery (for electricity) have been chosen to symbolize the future shift from combustion to electric vehicles and e-mobility). The icon styled shapes (How) are illustrated as small streets or even car race tracks in order to provoke the readers to think about mobility. This visualization finally became the title page of the final publication.

Level 2: Visualizations for the scenario descriptions

The level 2 visualizations were aimed at stimulating a clear, recognizable, but at the same time distinctive, visual identity for the four alternative scenarios. The differentiation was underlined by choosing characteristic icons (How) reflecting the core messages of each scenario regarding its underlying mobility concept. Thus, by the illustration of footprints (for walking/slow mobility), streets, or a railway, the types of mobility systems used in the corresponding 2030

scenario (What) were explained (see figure 3). Thus, these visualizations also incorporated an extended, yet still simple function of information transfer (Wherefore).

Figure 3: Icon styled title visualization for scenario “Light eMobility” of ZEMS

Level 3: Layout of visualizations for the scenario illustration

Since the parts of the scenario illustrations were presented as fictional narratives in the form of a special magazine issue about the Geneva Motor Show 2030, the visual elements at level 3 focused on comprehensive layout designs rather than single icons (How). The contents of the integrated visuals are rather abstract. However, the design followed a typical magazine model and visually reflected the main ideas and concepts of the scenarios (What). Thus, the different layout designs were thought to support the understanding of each scenario (Wherefore) and they should evoke personal and visual empathy and imagination (see figure 4). Therefore, the function focused on stimulation, information transfer and insight generation (Wherefore).

Figure 4: Layout Visualization for the scenario illustration “Light eMobility”

Level 4: Graphical visualizations within the scenario illustration

A variety of graphics were placed within the scenario illustrations (How). Their design followed their functionality (Wherefore): Info graphics were used for information transfer, like the explanation of a scenario timeline (What), whereas fictional advertisements, like the offering

of multimodal mobility services in the year 2030 (What), focused on emotional stimulation and insight generation.

Level 5: Vehicle and street sketches within the scenario illustration

Within the scenario illustrations the most contextualized visualizations can be found. They are presented in the form of specific vehicle and street sketches reflecting “pictures of the future” of urban streets and mobility areas in Switzerland in 2030 (How). To maximize their credibility, visual elements such as Swiss city skylines, public transport systems or even buildings are integrated into the sketches (What). The sketches focused on the two functions of stimulation and insight generation (Wherefore).

Generally, the two dimensions of “context” (Where) and “audience” (Who) are constant at all levels, since all visualizations are used in the final published study, which targets e-mobility industry experts, as well as media and stakeholders. However, some versions of the presented visuals had already emerged in the participatory scenario workshop sessions. For example, the level 2 scenario icons were used for discussion, knowledge externalization and exchange. Finally, they supported the specification and definition of different scenario drafts. Furthermore, most visualizations are important illustrative instruments for oral presentations to different audiences.

5. Conclusion

Referring to the established concepts of the “memory of the future” and to the observable practice of visualization foresight results, our aim was to present not only empirical evidence of the use of visualizations in foresight but also to elaborate on a framework for the usage of visualizations and its application in the ZEMS study of foresight.

While the “success” of a foresight study remains difficult to evaluate, the structured framework supported visualizing the study. Further, through this structured approach to visualizing the ZEMS study a number of advantages could be leveraged. The *Visual Futures* project underlined not only the relevance of visualizing foresight results and some common practices, but also the study emphasized the relevance of understanding the functions and dimensions of visualizations in this context.

The framework suggests that it is worthwhile to define and align all dimensions, with a bottom-up approach appearing to be most feasible. Further, we have argued that a deliberate visual strategy is required when using visualizations to communicate foresight results. While we have defined a framework and referred to a number of interviews as our empirical basis, further case studies could shed more light on visual strategies in the context of foresight. Further, investigating at what stages of a foresight process to use visualizations could be promising in order to not only understand visualizations as a means to communicate the insights but also to enhance the process of generating foresight.

If we follow Tufte’s (1990) argument that principles of design replicate principles of thought and that the act of arranging visualizing information becomes an act of insights, we need to take a closer look at the specific design principles for foresight. At the core of developing design principles is the aim to improve the understanding of how visual communication can affect the perception and cognition of knowledge (Agrawala et al., 2011). This also implies a better appreciation of the cognitive implications of visualizations in the foresight context. Further, it could be promising to understand in which cases a visual image might be limiting engagement or imagination, whereas a written narrative might further stimulate alternative pictures of the future.

Foresight exercises can take the form of a large participatory process (e.g. Cuhls & Georghiou, 2004) or an exercise run by a small group of experts. In the everyday practice of both cases, an

effective communication of foresight insights and results is a critical success factor. While the argument has already been made that visualizations can increase the effect of creative stimulation, (en)visioning journey (Baerten, 2007), knowledge transfer, insight generation and a stronger buy-in of stakeholders on both levels, rationally and emotionally, the challenge remains how to design and use these visualizations in context of a specific foresight case.

In this article we have not only argued for the relevance of visualizing foresight results as a central means for communication, but also provided a dimensional framework for using visualizations in the context of foresight.

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