

# Imagination Workshops: An Empirical Exploration of SFP for Technology-based Business Innovation

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**Abstract.** This article explores the potential use of Science Fiction Prototypes (SFPs) as a vehicle to promote creative thinking and innovation in the business and technology development process. In particular, the paper describes a tool, “The Imagination Workshop”, which business people can use to drive near and far term product innovation, futuristic business and entrepreneurship. A key contribution of this article is the use of a modified evolutionary model of the Science Fiction Prototyping creation process (cyclic SFP), which, instead of being linear process (as in earlier approaches), is based around a set of feedback loops in the form of an iterative evolutionary co-creative process. In addition, the paper describes how the SFP methodology has been applied to business innovation and entrepreneurship in two small UK companies. Finally, it reflects on the strengths and weaknesses of these methods from a business perspective.

**Keywords.** Innovation, creativity, scenario, business model, science fiction prototyping, entrepreneurship

## 1. Introduction

A Chinese proverb states, “*Heavenly secrets must not be leaked*”. However, it is natural for people to be curious about the future, satisfying this need by a variety of means such as consulting fortune-tellers, guessing, dreaming, imagining, predicting, or forecasting. Envisioning the future motivates and gives hopes to our lives. Because the future is beyond the present, we need to construct a bridge to reach the future and to explore the possibilities that it holds; that bridge is imagination.

Johnson (2011), Intel’s Futurist, proposed a methodology *Science Fiction Prototyping* (SFP) for use by scientists and engineers to support product innovation in Intel Labs [1]. This method was released to the public in 2010 via a workshop labelled Creative Science [1] and published as a book in 2011[2]. SFP has the potential to play a strategic role in promoting creative thinking and innovation by enabling people from different areas of business and society to co-create their visions of the future. The deliverables arising from SFP are future scenarios, and the associated R&D and business model specifications.

In ‘future studies’, researchers try to establish methods to predict and forecast the future. In the book *Long-Range Forecasting* [3], Armstrong (1985, pp.440) provides a

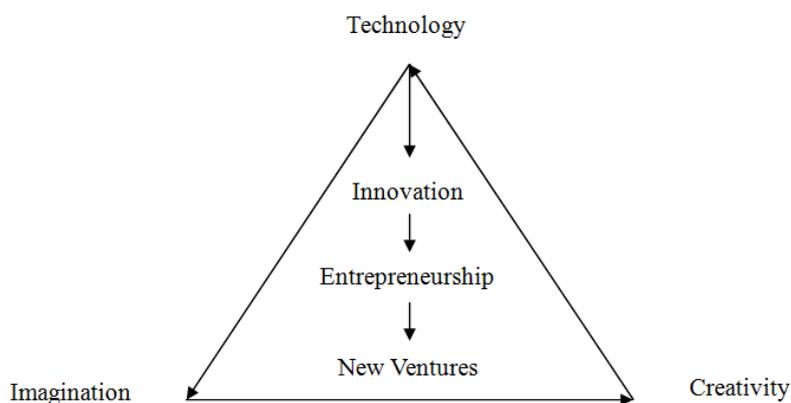
guide to forecasting methods. It identifies and discusses several research areas for long-range forecasting including implementation, judgment, extrapolation, econometric, segmentation, bootstrapping and combined forecasting. An interesting finding of the book was that more emphasis should be given to the assessment of uncertainty. In the work by Saaty and Vargas (1990), “*Prediction, Projection and Forecasting*” [4], they identify four general types of approach to prediction; (1) systematic generation of alternative paths to the future, (2) extrapolative trend examination, (3) historical analysis and analogy, and (4) collective opinion techniques. More broadly, researchers have attempted to find ways of reducing errors in long-range forecasting, but, given it is largely based on decisions of people, who are essentially non-deterministic operating in environments with some degrees of uncertainty, it is inevitable that it might still be possible to lead to an erroneous result. Regarding the time-windows that these processes operate over, extrapolation is used for short to medium-term needs whereas scenario development is more commonly used for longer-term work [5]. Johnson’s SFP can be described as a methodology for driving “*visionary scientific innovation*” by combining extrapolation and scenarios [2]. In Saaty and Vargas’s definition, a visionary forecast is “*a prophecy that uses personal insights, judgment, and when possible, facts about different scenarios of the future. It is characterized by subjective guesswork and imagination; in general, the methods used are non-scientific*”. One difference between SFP and forecasting is that the SFP approach is based on scientific fact or theory. Barel (1971) offers a useful view by breaking forecasting into two functions; an analytic function (for modelling, decision support, assessment of past and present, and gaming); ideological functions such as visions, creating ideologies, and entering a debate to get resources [6]. Some commentators have argued that all such methods are not enough on their own [7] and that the core engine behind innovation is imagination. Thus the question arises, where does imagination come from? Are there systematic ways of being inspired? How does a person start to imagine? According to Oxford Dictionary, creativity is “*the use of imagination or original ideas to create something; inventiveness*” and imagination is “*the faculty or action of forming new ideas, or images or concepts of external objects not present to the senses*”. Legrenzi (2007, pp.42) [8] stated:

