Creative Prototyping as an Inter-Dimensional Portal Between Disciplines

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Abstract. This paper uses a narrative literary study to discuss how the science fiction prototyping method has been applied so far in different disciplines, including technology and engineering research (specifically Intelligent Environment research), foresight, futures- and business studies. Then the paper presents very similar practices in human-computer interaction, entitled as e.g. critical design, speculative design and design fiction. After that, the paper focuses on their common denominator, scenario planning and scenario design, and deliberates briefly on how the creative, future-oriented prototyping differs from them. The main contribution is to propose a conversional tool – an inter-dimensional portal – for all the involved disciplines that is aimed at uniting their forces and passion for science fiction – for the greatest benefit of all mankind.

Keywords. Science fiction prototyping (SFP), Intelligent Environment (IE) research, Creative Science (CS), future studies, human-computer Interaction (HCI)

1. Introduction

This paper presents a loose narrative literature synthesis (Cassell et al. 2006) that aims to provide a contemporary snapshot of the state of the science fiction prototyping (SFP) method (Johnson 2011). The aim is to deliberate on how the method has been applied so far by different disciplines, including foresight, future studies, business studies and, as expected, the many engineering and technology research areas supported by the host of this Creative Science (CS) workshop; the international conference series on Intelligent Environments (IEs). After that the paper briefly deliberates on how the SFP method positions itself next to similar science fiction[2] -related and future-oriented methods in human-computer interaction (HCI), e.g. critical design, speculative design and design fiction. Then the paper focuses on their common denominator, scenario planning (in futures research and foresight) and scenario design (in IE research and HCI), and considers how the creative prototyping methods differ from them. The main contribution of the paper is to suggest that the creative prototyping methods could act as an inter-dimensional portal that may provide a conversional tool between the disciplines. The paper limits itself to reviewing the SFP path from past to present, and underlines that it does not commit itself to such important matters as e.g. describing the SFP process (presented earlier e.g. in Johnson 2011, p. 25; Creative Science Cycle by

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[2] Thacker (2001) defines science fiction as "a contemporary mode in which the techniques of extrapolation and speculation are utilized in a narrative form to construct near-future, far-future or fantastic worlds in which science, technology, and society intersect."

Ercan Bostanci[3] and more elaborated framework by Graham et al. 2015, p. 2) or the difficult task of writing a creative and compelling science fiction short story.

2. The co-evolutionary spiral and the SFP path from past to present

The relation between science fiction and science fact (i.e. here explicitly technology research) has been clearly identified by scholars, technology designers, futurists and researchers from different disciplines, e.g. by Greenfield (2006); Schmitz et al. (2008); Bleecker (2009); Johnson (2009a, 2011); Shedroff and Noessel (2012); Marcus (2013); Dourish and Bell (2014) and Lindley and Coulton (2015). Greenfield has labelled this symbiosis "a co-evolutionary spiral"[4], which means that the science fiction stories told in movies and novels come to shape the course of real-world invention, and these in turn serve as a seed stock for ever more elaborate imaginings. Dourish and Bell (2014) – who firmly suggest reading science fiction alongside ubiquitous computing research – comment that science fiction does not merely anticipate, but actively shapes the technological futures through its effect on the collective imagination, and as such has a profound, albeit little documented, impact on ubiquitous computing and its discursive practices. As an example, a widely referenced artefact in the research publications has been inspired by Star Trek television series, namely the clamshell phone design and those of the early PDAs (presented e.g. by Evangelista, 2004); and as an example of commonly referenced innovation from science fiction literature is conceivably Arthur C. Clarke's (1945) speculative communication satellite.

Although many scholars have remarked on the devoted co-evolutionary spiral of science fiction and fact, Johnson (2011) was the first to turn it into an actual method, which he labelled as science fiction prototyping. Johnson describes the outcome of the process as being "stories grounded in current science and engineering research that are written for the explicit purpose of acting as prototypes for people to explore a wide variety of futures." According to Johnson, science fiction prototypes serve a purpose for scientists and engineers in stretching their work; or, on the other hand, they can be created by any interested party who wants to influence the work of researchers. An important benchmark of the way in which the science fiction authors employ the method is Johnson's *Uber Morgen* (or *Tomorrow*) -project (2010)[5], which was published as a collection of science fiction stories made by acknowledged science fiction authors[6]. In the project, the authors were first introduced to future technologies in the Intel laboratories, and were then asked to explore the new innovations and imagine them by the means of SFP. Later, the project continued through a world-wide effort of engaging science fiction authors (both professionals and amateurs) to write the *Tomorrow project anthology* (2013)[7]. Nevertheless, Johnson considers that essentially the SF-prototypes are most expedient when used explicitly as a step or input in the

[3] Presented at the CS' event, at the University of Essex, 2011 (published e.g. in Kymäläinen 2015 (p. 61).

