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ORIGINAL ARTICLE

Foresight 2.0 - Definition, overview & evaluation

Jörg Schatzmann · René Schäfer · Frederik Eichelbaum

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Abstract This paper contains a definition of Foresight 2.0 and summarizes the status quo of current methodological approaches in the field. It offers a categorization of individual applications by their technical feature sets and concludes with an outlook on potential specifications of future applications. This report therefore manifests the starting point for evaluating digital-collaborative Foresight applications by their intended use, knowledge generation and quality of results.

Keywords Foresight 2.0 · Web 2.0 · Foresight · Futures research methods · Open · Collaborative · Scenario · Prediction market · Social rating · Wiki · World brain

Foresight

Ever since Futures Research has been established as an academic discipline in the 1940s, the concepts of participation, interdisciplinarity and dynamic feedback loops have been fundamental to the development of its methods. Major early institutions in the field (such as RAND or the National Bureau of Standards) used novel sociological and economic models together with computer simulations to build the theoretical foundation for putting controversial futures into the hands of many participants instead of a few.

The main focus of this paper will be to introduce and discuss the umbrella term of Foresight 2.0. The initial empirical data base for this are features of web applications that explicitly or implicitly aim to support Foresight processes

- using online frameworks
- and a massively collaborative approach.

The reason for choosing these two criteria as a narrowing focus is the following: while Foresight methods have enjoyed a long tradition, the potential to include several hundreds of participants remotely in a real-time Foresight experiment has only been emerging through the large-scale adoption of internet access that happened over the last 15–20 years. Inversely, any application that does not make use these potentials could have been modeled prior to the introduction of the consumer internet. Introducing and discussing the term Foresight 2.0 is therefore a way to take a novel perspective on how Foresight processes change qualitatively and quantitatively when they are built on the backbone of a large-scale IT infrastructure that is broadly accessible.

The recent academic dialogue about Futures Research in Europe has been coined by the concepts of participation and collaboration: Bertrand De Jouvenel was one of the first to formulate the idea of an open and non-deterministic approach to Futures Research in 1964 when publishing "L'art de conjecture" and calling upon practitioners to use "previsionary forums" where "experts from very different disciplines contribute their individual foresight, resulting in harmonized depictions about possible futures" [1] . His goal was to generate a deeper understanding of social developments, behaviors and processes to advance and enable collaborative action upon the future. Until today, those ideas have a profound influence on common methods of Futures Research

J. Schatzmann (✉)
Department of Futures Research, Faculty of Education Sciences and Psychology, Freie Universität Berlin, Kiehlufer 7, 12059 Berlin, Germany
e-mail: js@hypermorgen.com

R. Schäfer
Department of Futures Research, Faculty of Education Sciences and Psychology, Freie Universität Berlin, Limburger Strasse 5, 61479 Glashütten, Germany
e-mail: rs@hypermorgen.com

F. Eichelbaum
Department of Futures Research, Faculty of Education Sciences and Psychology, Freie Universität Berlin, Karl-Marx-Strasse 43, 12043 Berlin, Germany
e-mail: fe@hypermorgen.com

(such as the Scenario Method, Delphi Studies, Roadmapping or Future Workshops).

The term *Foresight* is used in academic discourse to delineate from *Forecasting* [2] and emphasize the explorative nature of the processes involved. The scope of the term *Foresight* extends to both normative and explorative approaches to Futures Research.

However, there is still disagreement about the name and the contour of the discipline. For a recent discussion about an attempt to define and to deliminate *Foresight*, take a look at the anthology *Recent Developments in Foresight Methodologies* from Giaoutzi & Sapio [3].

Foresight as a tool for decision making and complexity reduction

Past events lead to conclusions about future events. It is impossible to design a robust empirical test for those conclusions about future events and developments [4]. However, deciding to believe in a path that future events might take and evaluating the importance of certain topic areas are inevitable steps to retain the ability to act upon the future. Since these decisions are subject to cognitive limitations, as well as insufficient time and information, they can only be considered partially rational [5].

An analysis of the present status quo is a necessary condition for predictions about future developments [6]. This status quo, however, may be subject to subjective interpretation. Uexküll distinguishes between the terms *Umwelt* (general environment) and *Umfeld* (immediate surrounding) to stress that the subjective perception of the *Umwelt* is generally in mismatch with the objective perception of the *Umfeld* [7]. By combining subjective versions of each individual's *Umwelt ,* a more complete picture about the *Umfeld* can be achieved.

Foresight processes are ideally not only used to collect information for further analysis and prediction, but also to reduce complexity and create knowledge, e.g. through clustering them by their underlying assumptions, without losing important information. Only then are the results transferable as guidelines or decision making support systems. The goal is to gain an increased awareness about possible futures and the levers through which to act upon them and in doing so ultimatively save time in strategic processes and absorb uncertainty [8].

Strategies to reduce complexity are manifold: examples are system modelling, contradictory analysis or prospective imagination.

Quality requirements for Foresight processes and results

From the outside, a Foresight process is often misunderstood as a "look into the future". Even though predictions are often judged post-factum in terms of their (non)occurrence, a fundamental credo in Futures Research is that a prediction should only serve to help envisioning possible futures.

Often this could also mean to communicate undesirable futures to foster action against them. These types of predictions serve to become *self-inhibiting prophecies*. This is only one of the reasons why Foresight cannot only be evaluated in terms of its predictive capabilities [9]. The following is a summary of alternative criteria for evaluating the quality of a Foresight process and its results.

Communication and informal exchange amongst the participants are fundamental aspects of Foresight processes. The effect of those aspects is a change in awareness about a topic and as a result network and capacity building and increased collaboration. By looking at a large spectrum of factors that could influence their future and ideally by also learning to understand the cross-impact relations between those factors, participants train their capacity to think in terms of alternative plausible scenarios and understand their individual influence on the emergence of those futures.

A major criterion for the success of a Foresight process is therefore the level of increase in awareness that the process created amongst participants to equip them with an understanding of the plausible alternative futures, potential paths of action and consequences. It is important to note, however, that this criterion for success only holds if participants understand the hypothetical character of results and the illusion of predictability and controllability is relatively low.

In contrast to animals, acting upon the future largely based on expectations, humans have the possibility to formulate predictions about future events. Since these predictions have hypothetical character and are much more than their predictability, Jouvenel suggests to speak of *conjectures*, which can be understood as a "proposition" [10]. The substantiation of such propositions about the future can be achieved by looking at potential causes in the present and signals for future change. Predictions in the "original empistemological sense are [therefore] prognostically framed explanations of causes in the past" [11]. It is, however, not guaranteed that, apart from potentially low probability of its occurrence, a conjecture's premises are always correct, as its real causes might have been overlooked.

The basic premise of Futures Research is therefore not the science of future-tense presents. Contemporary theories support the view that the future is open and unpredictable [12] and therefore Futures Research is much more a science of present-tense futures in the form of images about the future [13, 14]. Hence, the results of a Foresight process are not predictions, the results should be insights through imagery that depicts possible courses of action and consequences of such to make organisations and individuals resilient against future shocks.

We therefore define one central criterium for the quality of the results of a Scenario process: the depictive precision of all future images that are relevant to any future in observation. A high depictive precision is evident in future images that

- consider as many 'weak signals' as possible (i.e. are up to date)
- consider as many 'blind spots' as possible (see "prospective imagination")
- have been through as many cycles of explorative evaluation as possible (with regards to possible cross-impacts, contingencies, probabilities, as well as internal and external consistencies)
- have been through as many cycles of iteration and utility evaluation as possible (with regards to impact, possibility and desirability)"

Foresight 2.0 - terms and definition

The suffix 2.0 is often used in decorative ways for many terms to separate an older from a newer generation of a concept and to indicate that the one at hand is the most modern and contemporary one. While the term Foresight 2.0 was born out of a relatively unreflected usage of the suffix 2.0, we later found that it was a perfect fit for the types of methods we sought to describe.