*Whereas for psychologists concerned with insight, what is crucial is the demonstration that the imagination is something other than creativity. Creativity is imagination but it is also rigor, method, reflection, pondering, and application of the intellectual mind. Only if we free ourselves of our fixations, can we trigger the necessary insight for problem solving.*

Thus, from the above, it is clear that innovation is a complex and somewhat nebulous process and there is a need to employ some tangible methodologies to create a practical process for applying imagination to product and business innovation. One of the most popular tools is scenario development in which a developer writes a story that incorporates the technology being investigated, into a lifestyle. Much has been written on this topic with examples of useful literature being Van Notten et-al [9] who presents a scenario typology, Börjesona et-al [10] who provides a comprehensive overview of scenario types and techniques and Varum and Melo [11] who provide a thorough analysis of literature from 1945 to 2006 including setting up a future research agenda. In Börjesona’s review, workshops were identified as being the key creative vehicle:

*Workshops can facilitate broadening of the perspectives, since decision-makers, stakeholders and experts can be included in the process. Moreover, workshops can increase the acceptance of decisions or scenarios among the participants. In the workshop process, it is also possible to include techniques that liberate the creativity of the human mind.*

Despite this wealth of research the question remains of where and how we get the sources and motivate us to imagine. In this article a solution is proposed that uses the SFP process, but mediated by a collection of mechanisms that is collectively labelled as an “*Imagination Workshop*”. The aim in creating this workshop was to provide the means to induce technology-based innovation, entrepreneurship, or new ventures, by drawing on technologies, imagination, and creativity for building the vision of future business. Figure 1 depicts how an SFP is formed by motivating technology, imagination, and creativity to achieve innovation, which stimulates entrepreneurship to create new ventures. The various combinations of technology, imagination and creativity can lead to different types of innovation. Technology plus imagination can create far-term projections of new technologies. Imagination plus creativity can create new designs. Creativity plus technology can bring creative applications. These three components create an ‘innovation triangle’ which has the potential to lead to technology innovation and, ultimately, new entrepreneurial ventures. The triangle of innovation framework is illustrated in Figure 1 and underpins the fundamental ideology of this paper.



**Figure 1. The innovation triangle: three components of technology-based innovation and entrepreneurship are creativity, imagination and technology.**

Finally, the Science Fiction Prototyping and Imagination Workshop process introduced above can be regarded as a visionary forecasting method. However, perhaps the most important facet of the Imagination Workshop is that also it provides a mechanism to invigorate innovative thinking. The following section introduces SFP and a variant termed “Cyclic SFP”, which forms the core mechanism of an Imagination Workshop, which aims to improve the effectiveness of the SFP process, especially for people that are new to the SFPs methodology.

## 2. An Evolutionary Model of SFP Creation Process

### 2.1. Five-step Linear SFP Creation Process

An SFP can assume numerous forms such as short stories, movies, plays and even comics. Johnson suggests the use of five steps to create an SFP, 1) selecting the science and building an imaginative world, 2) identifying a scientific inflection point, 3) analysing the ramifications of the science on people, 4) identifying a human inflection point, and 5) reflecting on what was learnt. [1] These steps are illustrated in Figure 2 and are designed to force proponents to think about their innovative ideas within a realistic setting, comprising people and society. This process can expose both positive and negative outcomes, thereby enabling those concerned to better insure that the proposed innovations are beneficial to society.