[4] It should be said that Arthur C. Clark already explicated the co-evolutionary spiral by saying: "All of the pioneers of astronautics were inspired by Jules Verne, and several (e.g., Goddard, Oberth, von Braun) actually wrote fiction to popularize their ideas (Johnson 2009a)."

[5] Open access electronic article:
http://www.intel.com/content/dam/www/public/us/en/documents/technology-briefs/intel-labs-tomorrow-project-complete-brief.pdf

[6] The Authors: Scarlett Thomas, Markus Heitz, Douglas Rushkoff and Ray Hammond.

[7] Open access electronic article:
http://isef.tomorrow-projects.com/2013/10/cautions-dreams-curiosities-anthology/

development process; i.e. when the outcome is fed back into a scientific process to shape the research and its outputs. Johnson illustrates this type of procedure by, at first, familiarizing himself with the research of Egerton et al. (2008), and then creating a SF-prototype of the work, entitled as *Nebulous Mechanisms* (2009b). Ultimately, the process has turned out to be highly iterative, as the prototype became the first part of a series called *Nebulous Mechanisms: The Dr Simon Egerton Stories*. This work is presented in detail in Johnson (2011) and complemented by his latest work *21st Century Robot* (Johnson 2015). Graham et al. (2015) consider this type fictional prototyping being a recent spin-off of the "hard science fiction"[8].

3. Applying the SFP method to the Intelligent Environment research

The great majority of the early SF-prototypes have been published within the Intelligent Environment research domain. This is because the SFP method made its first public appearances within the international conference on Intelligent Environments, at the Creative Science workshop 2010, in Malaysia. This workshop was, in fact, also the initiative for the birth of the Creative Science Foundation[9] – a society that arranges forums, workshops and publication channels with the aim of finding means for any interested parties to collaborate, peer-review and publish their creative science work (Zheng and Callaghan, 2012). In an IE context, the authors (mostly science and engineering researchers) have written about people's complex relationship with new technologies, their potential effects on society and environment, change in the lifestyles of people and transposition of realities. Fig. 1 gives a brief illustration of the technologies that the published prototypes touched upon. The graphic synthesis is based on primary publications that can be found from the proceedings of 6th, 7th and 9th international conferences on Intelligent Environments, and the full literature synthesis on the SFPs can be found in Kymäläinen (2016).

Figure 1. Cosmic expansion after the launch of the SFP method; the graphic synthesis presenting some of the early topics for the science fiction prototypes.

[8] In the 1970s a more radical movement formed around the "hard sciences" (e.g. computer science, astronomy, physics and chemistry), in which science fiction literature started to use either established or carefully extrapolated science as its backbone (Johnson 2011).

[9] http://www.creative-science.org/

4. SFPs in futures studies, foresight and business studies

The breakthrough entree for academia was apparently the two special issues in *Futures* (vol. 50, 2013) (introduction by Bell et al. 2013) and *Technological Forecasting and Social Change* (vol. 84, 2014) (introduction by Graham et al. 2014) that were nominated for exploring the possibilities of SFP and creative prototyping activities. It should also be noted, that in this context – within futures studies and strategic research – there has correspondingly been an extensive earlier history acknowledging the influence of science fiction on research (e.g. Miles 1993; Love 2001; and Bergman et al. 2010). In futures studies, Bell et al. (2013) encourage the explicit use of SFPs particularly for the study of evolutionary futures. They assume that any totalizing predictions of the future are nevertheless flawed, biased and ultimately fix specific aspects of an imagined future, and justify the use of SFP by arguing that "a revolutionary technology defies predictions." Consequently, there has also emerged a co-evolutional spiral within futures studies and SFP. In this context, the method has been used for making visible some influential research concepts. For example, Birtchnell and Urry (2013) tackle the *black swan* -events in their SFP by experimenting with the use of complex geometries and laser sintering of metals in high-risk products. Schwarz and Liebl (2013) argue that SFPs, as cultural products, may be used for detecting *weak signals of change* in the environment, and emphasize that technological developments go hand in hand with the changes in sociocultural practices.