This paper clarifying the concept of Foresight 2.0 and emphasizing the importance of participation as a design criterium within that concept.

The following section will therefore outline common characteristics of Web 2.0 applications, which serves as a starting point to build a theory about the current state of the art of collaborative and participative Foresight methods that are not web-based yet. From there, it is possible to derive potential future trends for Foresight methods that are based on web platforms.

Web 2.0

The principles of Web 2.0 build the basis for the further description and analysis of the applications that we found during our research. Although the term and the definition of Web 2.0 is controversial according to scientific and academic standards, it is generally accepted and widely understood. As noted above, we will use the characteristics of Web 2.0 to describe features and attributes of Foresight 2.0 applications. Therefore, a brief introduction to the various definitions for and potentials of Web 2.0 will follow.

O'Reilly understands the Web 2.0 as *"(1) a platform for offering specialized services" that are coined by "controlling unique data sources that are difficult to remodel and have a value that proportially scales with the user frequency. To generate such data it is necessary to (3) trust users as co-developers of of content as well as the service itself to (4) use collective intelligence. This requires a shift in the perception that it is necessary to distribute software in the form of closed-source packages. The most important requirement is the (5) formation of communities, as only a high number of members can guarantee the formation of some sort of collective intelligence." To enable the participation of members as both users and co-developers of the processes, O'Reilly also demands "(6) lightweight user interfaces and development structures that (7) go beyond the limits of individual devices."* [92]

At a later stage, O'Reilly had re-drafted this lengthy definition in favor of a shorter one: Web 2.0 is the *"revolution of business models in the computer industry, which was caused by the internet as an application platform and at the same time the attempt to understand the criteria for the success of this revolution. The most important success criterium seems to be the creation of platforms that make use of network effects and scale the quality of results with the number of their users"* [15].

From a socioeconomical perspective, Web 2.0 technologies caused a rapid increase of content that can by used by the commons and are generated by a large number of volunteers. If Web 2.0 technologies are embedded in processes that do not only guarantee easy and low-barrier participation, but also the legal framework to protect the rights for individual works that have been created, completely new forms of collaborative projects can emerge. The deciding factor for the success of such projects is the degree of modularity (how many independent modules can the project be divided into), granularity (how much experience and motivation is necessary to make a single contribution) and integration (is it possible to combine the individual efforts without much friction into a meaningful whole). One prominent example that fulfils all three criteria is Wikipedia [16].

The design of such mechanisms that enable "social computing" in applications can be highly complicated. The number of possible embeddable elements is high and hard to manage. When designing a Web 2.0 application, it is necessary to first clarify which elements are actually embeddable in a 2.0 fashion and which aren't. Typical 2.0 elements can be rating systems (example: the rating of products reviews on the online retail platform amazon.com from "helpful" to "not helpful") or moderation mechanisms for content (example: discussion and dispute management system on wikipedia.com). They all have in common that they can help to rapidly increase perceived legitimacy amongst users as well as quality of content on traditional web applications [17]. The young discipline of interaction design is therefore one of the core disciplines for designing a web 2.0 application. For a historical overview of interaction design and its impact on Web 2.0 see Carroll [18].

Furthermore, the terms *media* and *media use* needed to be revisited after the emergence of Web 2.0 applications. There is no longer one cable sending messages one way - there are a multitude of options to involve users as content creators and decision makers in the process of creation. Traditional problems with the logic of web applications can be completely redefined when applying 2.0 principles. There are a number of emergent potentials in different problem areas - from categorisation (using folksonomies) to indexing (using hashtags), hyperlinking (using user-generated links) and recommendation systems (using social graphs), which aren't fully explored in many disciplines yet.

Open & collaborative foresight

Foresight processes are often based on expert judgement. Experts about the future are ideally those who have a knowledge advantage in a field of expertise but at the same time spent considerable time reaching beyond the boundaries of their own discipline to understand current and future developments in their field within the broader range of external circumstances. Such experts are thought to produce future images of more accurate terminology and scope than amateurs. These future images are *"dependent on the subjective observer, time of observation and describe future matters - developments, states, situations, events, processes - within a selected range of possible worldviews.* [19]*"* The formulization of future images is succeeded by the next step of evaluating, selecting and refining the most likely and/or most desirable future images for further use in deriving implications - e.g. courses of action, strategies, product ideas, or political agenda setting.

Even if it is theoretically impossible to attest full validity to the resulting future images, the reference to expert participants can increase public credibility of these results of a Foresight process.

While this traditional approach to closed-loop expert-based Foresight has been fruitful in the past, new collaboration and communication tools create new potentials for *Open Innovation* [20]. The basic premise of Open Innovation is to facilitate communication between insiders and outsiders, between experts and stakeholders as early as possible to avoid too homogenous future images. The most important characteristic of the development phase of an Open Innovation process is the flexible adaptation of predetermined goals and the possibility to also pursue innovation ideas that are outside the initial research scope.

This procedure can be adapted to a collaborative and open Foresight process [21]. *"The problems, challenges and dilemmas that organisations face today are often multi-layered, interconnected, chaotically organised and difficult to separate. Only if multiple stakeholders collaborate and express their individual views and opinions can those be solved in a sustainable way.* [22]*"*

Additionally to creating a multitude of different future images, a collaborative approach also enables future images to be evaluated for external validity, i.e. their validity outside of current ideology, myth or contemporary storytelling. Especially this ability to construct, deconstruct and reconstruct future images collaboratively is the *"fundamental building block to produce less trivial (unfortunately often also less plausible) future images.* [4]"

These governing patterns are not only restricted to organizational Foresight. They are present in any Foresight process that attempts to challenges arising from social, technological, ecological, economical or political factors and variable that are subject to ever increasing uncertainty due to increasing complexities and contingencies.

Open Foresight can therefore also be described as *context-based Foresight* as it is typically based on participation and interaction during the description of all steps in a Foresight process, from scenarios and wild cards to future strategies. Its main focus are anticipations of discontinuities [4] and the deep integration of sociocultural and -technological dynamics that arise with a ubiquitously connected society.

Furthermore, Daheim and Uerz mention additional characteristics of Open Foresight apart from a multi-stakeholder approach: transdisciplinarity and goal-state flexibility. Other quality criteria they assert are high levels of transparency, methodological hybridity, contextual orientation, discussion and participation [23]. These are features that are also subject of a broader debate about general quality criteria and standards in Foresight. According to Burmeister and Schulz-Montag, "*Open Foresight has the potential to generate knowlegde about the future in a decentralized fashion which in turn means that it can be collaboratively applied* [24]." Organisations should therefore exploit specific knowledge about future matters through collaborative activities to make the organisation profit as a whole. Burmeister and Schulz-Montag plead for an *"intelligent pooling and usage of the global future intelligence"* in any organisation.

Through increased accumulation and sharing of future-oriented knowledge, economies of scale could be used and the cost of Foresight processes be significantly reduced, which in turn would empower more small and medium sized organisations to develop more sustainable long-term thinking. One proposed method to start generating such knowledge is, as Jouvenel already proposed several years ago [10], an industry- or topic-specific evaluation of all available future studies by letting their conjectures be rated on "common sense" and deviating views.

Additionally, an open and collaborative Foresight process should, apart from the translation of knowledge about the future into implications for the present, also cater for those who need to act upon those implications. Gerhold perceives a lack of focus on the subject in current Futures Research and demands a stronger participation of the perceiving and acting individual in the process of "*developing futures research questions, planning and realisation of research projects* [25]" as well as a stronger participation of individuals in a larger contect of participative and transdisciplinary processes to shape an organisational futures. Gerhold also suggests to experiment with surveys that gather both expert as well as amateur feedback to better understand how those differences could be roadblocks to successful design of Foresight processes.