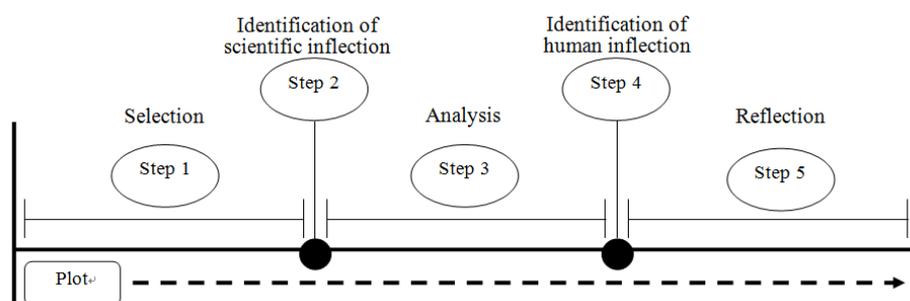


Figure 2. Five-step SFP creation process (adapted from Johnson 2010)

### 2.2. The Evolutionary Model of SFP Creation Process

SFP methodology is comparatively new, and like all new disciplines is evolving. Originally, when this tool was introduced by Johnson in 2010 it was only applied to technology innovation but more recently there has been interest in applying it to business. For example, Ping Zheng, is pioneering the use of SFP to teach entrepreneurship modules within Canterbury Christ Church University Business School. She is also exploring wider support for entrepreneurship via an inter-university cooperative movement (some of which is linked to SFP origins) [12]-[13]. While, there has been no prior work reported in the published literature on applying SFP technique to business, there are accounts of SFP having been applied to education such as Tadayoshi Kohno's computer security course at the University of Washington [14].

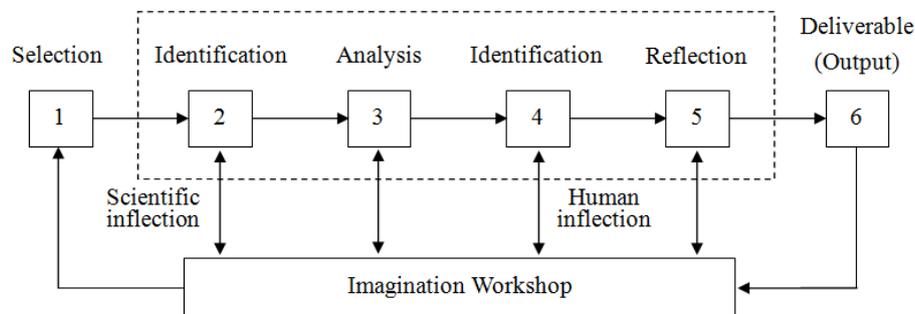


Figure 3. An evolutionary model of SFP creation process

In this work a modified evolutionary model of the SFP creation process is proposed; see Figure 3. [15-17] Instead of being linear process (as in earlier approaches), this model consists of a series of processes containing feedback loops, which is termed ‘cyclic SFP’ and forms evolutionary process to that leads to delivering a scenario and associated product specifications or business models. This process is managed within a framework labelled an “Imagination Workshop”, which acts as a catalyst to create new SFPs inspired or based on existing SFPs. It functions by mediating the steps in the process of scenario creation and thereby reinforces the generation of new SFPs. A noteworthy difference to earlier SFP is the existence of an additional step (6), which provides a deliverable that goes beyond delivering only a scenario but, for example, might include delivery of a simple product specification or business model.

### 3. Imagination Workshop: The World in 2050

The principle of an Imagination Workshop is to gather together a group of participants, specify a goal (innovating some types of business or technology), provide a context (eg business, home etc), set a timeline (usually ten or more years in the future) and offer support for brainstorming about possible futures [18-19]. More specifically, in the *Imagination Workshop* described in this paper, the theme adopted was “*The World in 2050*”. The aim of the workshop was to get the participants’ to conduct a “mind simulation” of a world some 40 years into the future (envisioning what the world might be like and the type of businesses and technologies that may exist, or they would like to exist). In this exercise, they are allowed to extrapolate the present world (perhaps overcoming shortcomings in current business or technology), or draw on other SFPs for inspiration.