In economy and business sciences, Graham et al. (2013) have explored the use of creative fictional prototyping in order to motivate and direct research into new high-tech products, environments and lifestyles. In their prototype, Graham et al. considered the co-creation paradigm in an online environment and the possibilities of further refining the dominant logic of services marketing. Wu (2013) has taken up the challenge in completing the SFP by introducing "imagination workshops" that aim to provide an evolutionary model of the science fiction creation process. These futures workshops employ existing SFPs as their source of inspiration, and the process includes several feedback loops. Zheng and Callaghan (2016) extend this line of thinking by introducing a process called Diegetic Innovation Templating (DiT) as a mean to explore how science-fiction and fantasy, particularly in the form of films, may be used as a systematic source of ideas for design and product innovation, and demonstrate the work through empirical case studies. This work is important especially because it moves the approach closer to social sciences, namely towards the diegetic prototyping introduced by Kirby (2010).

5. Human-computer Interaction and its relation to science fiction

Within the human-computer interaction (HCI) there has also been a great deal of discussion on future-oriented fiction. Instead of SFP, however, the engagement between research and science fiction has been carried out under such methods as reflective design (Sengers et al. 2005), critical design (Dunne and Raby 2001; Wolf et al. 2006) speculative design (Dunne and Raby 2013; Auger 2013) speculative visualization (Kim and DiSalvo 2010) and design fiction (Bleeker 2009; Tanenbaum 2014; Linehan et al. 2014). In addition, Auger (2013) extends future-oriented practices to cover discursive design and design probes, and Dunne (1999) includes value fiction in the list of methods. According to Auger (2013), there is evidently much overlap

between the practices, and their differences are more or less subtle. Yet, they all aim to remove the constraints from the normative design processes, increase the social awareness, use models and prototypes at the heart of the enquiry, use fiction to present alternative products, systems or worlds, and provide a system for analysing, critiquing and re-thinking contemporary technology (Auger 2013; Dunne and Raby 2013; Tanenbaum 2014). For those engaged with SFP, these reasons and benefits sound remarkably familiar.

Most synergy with SFP can evidently be found from design fiction. According to Lindley and Coulton (2015a), design fiction draws on speculative design, and its primary focus is on generating understanding and insights. Design fiction dates its birth from 2005 when science fiction author Bruce Sterling coined the term (Tannenbaum 2014). Bleecker (2009), however, was the first to suggest using design fiction – i.e. speculative stories through objects – as a formal method or inquiry in design. In his view, the physical prototypes, conceptual inventions and building the actual technology could be described as "confrontation of design, science fact and science fiction." As concrete evidence of these practices, there have been some HCI papers that present entirely fictional prototypes, and which, as such, appear very similar to SF prototypes. Lawson, et al. (2015), for example, present three fictional products relating quantified cats and dogs, and position their work in the fields of critical design and design fiction. Lindley and Coulton (2015b) refer to design fiction when they present a visual drone enforcement system in their paper *Game of Drones*. Kirman et al. Linehan, (2013) do not position their work under any process or practice; however, their witty and humorous abstract *CHI and the future robot enslavement of humankind: a retrospective* could well exceed the definition of most of them, including SFP.

The main difference between SFP and science fiction-oriented HCI methods seems to be that the latter aim clearly at the production of physical objects or artefacts (for an excellent collection of references, see Gever and Martin 2000 and Auger 2013) or they use a variety of media (text, video, objects and graphics), such as presented e.g. by Markussen and Knutz (2013). Blythe's (2015) design fiction novel *Practical products for centenarian spies* is an exception to the practice, as it is completely literal. As compared to SFP it does not, however, make a reflection on the research or technologies it presents. Another difference compared to the SFP method and future-oriented HCI practices is in defining the process, which in the latter seems to be rather vaguely explained. For example, Lindley and Coulton (2015) mention that design fiction is inherently ambiguous; Markussen and Knutz (2013) state that "it is obvious from the growing literature that design fiction is open to several different interpretations, ideologies and aims." Auger (2013) justifies the lack of process description as: "Every speculative design project is unique and the diversity of possible subjects, contexts, technologies, perspectives and audiences make a definitive 'how to' guide impossible". Dunne and Raby (2013) state that critical design and speculative design proposals are more of an attitude than anything else; "a position rather than a method." Consequently, the main difference between the practices appears to be in relation to the form and fidelity of the prototype and how the process is discussed.