This raises another question: what is the next step after having accomplished a sound design for a Foresight process? By inviting participation of stake- and shareholders in problem solving processes there is often a shift in the relation of perception of specific details to the bigger knowledge map around decision making processes. This, however, does not influence the quality of predictions significantly. Studies have shown [26] that expertise can even lead to misperceptions of odds in stock market trading or sports betting [27]. Furthermore, meta-level analyses with Delphi studies show that expert opinions often become increasingly divergent, the further away the time horizon for the prediction to be made [28]. These findings suggest to not blindly trust expert opinion, since even experts are "just" humans without precognitive abilities [29]. A study of Hong and Page also shows that group heterogenity beats individual ability, at least if the research question is well defined [30] (the best answers are obtained if the group does consist mainly of experts but there is a high heterogenity in their fields of expertise). The combination of specific fields of expertise and crowd intelligence is the potential that we seek to emphasize for the future design of Foresight processes.

Status quo of research about foresight 2.0

One result of the rise of Web 2.0 platforms and technologies is the exponential increase in contextual data and knowledge management systems.

Together with the increase of such data, the classical prediction (in terms of a simple trend extrapolation) went through a renaissance. Not only trend and market research companies, but also big internet companies such as Google (one example of a predictive analytics start up that Google invested in is recordedfuture.com), Facebook or Amazon (see [31] for a detailed description of how Amazon works with content-based collaborative filters for predictions) have started collecting quantitative data to generate predictive analyses for profit. Their models promise valuable insights about short- and medium-term changes and developments within a bigger systems thinking context.

However, the exact workings of those models are usually not publicly disclosed. Fortunately, one can also look at use cases where publicly available data is used to make real-time predictions, based on a transparent method for aggregating web data for predictive analytics [32]. **In the remaining parts of this paper the term Foresight 2.0 shall be used to describe such digital-collaborative versions of Foresight processes.**

One example is the quantitative approach of Asur and Huberman who describe a way to aggregate data from social media channels (in their case Twitter) to derive predictions about the future. They show how even relatively "simple" predictive models can yield accurate market-based predictions [33].

According to Pang [29], the web can be useful to professional forecasting (respectively Foresight) in three ways: (1) *Social Scanning*, a systematic approach to pattern recognition in freely accessible, openly available data that Futurists have listed on the web for a broader Foresight community to analyse and evaluate (see [34]). (2) *Prediction Markets*, which help to aggregate expertise through participation and (3) *Reviewing Forecasts*, which serve the evaluation of the broder utility and output of applied Foresight methodology.

This perspective at Foresight 2.0 as a combination of knowledge transfer and horizon scanning is already a useful start to understand the qualitative difference to traditional Foresight methods, but it does not explain in detail how specific digital participation and collaboration mechanisms can help to improve Foresight.

Another approach is described in Chachia, Compañó and Da Costa [35]. They provide an overview for the potentials of online communities for Foresight and arrive at three conclusions: (1) Interaction and communication in online communities sparks creativity. (2) Online communities are an excellent indicator of rapid changes and trends in sentiment and social behavior. (3) Online communities combine individual thought processes to build records of the bigger picture and therefore nurture collaborative intelligence in the process of debating potential long-term future goals.

Online communities are described as the basis for a bigger *Brainstorming* in which future concepts, ideas or scenarios can be tested and refined. The authors also point out disadvantages of online communities: (1) In unstructured and non-hierarchical information management systems there is an imminent risk of quickly derailing any discussion away from the central topic. (2) Privacy and information rights of participants need to be formalized and communicated to greater extents than in offline settings. (3) Data can be unstructured, in raw formats and void of machine-readable semantic relations. The authors therefore lean towards a definition of Foresight 2.0 as the process of aggregating future-relevant information online as opposed to generating new information through collaborative processes.

The most recent paper within the time frame of this study is a PhD thesis by MIT postgraduate Noah Raford, titled

"Large Scale Participatory Futures Systems: a Comparative Study of Online Scenario Planning Approaches" [36].

In his thesis, Raford cites two case studies of Foresight processes that were specifically designed and tested for the thesis[1] and a comparative analysis of three further digital Foresight approaches,[2] as well as a comparison of all five processes to a Base Case Scenario process.[3] Raford points out that the number and heterogenity of participants in his digital versions of the Scenario process is several multiples larger (125–700 participants from 18 to 82 countries) than in the traditional Scenario process that he conducted (35 participants from 5 countries) and that the global outreach to and diversity of experts is of a much broader scale.

Raford therefore concludes with several advantages of true Foresight 2.0 processes: (1) An increase in the amount of future impact factors to scan and assess. (2) A large diversity of perspectives. (3) A very time-effective approach to identification of relevant factors and complexity reduction. (4) A high transparency of the process - all individual steps that led to the results can be tracked. (5) A very scalable participant pool. (6) The ability to collect data in real-time.

Disadvantages that have been identified include: (1) an absence of important psychological and social negotiation aspects due to the anonymous nature of online dialogues (socialising, co-shaping opinions, persuasion and rethorics, personalisation of results, etc.). (2) a lack of scientific work on how to design, plan and execute a Foresight 2.0 process due to its relative infancy.

Overview and categorisation of approaches

In Chapter 2 we outlined current approaches to define web 2.0 (2.1) and open & collaborative foresight (2.2) and tried to shed a light on current approaches to define Foresight 2.0. Based on the intersecting principles between the aforementioned approaches we suggested that any online platform where publicly available data is used to make (and rate) real-time predictions, based on a transparent method for aggregating web data for predictive analytics is possibly a Foresight 2.0 application. In the remaining parts of this paper the term Foresight 2.0 shall be used to describe such digital-collaborative versions of Foresight processes.

Accordingly, this study was carried out through an 1 year exhaustive electronic search for digital collaborative prediction and foresight applications using internet search engines and online databases and indexes. The search results were collected in an online spreadsheet (spreadsheet accessible online at http://www.hypermorgen.com/research). While the database was growing different approaches and categories began to loom from which we derived a systematic categorisation of the existing Foresight 2.0 approaches on basis of terminology and concepts of the previous two chapters.

The surveyed applications were subsumed into four categories:

1. Databases/Wikis
2. Prediction Markets
3. Social Rating Systems
4. Collaborative Scenarios

These four types of Foresight 2.0 approaches have been further analysed with regards to the following three aspects:

- how they operate
- what their purpose is
- how they differ from the other approaches

Chapter 4 is an evaluation and a summary of advantages and disadvantages of each category of applications.

Databases and wikis

A database is a digital archive that provides a classification schema for information. In contrast to a database, a wiki does not only sort information into classification schemata, but also provides for the possibility of cross-linking information into a hyperlinked structure. While the classification schema has to be defined before information can be stored in a database, a wiki is much more of a collaborative effort to develop suitable ontologies after information has been entered for storage. The resulting ontologies are usually devoid of hierarchy and the process of arriving there is through discurse and structured argument. It is one of the fascinating examples of aggregating individual intelligence and forming a bigger picture from it, a collective intelligence [37].

Collecting and categorising future-related information happens for a diverse set of intentions and yields as diverse sets of results. Examples of future-related databases include wildcard databases, prediction databases, trend databases, databases that are used for horizon scanning and databases that are used for mapping strategic Foresight. One common feature of the category of databases and wikis is that they are at the core of forming a digital-collaborative network of practising Futures researchers

[1] Futurescaper: The Impact of Climate Change Impacts on the UK (186 future impact factors, prioritised, ordered, analyse and visualised as systems map); SenseMaker Scenarios: Future of Public Services Under Financial Uncercainty, 265 participants, micro scenarios, aggregated to form three scenario drafts on the basis of predefined scenario archetypes.