#### 3.1. The Format of the Imagination Workshop

In more generic terms, an Imagination Workshop is started by describing its purpose and the Cyclic SFP method. The World Café approach [20] is adapted to stimulate brainstorming and discussion. Participants are randomly placed in groups of four members as that lubricates discussion and aids creativity by shuffling backgrounds. A flipchart is provided to each group to record key points. The facilitator initiates a

discussion by putting questions to the group that induces creative thinking. Each group is given five minutes to address each question, with one person acting as the chair/spokesperson to sum up (everyone contributes to the decision). The following are examples of questions used in the workshop described in this paper:

- What will the *living environment* be like?
- What will *people* be like?
- What kind of *lifestyles* will people have in urban and rural areas?
- What *technologies* will be dominant in our life?
- What will *business* be like? (What new ways might it be conducted?)
- How will the *society* evolve?

Finally, after the brainstorming sessions, participants are asked to publically present their results so as to pool their ideas.

### 3.2. The Exemplary Scenario

In order to give the participants a clearer insight into the process, and to provide some inspiration, the workshop includes a presentation on earlier SFPs. The SFP used in the workshop described in this paper was “*The Spiritual Machine*” SFP [21]. Briefly, this SFP concerns a future time where technology has advanced to a point where reality and virtuality become confused and where people can become so engrossed with the technology; it resembles a computing version of hallucinatory drugs! The story revolves around a technology rich environment called a *WonderHome* which features very advanced technologies such as a smart-paint called “*iSkin*” which, when painted on surfaces, turns them into interactive multi-media mediums, or immersive reality environments; see figure 5. The SFP explored a number of themes ranging from the innovative technology to the businesses it might generate and, interestingly, the balance between the forces of technology and spirituality in the form of the ancient Chinese practice of Chan, a variant of Buddhism [22-25]. Figure 4 reproduces a fictional advertisement for *iSkin* paint taken from that SFP.

This SFP was chosen primarily because it illustrated a comprehensive set of future but realistic technologies, from science-based PhD projects [26-30], drew on cutting-edge business concepts from Master projects [31-32] and connected with the local culture through Chan Practice [22-25]. In addition, previous experience has shown it to be an engaging story that quickly gives rise to conversations about the future. A facet of this SFP is that it probes the wider context of people’s lives (love, relationships etc) which Johnson argues is necessary for informing the needs of future technologies and businesses [1].

**[Additive Technology iSkin]**  
**iSkin - Smart Paint for smart homeowners**

Join the technology revolution; turn any surface into an interactive intelligent surface

iSkin paint contains millions of nano-agents (microscopic computers) each containing programmable sensors and effectors that can function as video displays, audio transducers, touch, light, heat and pressure sensors.

Paint iSkin on the walls of your room and create a immersive reality chambers

Select from thousands of iSkin Apps in the iSkin market including our popular Wonderhome-3, for making immersive reality rooms

iSkin are simple to program using special electronic brushes that inject 'Smart-Apps' directly into the nano-agents

iSkin Use the latest nano-agent technology with integrated:

- Think-Fast© - Quantum processor
- Tender-Touch 4.2© - Haptics
- Spirit 8© - Personality Engine
- My-Eyes 6.1© - 3D Media
- Real-Love 4.2© - EmotionWare
- GalaxyiNet 2© - Communications

Additive Technology, Bank Tower Bldg, 205, Tun Hwa North Rd, Taipei, Taiwan

Figure 4. A label advertising the Additive Technology *iSkin* paint

### 3.3. The Exemplar Imagination Workshop

A three-hour trial workshop was given to an NTU e-Commerce course consisting of some 45 students in spring of 2012. It was structured as a thirty-minute introduction followed by a forty-minute session that included discussion, sharing and brainstorming. Next there was 10 minutes for each group to share their ideas with the workshop participants followed by an overall summary from the facilitator. Figure 5 illustrates the workshop process; 1) brainstorming and discussion; 2) presentation and sharing; 3) idea scratch (flipchart).