6. Relation between SFP and scenarios

The common denominator for all the mentioned disciplines is that the future-oriented practices may sound as if they have a distant resemblance to scenarios: scenario

planning (in futures research and foresight) and scenario design (in IE research and HCI).

Generally speaking, scenarios are used in strategic planning e.g. for stimulating strategic thought and communication within companies, improving internal flexibility of response to environmental uncertainty, providing a better preparation for possible system breakdowns and reorienting policy options according to the future context on which their consequences would impinge (Godet and Roubelat 1996). When studying the ideas of change, evolution or progress in societal systems, Mannermaa (1991) has distinguished an extension to a more traditional scenario paradigm as being evolutionary futures research that aims to study complex, self-organizing evolutionary systems. Bell et al. (2013) suggest the explicit use of the SFP method for studying them. In essence, they consider the main difference between scenarios and Sf prototypes to be that scenarios act as the mechanisms for testing strategic direction, while prototypes offer a mechanism for analysis. The scenario is thus a specific set of predictions that depicts a future that could occur, and actively encourages its realization, whereas prototypes express "hope," and an approximation of the future that is a consolidation of inspiration (ibid.).

IE research and HCI has taken a somewhat different approach when defining scenarios. According to Carroll (2000), technology scenarios are often used to generate requirements, to uncover missing features, to verify and validate requirements, and to integrate analysis of functional and non-functional, or "quality," requirements, such as e. g safety, reliability, portability and cost. He goes on to state that scenarios have been used to support design brainstorming and prototype development, to generate issues and trade-offs in a design, and to provide usability walk-throughs ensuring that the system features are evaluated relative to a specified context of use, design space analysis and use representations. Erickson (1996) elucidates the difference between stories and scenarios in detail, which explains the difference between SF -prototypes and scenarios as well. For example, the most obvious difference is that stories are concrete accounts of particular people and events, in particular situations, whereas scenarios are often more abstract, being scripts of events that may leave out details of history, motivation, and personality. In general, Greenfield accuses the technology-driven scenarios of decomposing all possible situations into them: every party to an interaction must be named, as well as all the attributes belonging to each of them. He believes scenarios also neglect to model the fuzzy, indirect and imprecise behaviours; the "AI-hard" issue that surrounds us in everyday life. Buxton (2007) considers the problem with scenarios to lie in the fact that they try to tell, show, explain and convince rather than invite, suggest and question. His suggestion for changing the situation is to provide more advanced tools for users to speculate about the alternatives.

7. Discussion about the inter-dimensional portal between disciplines

Consequently, more than in conventional scenario planning or scenario design, the future-oriented, creative prototypes may provide a means to consider the emerging technologies and their implications within a broader web of relationships. Instead of arguing what discipline has coined the science fiction-related terms and methods first or most pragmatically, the discussion part of this paper focuses on underlining the common enthusiasm that all the disciplines mentioned share for science fiction practices. This observation leads us to consider that, as they are all working with

comparable future-oriented problems, the stakeholders mentioned should rather unite their efforts in creating an inter-dimensional portal that may provide a conversional tool between the disciplines. It should be noted that this argument has already been coded into the SFP method and the efforts of the Creative Science Foundation. This is evident also in creative HCI practices, as Dunne and Raby (2013) also find the role of design fiction "not to show how things will be but to open up a space for discussion." Graham et al. (2015) furthermore encourage the collaboration between the disciplines, as "…we set out to build something strategically visionary with respected researchers, activists or consultants that are guided more by logic and intuition than by ideology".

Consequently, the proposed inter-dimensional portal (see Fig. 2) may be associated with three interrelated design dimensions introduced by Weiss (2002) – people, technology and business. The portal seeks to answer the questions: 1) What do people find desirable in future products or services? *(people)*; 2) What is technically feasible in future products or services? *(technology)*; and 3) What is viable from a business perspective in future products or services? *(business)*. Thus the portal seeks to open a new kind of design space that creates cohesion and delivers science fiction-oriented or -inspired, creative fictional products, services or concepts that – when combining all three dimensions – will be desirable, feasible and viable. The united efforts will allow science fiction -related activities to be more than the sum of their parts as the design take into account the technological, human and business factors when exploring important future-oriented issues[10]. In this way, the inter-dimensional portal requires the use of judgment of all the different stakeholders with dissimilar background and knowledge bases. It does not aim for a theoretical framework, but allows multiple perspectives on the same issue to be explored and communicated. The contribution requires a balance between concreteness and openness: they need to be specific enough to evoke intuitive reactions, yet indefinite enough to encourage imaginative extensions, the criteria that Gaver and Martin (2000) suggest for new innovative design spaces.