[2] Wikistrat: a collaborative Forecasting Plattform; Foresight Engine: a project of the Institute for the Future and the Open Foresight Future of Facebook Projekt

[3] The question of representativity of participants can be found on p. 217 in the thesis.

worldwide. Coenen et al. [38] posit that this feature is central and primary to knowledge management systems for Foresight communities. One prominent example of a collaborative database for predictions is TechCast [39], a collection of long-term conjectures from fictional and non-fictional literature since 1998. According to the publications from the founders of this database, this type of Foresight should be primarily understood as a learning system or a community of practice with the purpose to iteratively refine and improve upon the vocabulary (e.g. through a Delphi-survey for the predictions in the system). One example of a database for weak signals to establish a learning community around those is the iKnow project of the European Foresight Monitoring Network (EFMN) [40]. The initiators of the project describe the plaform as a valuable source of information and as basis for strategic discussions about the role of collaborative Foresight in EU member states [41].

This collection and categorisation of weak signals and predictions in order to form stronger networks and a global learning community of practising Futures researchers is an answer to an increasing demand for a platform where Futures researchers can reflect the results and products of their own work together [42].

Social rating systems

Social Rating Systems are the biggest class of Foresight 2.0 approaches that have been identified over the course of this research. In the context of Foresight 2.0 they are used for various purposes and goals. It is either to collect and rate base data like trends and weak signals to derive predictions or to collect and rate predictions and then argue for or against them with such base data.

The fundamental first step to such a process is ideally the precise definition of a scope to draw a line in the vast set of assumptions, predictions and conjectures that can be made. After collecting those, they can be rated on scales like “relevance”, “impact”, “likelihood” or “desirability”, for example. The immediate quantification of qualitative data in peer-review processes is a common method of empirical social studies [43]. It is especially applicable when the subject of research is very complex or even unknown since qualitative methods require lower levels of abstraction and produce results that are closer to the research question than quantitative methods. This translates to the online principle “publish first, filter later” which has been coined by the author Clay Shirky [44] with regards to the structures of new collaborative forms of knowledge generation.

Qualitatively collecting data also allows for the expression of extreme opinions (which might translate to wild cards in Futures Thinking). The subsequent quantitative rating of those data allows for ordering such data and identifying the most important for further use in the research process. These do not necessarily have to be the best or most attractive, they could also be the most controversial ones.

In this respect the Future of Facebook project is especially relevant, which used the Q&A platform Quora to gather future opinions. Since Quora is already equipped with multi-level social rating features there was no need to build a dedicated platform for this project.

Prediction markets

Prediction Markets are based on the principle that predictions about any future event can be traded like a stock or option on a virtual market. The current value of such predictions can then be used as an indicator for their future likelihood of occurrence. One major drawbacks with prediction markets as Foresight tools is that they cannot depict anything but the likelihood of occurrence. Other quantitative data such as “desirability”, “impact” or “relevance” can hardly be traded and are therefore inaccessible on prediction markets.

The roots of prediction markets are futures markets (which are markets for options on future price developments). In the same way that options on future price developments can be used to derive indicators about future prices (the prognostic quality of such estimates has been reviewed since the 1930s by economists like Keynes and Hicks) [45], a prediction market can be used to derive indicators about likelihoods for future events. Prediction markets use the efficiency of markets and often reach higher levels of prognostic strength than expert panels, Delphi studies or other forms of surveys [46].

It is worth noting that the time horizon for almost all examples is <1 year. Since there is virtually no other quality criterium than likelihood of occurrence, prediction markets unfortunately do not provide for enough processes that would make them attractive as a true Foresight 2.0 tool. Both betting on a self-destructing prophecy as well as speculating on events with a time horizon >1 year does not make sense to the individual user on those platform due to the absence of adequate incentives to do so. Furthermore, the process is designed in a way that participants cannot collaboratively debate their opinions and views about future images, which means that there is almost no qualitative measure of crowd intelligence.

Collaborative scenarios

Collaborative scenarios are the only class of Foresight 2.0 approaches that try to weave interconnections between predictions made by the participants. The scenario method is a planning technique which was heavily coined by the military strategist Herman Kahn during his post as Futurologist at the RAND Corporation.[4] Its advantage in comparison to a set of trival predictions is that it *"offers the possibility to display many alternatives for future paths of development* [47]*"*. Since trivial predictions cannot capture such levels of complexity, the scenario method has gained in popularity and is regarded as one of the core techniques of contemporary Futures Research. In the past years there have been publications for over two dozens of specialized scenario techniques [48]. They usually have in common that they aggregate assumptions about future developments into scenarios. Greene et al., who initiated the project Future Fusion[5] claim that collaborative scenarios are especially well suited to discover blind spots that are usually disregarded in other methods [49].

The most prominent example of collaborative scenarios are MMORPG (massive multiplayer online role playing games). Such a Foresight game has been developed by the California-based Institutes for the Future (IFTF), who built their own framework, the Foresight Engine, which is now used to launch annual collaborative Foresight competitions. The first time that framework was used was when the game "Superstruct" was announced to the public. This game, developed by game designer Jane McGonigal, used crowdsourcing to let teams find solutions to future challenges. The application used open APIs from Facebook and YouTube and was embeddable in blogs and online forums. Some of the most well-known protagonists of the web 2.0 such as Jimmy Wales (Wikipedia) and Tim O'Reilly (O'Reilly Media) were taking part in that game.

In the past years, several other Foresight games have been played based on the IFTF foresight engine: 2009 signtific [50] (still active), after a remake of the engine in 2011 there were three more: Breakthroughs to Cures [51], magnetic south [52] and Smart Grid 2025 [53]. The fourth project of 2011 called "mmwogli" was delayed until further notice due to lack of public interest [54]. The most recent example of 2012 is the "Health Horizons 2012" Forecasting Game [55].

This procedure is resembling of a Wiki. However, it differs from such both by focussing on pooling only potential scenarios and solutions to specific future challenges and the ability to aggregate assumptions about the future into scenarios.

Desktop Software for Scenario planning usually also incorporates features like automatic creation of scenarios (e.g. Eidos Suite of the firm Parmenides or the Foresight Toolbox of Michel Godot). Unfortunately, all surveyed online scenario planning platforms lack such features and exhibit a fairly chaotic structure as a result.

Worth mentioning in this context is also the thesis of Noah Raford, which has already been mentioned in chapter 2.3. Raford recognized the implications of lacking such a feature and wrote a prototype for creating online scenarios collaboratively.[6] This prototype, called Futurescanner, is an interface to bookmark base data (such as trend data or weak signals) which can then be linked to other data in the future. However, during test runs, the prototype failed to automatically create meaningful scenarios from the base data without further human intervention.

Others

In the context of Foresight 2.0 applications two other types that are often mentioned include Roadmapping and Gantt-Chart Software, as those also belong to the group of collaborative online techniques used for Futures Research. These techniques reduce complexity not through qualitative or quantitative analysis, but through visualisation of all the different perspectives that actors upon the future can have on a subject matter [56]. However, none of the surveyed applications truly tried to harvest the potentials of the web 2.0 beyond being an online copy of a method that was traditionally conducted offline

Also worth mentioning is "tweetthefuture". This database lists all tweets (messages on Twitter [57]) that contain the keyword "future". Even if it is just a gimmick so far, this would be a valuable addition to more academically sound Foresight 2.0 processes to collect base data, as Pang suggests [29], to add new predictions fast and effortlessly to an initial screening database. This idea has also already been implemented by the platform wefutr[7] which used the Hash-Tag #predictions to filter predictions and number of retweets to prioritize those that had been found.

This overview does not further comment on platforms that are no longer accessible, such as The Wrong Tomorrow[8] (hindsight-tool), ziitrend (Social Rating of predictions) and trendio (prediction market for trends in the form of news). The latter two are applications that are not just based on simple predictions, but in fact well-argued conjectures.

[4] The origins of the scenario method are highly debated. See [9] p .51.

[5] see Appendix Table 1

[6] Not listed in the table of tools due to lack of background information that could have been used for thorough analysis.

[7] screenshots and description at http://oneforty.com/item/wefutr

[8] an archived versino of the page can be accessed at über http://www.waybackmachine.com or directly at http://web.archive.org/web/20090927180848/http://wrongtomorrow.com/

Analysis and evaluation

The following is a general view on advantages and disadvantages of the types of Foresight 2.0 approaches, especially with regards to the particularities and possibilities of digital collaborative applications. As guidelines we used general standards of empirical social research [58] as well as criteria and standards for Futures Research [59].[9]

Due to the complexity of the topic, a technical analysis is beyond the scope of this research. Fundamental criteria for interface design can, however, be described. One of those is accessible design for all sorts of participants to avoid selection bias. This also implies that contents are perceivable by all participants, irrespective of their technical setups like browser version, browser plugins or physical disadvantages like poor eyesight or hearing. Accessibility can be increased by using multiple modalities (e.g. video *and* text). A frequent problem of poorly designed interfaces is the lack of definition and affordability of interface elements which leads to a lack of clarity on the side of the user about their intended use, the order in which they should be used and what consequences they lead to [60].

Apart from these basic technical criteria that apply for every application there are specific criteria for the stages data collection, data processing and results that we will discuss in the following chapters.

Data collection

Contrary to predictions that are based on statistical methods[10] the base data of Foresight 2.0 processes are generated by the users for the users. If the quality of data at the beginning of such processes is low, the end result will also be of poor quality [61]. Three factors contribute to the quality of base data in Foresight 2.0 processes:

- The composition of the participant pool
- The motivation of the participants
- The expertise of the participants

Furthermore, a fundamental building block is a concise definition of the research question and the vocabulary used, i.e. the subject matter should be clearly delineated. These factors will be described in more detail in the following paragraphs.

Systems without control over invitation (e.g. via invitation codes) may suffer from participant selection bias and under- or over representative numbers of participants from particular sub-clusters. The answering and participation behavior can vary largely depending on culture [62]. The Forecasting game scientific of the IFTF, for example, encountered the problem that regional and cultural differences amounted for a lot of the variability in estimates of technological developments [63].

Furthermore, the default language of the website should be sensitively selected. A German Website can only be used by German speakers. If English is used, many Asian or Arabic regions might be underrepresented. In the same manner, distribution of gender (e.g. authors of Wikipedia are only 6 % female [64]) and age of participants should be reflected. If the sole purpose of the system is just to collect information and not to make sense of it, that is a negligible factor. If the purpose of the system however is to instil cooperation or competition to make sense of Futures it would be a disadvantage to have a highly skewed participant pool, especially with regards to the major advantage of Foresight 2.0 approaches to even out individual bias.

The biggest challenge is to incentivize participation and interaction. Google+, Facebook ,Wikipedia, Xing, Twitter or Youtube all share a similar usage pattern: *"In most online communities, 90 % of users are lurkers who never contribute, 9 % of users contribute a little, and 1 % of users account for almost all the action.* [65]"

It should be noted that the motivation of users is highly dependant on motives. Most of the surveyed Foresight 2.0 applications simply invited anyone interested and did not show signs of reflections on the potential motivations to participate. This is especially problematic for applications that require high motivation to truly help reducing complexity or applications that require a high number of participants to reach compelling conclusions.

An exemption are prediction markets, which have almost perfect alignment of motivation and incentive (play money or points that can later be exchanged for tangible value). This type of motivation, in turn, might attract fraud, on the other hand. An example where this happened is the Popular Science Predictions Exchange which used to be a prediction market that is now closed since it was found out that real stock market movements could be manipulated with predictions about automated trading algorithms.

Another promising approach in this respect are the online role playing games be the IFTF that motivate users to participate solely by entertaining them. Without further discussing the psychological workings of gamification, success examples such as Folding@Home [66], SETI@home [67]

[9] For more theories on the commensurability and quality of Foresight processes see also chapter 1.2.
[10] This area is especially interesting in light of topics like Open and Big Data.

and Rosetta@Home [68] indicate how much of a motivator entertainment value can be online [69].

Another important part of motivation is in turn to avoid frustration amongst participants. It is essential to increase the users' motivation to contribute to the platform, make sure they understand what the application is about and how it works [70].

This can be achieved on one hand through priming, for example by using introductory videos like those on the Foresight Engine of the IFTF. On the other hand it can be achieved through specific feedback. Potential feedback mechanisms are, for example, dashboards with statistics about participants activity in comparison to their peer group [71]. Raford notes, however, that automated feedback proved less effective than feedback through the peer-group itself (e.g. via a commentary feature) [72].

Expertise and reputation in small communities is established through personal contact. In large and/or online communities it can either be assumed through a priori accreditation or achieved through participation and positive reinforcement through the community itself [73].

A priori accreditation like it is used on Wikistrat [74] or the Future of Facebook project [75] is especially suitable for systems with limited audience range. It is easy to achieve through personal invitations that include a survey upon registration to determine levels of expertise. Similar systems to verify experts have been implemented in TechCast, Wikistrat, iKnow and DeltaScan/SigmaScan. DeltaScan and WikiStrat are so strict in their accreditation process (it is not only based on questionnaires but also deep level certification) that it is questionable whether those systems can be considered Foresight expert judgement systems at all.

As mentioned in the introductory part of this paper, expert judgement is not always better than amateur judgement, as a 1980 study by Tetlock shows in which 27.451 predictions had been evaluated by 284 academics. In one instance, the academics did not reach achieve better predictions than randomly selected by apes [28]. Tetlock argues that this could be due to developing some sort of mole sight after having been too long into a specific field of expertise. He attributes this state to a lack of interdisciplinarity and communication with other "thought collectives" [76].

The assessment of expertise during the process is therefore better suited for Open Foresight processes than the a priori accreditation since it is dynamic and scalable and it is possible to define expertise post-hoc for very specific topic areas [73]. This works especially well if the evaluation questions are non-compulsory, which leads to only "true" experts answering them [77].

Since human judgement about complex topics can be incomplete and biased, any reputation system in online communities has to be designed in a way that does not only incentivise expertise but also semiotic precision in all communication and collaboration to improve the overall judgement ability of the group to the point where the sum is bigger than its parts [78].

One project that seeks to remedy the dichotomy between a priori and post-hoc expert judgement is a project by Forecasting ACE [79], funded by the IARPA and led by a consortium of Futures researchers. This project constantly evaluates results at any stage of the process with dynamical weights and therefore tries to improve overall likelihood of occurrence estimates for its predictions [80].

Recently, online communities also employ peer-to-peer accreditation systems, whereby participants can vouch for and invite each other.[11] Whether this is just a way to generate interest and simulate exclusivity or whether the connectedness of the communities is indeed improved is still to be evaluated. At the very least, such an approach minimizes those problems that occur due to the anonymity of participants [81].

Data processing

Many of the surveyed applications lack an academic background - partially because they have not be created on the premise of being scientifically sound but rather to serve as a quick experiment. Those that stated their theoretical frameworks could be evaluated in terms of suitability of technical tools. Methodological or epistemological evaluations were largely impossible due to a lack of statements about the actual scientific goals of the applications [82]. In order to achieve a complete picture of the quality of results, it would be important to not just look at how data was collected, but also how it was processed. The question "what has been collected" should even preceed those other two questions.

We therefore restrict the evaluation of the surveyed applications to the criteria of conceptional quality and scalability [83] and their importance to Foresight processes.

A sound Foresight process demands both clear definitions of fundamental concepts and terminology [4] and a clearly delineated subject of research. This becomes especially evident when looking at large organisations that suddenly need to let departments collaborate that have never been collaborating before and different language sets clash with each other. The research question and terminologies do not only the content-based participation but also the personal involvement of participants [84].

[11] Prominent examples at the time of writing were Google Plus und Spotify.

In further processing the collected data through sorting, rating and clustering it is important to pay attention to explaining rating criteria and consequences carefully to the participants. Especially the Social Rating platforms could have been more specific about the dimensionality of ratings, which questions the meaningfulness of ratings, since it is safe to assume that not all participants have rated on the same scale.