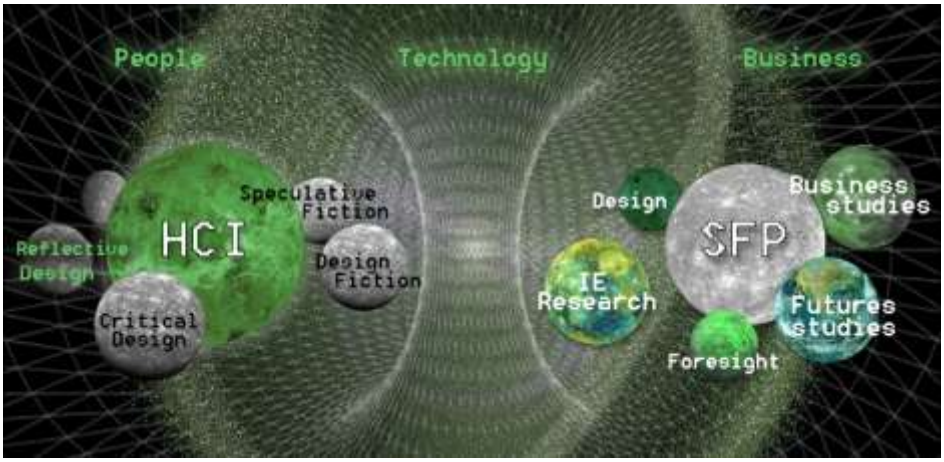

Figure 2. Inter-dimensional portal for the science fiction inspired disciplines. On the left: science fiction related methods orbiting HCI; on the right: SFP inspired disciplines orbiting the method.

[10] This is in accordance with Evans (2011), who claims that, if a wholly desirable product or service is developed without any regard for its technological feasibility or business viability, to a greater or lesser extent it may be just a creative exploration.

8. Conclusions

This paper presented a narrative literature synthesis that provides a contemporary snapshot of the state of the science fiction prototyping (SFP) method and similar creative, future-oriented HCI practices. The brief synthesis was not meant to be conclusive; its main intent was to extract some of the data from the published SF-prototypes, speculative design and design fiction contributions that were connected to technological innovations through the mediating variable of science fiction. The paper clarified the attempts of scholars from different disciplines, namely science and engineering; futures studies and foresight; business and management; HCI and design. An important contribution was to introduce the idea of an inter-dimensional portal that highlights the issue that science fiction may provide an important link between the disciplines, which may help to discuss the more profound implications of the emerging technologies at the broader societal level.

Overall, the referenced papers provided evidence of how the practices provide a means to concern ourselves to a greater extent with the wider socio-technical issues and consequences of technologies to society; nevertheless, there still remain many unexplored fields for research that need to be addressed. Apparently there is a lot to be discussed about the author/designer of the science fiction outcome, as he or she is the key protagonist of the creative design activity[11]. This topic is also related to the validation of the creative prototypes. These important discussions are, however, beyond the limitations of this paper. For now, it should be sufficient to state that, as the creation process is dependent on the designer's or author's intuition, imaginative engagement and creative expertise, the process is not necessarily demonstrable and replicable and, therefore, the validation becomes inessential, as confirmed e.g. by Evans (2011).

As a final word, it seems also significant to point out that the relentlessly evolving waves of technology research – and the fact that it is usually carried out behind the closed doors of diverse disciplines – might suggest that its development and advances are not at all visible to people outside the departments or laboratories. As a conversational tool, creative prototyping could also be seen as the currency of communication that helps us to understand the essential nature of the consequences of future technologies.

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[11] For example, in the case of SFP, the design of a prototype is challenging as the author/designer should be both a scientific and technological expert, engage with related materials provided e.g. by the CS community and also possess a capability to write compelling fiction (Graham et al. 2015).

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