If it is not or falsely determined what it is that the participants are rating on, the chance to collect valuable data (such as likelihood, desirability or impact of a prediction) is forgiven. This is especially unnecessary, since there is no post-hoc possibility anymore to automatically determine key factors, givens and wild cards even automatically create clusters of future assumptions [85].

It is also important to pay attention to the process how data is collected. The application SigmaScan is measuring controversy on an individual level, which should in fact be collected via non-reactive feedback.[12]

In order to judge the adequateness of the measurement instruments, it is also necessary to reflect upon the fundamental workings of crowd intelligence, as crowd intelligence is not just intelligence of a large group. It is rather the "intelligence of multiple, independent perspectives". For it is not the large group that corrects individual bias, but the presence of many different perspectives in such a group, that independently of one another, need to lead to contrary views and therefore have the potential to reduce bias [86]. Often, heterogenity / diversity automatically increases with the size of the group. It should not be assumed, however, that this is guaranteed. A group can exhibit "Groupthink" [87] as much as it can exhibit collective intelligence.

To ensure high levels of collective intelligence, the individuals in a group should already bring experience and/or knowlegde to the table, have sufficiently diverse perspectives on the topic and and be able to take decisions independently of one another. Levels of achieved collective intelligence are therefore both dependent on group composition as well as process design. The determining factor for the success of Foresight 2.0 is therefore also the reflection on ways to harness and structure drivers for collective intelligence in the context of digital Foresight platforms.

The digital community framework should therefore be equipped with incentives, rules, norms, rituals, etc. for collective intelligence and the architecture of the framework should be able to capture interrelations between future factors. Since one primary goal of Foresight is the systematic reduction of complexity, the decision-making frameworks of Pang [29] should be considered when developing digital collaborative Foresight applications. This would ensure a strong collaborative creation of future images, even for amateur participants. It could also be helpful to test the methodological structure and format in an offline workshop prior to implementing it online.

Only about a third of the surveyed applications were found to have a sound scientific background. It is thus beyond the scope of this paper to judge about the appropriateness of the individual applications as tools for general Foresight methods, since most of the methods did not offer criteria for evaluation. This survey, however, can be used as a pillar for grounded theory development [81].

Foresight processes are often subject to bias due to semantic blurriness when making conjectures or predictions. The list of possible causes for this is long [88]:

- Overestimation of own skills and knowledge
- Overestimation of own influence on the future
- Projection from own situation to situation of other individuals or groups
- A subjective perception of objective problems

These possible causes are just examples. An exhaustive treatment of those causes would be beyond the scope of this work. It is worth mentioning, however, that not only cognitive phenomena, but also individual motivations and Leitbilder [89] can be a potential cause for bias in the identification and evaluation of future impact factors.

When judging future images of others, it is usually easy to perceive them without attachment to ideology, societal myths or the contemporary Zeitgeist. According to Stienmüller, this sort of deconstruction is the *"fundamental building block to produce less trivial (unfortunately often also less plausible) future images* [4]."

One main advantage of Foresight 2.0 approaches is the possibility to scale the number of participants without limits. This helps moving from subjective evaluation criteria towards objective standards and deconstructing future images into their core assumptions. Nearly all of the surveyed applications took care of enabling such discourse.

Result

One main quality criterium for the results of Foresight processes is their applicability to reality. This translates to the criterium for Foresight 2.0 of enabling dynamic adaptation of results to changing environments.

Applicability is eventually critical to the utility of a method. This translates to reducing the gathered data through ratings, pattern recognition, clustering or simple selection mechanisms. Ideally the application is designed in a way to enable these transformations during the process.[13]

The surveyed applications were especially making use of tagging and rating or statistical algorithms that depict the Bayes

[12] One implementation of this method can be seen, for example on http://www.reddit.com

[13] see chapter 1.1, Strategies to reduce complexity.

theorem. This is increasing their utility in the sense that the dynamic data collection is close to depicting thought processes that are actually happening with the participants [61].

If the results are sought to diffuse well within broad groups of recipients, it is important to enable early participation for them in the process. The result of digital collaborative Foresight processes should therefore be translated into an easily comprehensible language, perhaps a visualisation. One typical format in the context of Futures Research is a timeline, like in the case of the applications Web of Fate and the New York Times Technology Timeline. Just as with Gantt-Charts and Roadmaps, these timelines have the advantage of organising Futures related data into a time context [90]. Foresight 2.0 applications additionally benefit from an application programming interface (API) or export features to ensure applicability of results.

Online methods enable applications that produce dynamic results. This is particularly relevant in the context of present Futures [13, 14]. The present is never standing still. As it moves along the time axis, dynamic models can change and adapt to new insights about desirable, possible and probable Futures [91].

Futures Research is thinking on stock.
Eckhard Minx

If Futures Research is thinking ahead then Futures Research is also thinking against a ticking clock. This poses a disadvantage for static models and an advantage for dynamic models that are able to adapt with time.

Another advantage of dynamic systems is their archiving feature which enables looking at old predictions and re-evaluating them. Dynamic systems also enable an evolution of the system itself according to new data [81]. Within the range of surveyed applications especially Wikis und databases fultilf this requirement. Collaborative scenarios do not fulfil it as much as they are usually time-constrained.

Conclusion

Thirty of the surveyed applications fell within the defition of Foresight 2.0 or subsets of such applications. The different types of applications have been described in the preceding chapters. A subsequent evaluation proved some of these applications to be especially fruitful in the context of Futures Research but most of the applications did not come with sound academic background and it was therefore very difficult to evaluate critical points such as representativity of participants or quality control for expertise and motivation.

The broad range of applications shows what the potentials of Foresight 2.0 are. Especially the high number of stakeholders involved and the potential to enable broad public discussion causes a rapid spreading of future images in the recipient group.

Furthermore, Foresight 2.0 applications enable transparent, efficient and rapid Foresight ("*Internet communities offer the advantage of instant information exchange and group decision that is not possible in real-life.* [71]"), as they are decentralized and almost ubiquitously available.[14] Their results can by dynamic and sometimes even real-time.

The challenge in the conceptualization of future Foresight 2.0 applications is the combination of established quality criteria for Futures Research with the potential of web applications.[15]

One important innovation potential is the combination of multiple approaches into a holistic process. An application that uses social rating in a semantically unsound way provides as little practical use as an application that is semantically sound but only classifies present information without explicitly looking at future implications.

We therefore propose triangulating as many approaches as possible while orienting the design along the following guidelines:

- Pushing for large-scale participation and scalability of the application
- Reducing conflict between individual motivations to participate and research interest
- Reflecting quality control when defining and recruiting expertise
- Being very specific about terminology[16]
- Adhering to a strict process logic[17] and implementing criteria for effective collaboration[18]
- Developing a result that is rich in content and highly applicable[19]
- Enable feedback loops to iterate and re-develop the results

[14] Technological progress in the field of mobile devices will increase their availability even further.
[15] cf. chapter 2.1
[16] see Wikis in chapter 3.1
[17] cf. Kapitel 4.2
[18] see decision-making structures (Pang) in chapter 2.1
[19] cf. Kapitel 4.3

Appendix

Table 1 Advantages and disadvantages of collaborative application types

Type	Advantages	Disadvantages
Databases and Wikis (LongBets, iKnow, Trendradar2020, Shaping Tomorrow, SigmaScan, Delta Scan, TechCast, Forecasting World Events, The Seven Hrizons, wrong tomorrow, Future Scanner, TechCast, TrendWiki)	Facilitate a (structured) collection and discussion of baseline data (forecasts & predictions)	Except TrendWiki and TechCast only predictions, no conjectures, no rating
Social Rating Systems(Is it Future proof?, bean sight, The Future of Facebook Project, predicto.net, wefutr, Web of Fate, Wikistrat, The Future of Facebook Project, Forecasting ACE, NY Times Technology Timeline)	Irrelevant data is sorted out by rating, thus the number of participants is perfectly scalable	Except weboffate no reduction of complexity
Collaborative Scenarios (superstruct, signtific map, Risk Interconnection Map)	Reduction of complexity by bundling assumptions, good motivation of participants at iftf platform games	Applications based on the foresight-engine framework are missing a system to sort the data and fail to narrow down the questions for the user which leads to a huge amount of almost unstructured data.
Prediction Markets (intrade, inklingmarket, iPredict, Popular Science Predictions)	High probability of occurrence of the predicted events on short perspective (upt to two years). The more participants the better the results.	Prediction markets are basically advanced polls with future related questions, thus quite similar to market- and diffusion research. Only suitable for a very limited range of branches (politics, sports, etc.), no feedback loops.

References

1. de Jouvenel B (1967) Die Kunst der Vorausschau. Luchterhand, Berlin, p 305
2. Cuhls K (2003) From forecasting to foresight processes—new participative foresight activities in Germany. J Forecast 22:93–111. doi:10.1002/for.848
3. Giaoutzi M, Sapio B (eds) (2013) Recent developments in foresight methodologies. Springer, New York
4. Steinmüller K (2007) Zeichenprozesse und Zukunft. Ideen zu einer semiotischen Grundlegung der Zukunftsforschung. Zeitschrift für Semiotik 29:157–175
5. Beck S (2003) Die Theorie begrenzter Rationalität-der Ansatz von Herbert A. Simon. Seminararbeit, FH Pforzheim
6. Endsley MR (1995) Toward a theory of situation awareness in dynamic systems. Hum Factors: J Hum Factors Ergon Soc 37:32–64
7. von Uexküll J (1909) Umwelt und innenwelt der tiere. Springer, Berlin, http://archive.org/details/umweltundinnenwe00uexk Accessed 04 July 2013
8. Luhmann N (2006) Organisation und entscheidung. VS Verlag für Sozialwissenschaften, Wiesbaden
9. Steinmüller K (1997) Grundlagen und Methoden der Zukunftsforschung: Szenarien, Delphi, Technikvorausschau. SFZ, Gelsenkirchen
10. de Jouvenel B (1967) Die Kunst der Vorausschau. Luchterhand, Berlin
11. Schüll E (2006) Zur Wissenschaftlichkeit von Zukunftsforschung. Der Andere Verlag, Tönning
12. Steinmüller K, Kreibich R, Zöpel C (2000) Zukunftsforschung in Europa. Nomos Verlag, Berlin
13. Grunwald A (2009) Wovon ist die Zukunftsforschung eine Wissenschaft? In: Popp R, Schüll E (eds) Zukunftsforschung und Zukunftsgestaltung. Springer Berlin, Heidelberg, pp 25–35
14. Luhmann N (2002) Short Cuts 1. Zweitausendeins, Frankfurt a.M
15. O'Reilly T (2006) Web 2.0 compact definition: trying again. http://radar.oreilly.com/2006/12/web-20-compact-definition-tryi.html. Accessed 04 July 2013
16. Krowne A (2005) The FUD-based Encyclopedia. Free Software Magazine. http://www.freesoftwaremagazine.com/articles/fud_based_encyclopedia Accessed 03 July 2013
17. Erickson T (2011) Social computing. Encyclopedia of human-computer interaction. http://www.interaction-design.org/encyclopedia/social_computing.html. Accessed 04 July 2013
18. Carroll JM (2009) Human Computer Interaction (HCI). Encyclopedia of Human-Computer Interaction. http://www.interaction-design.org/encyclopedia/human_computer_interaction_hci.html. Accessed 04 July 2013
19. Neuhaus C (2006) Zukunft im Management - Orientierungen für das Management von Ungewissheit in strategischen Prozessen. Carl Auer, Heidelberg
20. Chesbrough HW (2003) Open innovation: the new imperative for creating and profiting from technology. Harvard Business Press, Boston
21. Sautter B, Clar G (2011) Strategic capacity building in clusters to enhance future-oriented open innovation processes.

http://www.foresight-platform.eu/wp-content/uploads/2011/02/EFMN-Brief-No.-150_Open-Innovation.pdf. Accessed 03 July 2013
22. Pillkahn U (2007) Trends und Szenarien als Werkzeuge zur Strategieentwicklung. Publicis Publishing, Erlangen
23. Daheim C, Uerz G (2006) Corporate foresight in Europe: ready for the next step. Second international seville seminar on future-oriented technology analysis: impact of FTA approaches on policy and decision-making. pp 1–16
24. Burmeister K, Schulz-Montag B (2008) Corporate foresight. In: Popp R, Schüll E (eds) Zukunftsforschung und Zukunftsgestaltung. Springer Berlin, Heidelberg, pp 277–292
25. Gerhold L (2008) Für eine Subjektorientierung in der Zukunftsforschung. In: Popp R, Schüll E (eds) Zukunftsforschung und Zukunftsgestaltung. Springer Berlin, Heidelberg, pp 235–244
26. Camerer CF, Johnson EJ (1997) The process-performance paradox in expert judgment: How can experts know so much and predict so badly? In: Goldstein WM, Hogarth RM (eds) Research on judgment and decision making: currents, connections, and controversies. Camebridge University Press, Camebridge, pp 342–364
27. Cazes B (2008) L'histoire des futures. L'Harmattan, Paris
28. Tetlock PE (2006) Expert political judgment: How good is it? How can we know? Princeton University Press, Princeton
29. Pang AS-K (2010) Futures 2.0: rethinking the discipline. Foresight 12:5–20. doi:10.1108/14636681011020191
30. Hong L, Page S (2004) Groups of diverse problem solvers can outperform groups of high-ability problem solvers. Proc Natl Acad Sci 101:16385–16389
31. Pariser E (2011) The filter bubble: what the internet is hiding from you. Penguin Press HC, London
32. Gloor PA, Krauss J, Nann S, et al. (2009) Web science 2.0: identifying trends through semantic social network analysis. Computational Science and Engineering, 2009. CSE'09. International Conference on. pp 215–222
33. Asur S, Huberman BA (2010) Predicting the future with social media. Web Intelligence and Intelligent Agent Technology (WI-IAT), 2010 IEEE/WIC/ACM International Conference on. pp 492–499
34. Pang AS-K (2010) Social scanning: improving futures through Web 2.0; or, finally a use for twitter. Futures 42:1222–1230
35. Cachia R, Compañó R, Da Costa O (2007) Grasping the potential of online social networks for foresight. Technol Forecast Soc Chang 74:1179–1203. doi:10.1016/j.techfore.2007.05.006
36. Raford N (2011) Large scale participatory futures systems: a comparative study of online scenario planning approaches. PhD Thesis, Massachusetts Institute of Technology. http://hdl.handle.net/1721.1/68444 Accessed 03 July 2013.
37. Martin JP (2006) Gemeinsam Wissen konstruieren: am Beispiel der Wikipedia. In: Klebl M, Köck M (eds): Projekte und Perspektiven im Studium Digitale. Medienpädagogik 3:157–164. LIT Verlag Berlin. http://www-edit.ku-eichstaett.de/Fakultaeten/SLF/romanistik/didaktik/Forschung/ipk/material/papers/wikipedia.pdf/. Accessed 03 Jul 2013
38. Coenen T, Kenis D, Van Damme C, Matthys E (2006) Knowledge sharing over social networking systems: architecture, usage patterns and their application. On the move to meaningful internet systems 2006: OTM 2006 Workshops. pp 189–198
39. TechCast LLC (1998) TechCast - a virtual think tank. http://www.techcast.org/Forecasts.aspx. Accessed 25 Dec 2011
40. iKnow Project Team (2011) iKnow WI-WE Bank. http://wiwe.iknowfutures.eu/. Accessed 25 Dec 2011
41. Amanatidou E (2008) "Joint foresight": towards a mechanism for joint programming in Europe? Foresight 10:103–117. doi:10.1108/14636680810918603
42. Brin D (2005) David Brin's Official Web Site: "Accountability for everyday prophets: a call for a predictions registry". http://www.davidbrin.com/predictionsregistry.htm. Accessed 25 Feb 2012
43. Höhmann P (1977) Techniken der empirischen Sozialforschung - Datenanalyse. Oldenbourg Wissenschaftsverlag, München
44. Shirky C (2008) Here comes everybody: the power of organizing without organizations. Penguin Press HC, London
45. Berg J, Nelson F, Rietz T (2003) Accuracy and forecast standard error of prediction markets. Tippie College of Business Administration, University of Iowa
46. Tziralis G, Tatsiopoulos I (2007) Prediction markets: an extended literature review. j prediction mark 1:75–91
47. von Reibnitz U (1998) Szenario-Technik. Gabler, Wiesbaden
48. Bishop P, Hines A, Collins T (2007) The current state of scenario development: an overview of techniques. Foresight 9:5–25. doi:10.1108/14636680710727516
49. Greene K, Goan T, Creswick ER (2008) A collaborative eye to the future. In: Kadar I (eds) Signal Processing, Sensor Fusion, and Target Recognition XVII, Proceedings of SPIE, p 6968–38
50. Institute for the Future (2009) The signtific lab | massively multi-player thought experiments. http://play.signtific.org/. Accessed 25 Dec 2011
51. Myelin Repair Foundation (2012) Breakthroughs to cures. http://info.breakthroughstocures.org/. Accessed 24 Dec 2011
52. Landcare Research (2010) Magnetic South: exploring a future for christchurch together. http://magneticsouth.net.nz/. Accessed 24 Dec 2011
53. IEEE (2011) Smart Grid 2025 - IEEE Spectrum. http://spectrum.ieee.org/static/smart-grid-2025. Accessed 24 Dec 2011
54. Office of Naval Research (2011b) ONR delays online wargame due to surge in interest from public - news - office of naval research. http://www.onr.navy.mil/Media-Center/Press-Releases/2011/MMOWGLI-Internet-Wargame-Delay.aspx. Accessed 24 Dec 2011
55. Institute for the Future (2011) Health horizons' 2012 research agenda: the future of health information | institute for the future. http://www.iftf.org/HHAgenda. Accessed 25 Feb 2012
56. Möhrle MG (2007) Technologie-Roadmapping: Zukunftsstrategien für Technologieunternehmen. Springer, Berlin
57. Twitter, Inc. (2012) Twitter. http://twitter.com/. Accessed 25 Feb 2012
58. The British Sociological Association (2002) Statement of ethical practice for the british sociological association. http://www.britsoc.co.uk/equality/Statement+Ethical+Practice.htm. Accessed 25 Feb 2012
59. Gerhold L, Holtmannspötter D, Neuhaus C et al (2012) Qualitätsstandards für die Zukunftsforschung. In: Popp R (ed) Zukunft und Wissenschaft. Springer Berlin, Heidelberg, pp 203–210
60. Moshagen M, Thielsch MT (2010) Facets of visual aesthetics. Int J Hum Comput Stud 68:689–709
61. De Mesquita BB (2010) The predictioneer's game: using the logic of brazen self-interest to see and shape the future. Random House Trade Paperbacks, New York
62. Yang J, Morris MR, Teevan J et al. (2011) Culture matters: a survey study of social q&a behavior. International AAAI Conference on Weblogs and Social Media
63. Committee on Forecasting Future Disruptive Technologies; National Research Council (2010) Persistent forecasting of disruptive technologies–report 2. The National Academies Press, Washington
64. Merz M, Doering N (2010) Aktive Beteiligung an Wikipedia aus sozial-kognitiver Perspektive. 47. Kongress der Deutschen Gesellschaft für Psychologie
65. Nielsen J (2006) "90-9-1" Rule for participation inequality: lurkers vs. contributors in internet communities. http://www.useit.com/alertbox/participation_inequality.html. Accessed 25 Feb 2012
66. Pande lab Stanford University (2011) Folding@home. In: Folding@home. http://folding.stanford.edu. Accessed 22 Feb 2012
67. University of Carolina (2012) SETI@home. http://setiathome.berkeley.edu/. Accessed 22 Feb 2012
68. University of Washington (2012) Rosetta@home. http://boinc.bakerlab.org/rosetta/. Accessed 22 Feb 2012
69. Von Ahn L, Dabbish L (2008) Designing games with a purpose. Commun ACM 51:58–67

70. Burke M, Marlow C, Lento T (2009) Feed me: motivating newcomer contribution in social network sites. Proceedings of the 27th international conference on Human factors in computing systems. pp 945–954
71. Teschner F, Mazarakis A, Riordan R, Weinhardt C (2011) Participation, feedback & incentives in a competitive forecasting community. Proceedings of the International Conference on Information Systems (ICIS). Paper 16, pp. 1–14
72. Raford N (2009) Overcoming cognitive bias in group decision-making. http://www.noahraford.com/files/raford_overcomingbias.pdf. Accessed 04 July 2013
73. Karaganis J (2008) Structures of participation in digital culture. Social Science Research Council, New York
74. Wikistrat Inc. (2011) Wikistrat - geopolitical analysis, tracking globalization. http://www.wikistrat.com/. Accessed 25 Dec 2011
75. The Future of Facebook Project (2011) Future of facebook. http://futureoffacebook.com/?page_id=49. Accessed 25 Dec 2011
76. Fleck L (1981) Genesis and development of a scientific fact. University of Chicago Press, Chicago
77. Benkler Y, Nissenbaum H (2006) Commons-based peer production and virtue. J Polit Philos 14:394–419
78. Masum H, Zhang Y-C (2004) Manifesto for the reputation society. http://firstmonday.org/article/view/1158/1078 Accessed 04 July 2013
79. Applied Research Associates, Inc. (2012) Forecasting ace : aggregating the predictions of experts. http://forecastingace.com/. Accessed 21 Feb 2012
80. Glaser BG, Strauss AL (1998) Grounded theory. Verlag Hans Huber, Bern
81. Christopherson KM (2007) The positive and negative implications of anonymity in internet social interactions. Comput Hum Behav 23:3038–3056
82. Stottler Henke Associates, Inc. (2007) Future-Fusion.com. http://www.future-fusion.com/products.html. Accessed 25 Dec 2011
83. Eichelbaum F, Schatzmann J, Schäfer R (2011) Qualitätsstandards - foresight 2.0 (whitepaper – not published)
84. Teevan J, Morris MR, Panovich K (2011) Factors affecting response quantity, quality, and speed for questions asked via social network status messages. Fifth International AAAI Conference on Weblogs and Social Media
85. Kosow H, Gassner R (2008) Methoden der Zukunfts-und Szenarioanalyse: Überblick, Bewertung und Auswahlkriterien. IZT, Berlin, https://www.izt.de/fileadmin/downloads/pdf/IZT_WB103.pdf Accessed 03 July 2013
86. Soll JB, Mannes AE (2011) Judgmental aggregation strategies depend on whether the self is involved. Int J Forecast 27:81–102
87. DeMott DA (2011) The milieu of the boardroom and the precinct of employment. NCL Rev 89:749–1055
88. Kahneman D, Slovic P, Tversky A (1982) Judgment under Uncertainty: Heuristics and Biases. Cambridge University Press, Cambridge
89. Giesel KD (2007) Leitbilder in den Sozialwissenschaften: Begriffe, Theorien und Forschungskonzepte. VS Verlag für Sozialwissenschaften, Wiesbaden
90. Bohøj M, Borchorst NG, Bouvin NO, et al. (2010) Timeline collaboration. Proceedings of the 28th international conference on Human factors in computing systems. pp 523–532
91. Tiberius V (2011) Zukunftsorientierung in der Betriebswirtschaftslehre. Gabler Verlag, Wiesbaden
92. O'Reilly (2007) What is web 2.0: design patterns and business models for the next generation of software. Commun Strateg 1:17–37