Students were guided to think about a variety of basic living needs, such as aspects of food, clothing, shelter/housing/lodging, mobility/transportation/travelling, education/learning, as well as entertainment with a special emphasis on how technology and business might be involved. The students proposed several innovative ideas such as a virtual 3D supermarket accessed from home with food machine services, superchips embedded in human brain to realise virtual projection in air, human-robot/avatar relationships, immigration to other planets, holographic projection technology etc with many addressing societal issues such as the digital-divide, the urban-rural gap and the M-shaped society (ie squeezed middleclass) [34]. A Facebook group was created so that students who found SFP work interesting could search for, and share, supporting ideas. They were also given the option to create their own SFPs as part of their final individual coursework assignment which seventeen of the forty-five students elected to do. Four SFPs were considered to be of such quality that they were invited to submit their work to the Creative Science Conference in 2013.



nor attending a traditional lecture were good ways of engaging students in the ideas of SFP, as it involves an unfamiliar mix of unusual practices that straddle the arts and sciences. Rather it was found that a hands-on approach worked the best involving group activity and careful guidance by the facilitator using a mix of theory and practice. For instance, the most highly rated SFP arose from a student author who read the exemplar SFP and interacted closely with the facilitator.

As was discussed earlier, the aim of this article was not so much to provide a formal study of performance of the “Imagination Workshop” but rather to present an empirical account of teaching SFP to business people. Thus, this is simply an initial exploration of the application of SFP to business studies and more work should be undertaken to develop this methodology further such as exploring how to extract business models from SFPs by using business model generation and business planning tools and techniques.

Of course, the process of SFP and “Imagination Workshops” is just a first step in the entrepreneurial pathway. The next section presents two examples of how this process has contributed to real-world enterprises.

#### 4. From Academia to Industry

The preceding section discussed how SFP methodology supported by the Imagination Workshop could be applied to motivate creative thinking for future scenarios. The arguments made earlier in this article were twofold, first that the methodology was engaging to students; secondly that could be applied in the real world. To support this second hypothesis we will illustrate the practical usage of SFP by two UK companies; the first concerns the manufacture of innovative virtual reality desk, by ‘Immersive Displays’, and the second is the manufacture of a novel tool kit for innovative Internet-of-Things toolkit by a small startup company called ‘FortiTo’.

##### 4.1. SFP Example 1: eDesk

In 2011 a small British SME called Immersive Displays Ltd ([www.immersivedisplay.co.uk/](http://www.immersivedisplay.co.uk/)) began production of a novel new product, a desk with inbuilt virtual reality, which they labelled “*The ImmersaStation*”. The idea behind this product was to utilise virtual-reality to give online, geographically dispersed students a feeling of inhabiting a real classroom. The inspiration for this product came from an SFP called “*Tales From A Pod*” presented at the “1st International Workshop on Creative Science - Science Fiction Prototyping for Research Innovation (CS’2010)” which took place in Kuala Lumpur, Malaysia on the 19th July, 2010 [33]. The “*Tales From A Pod*” SFP took a speculative look at how artificial intelligence and virtual environments might be combined to change the nature of education by the year 2050. The centrepiece of the story was an environment called an educational pod (ePod), which the following extract from the SFP describes as:

*“ePods were effectively small cocoons; something like a comfortable armchair enclosed within a sound-proof egg-like structure packed with sophisticated but largely invisible technology that included immersive mixed reality and sophisticated AI. When participating in a movie (the industry had long dropped the word ‘watching’ which describing these new immersive movies)*

*the immersive reality technology aimed to make the participant feel as though they were truly part of a fictional physical world.”*

From the above description it can be seen that the user was given the feeling of being transported to another reality; a virtual world that most frequently took the form of a classroom, which the user shared with other remote students and teachers, in a way that made them all feel like they were in the same physical space [35-36]. At the time the SFP depicted the ePod being used (around 2050), the technological singularity [37] had been reached, and machine intelligence and interaction was equal or surpassed that of people. Thus, the SFP exploited this possibility by imagining this intelligence was used to create an “intelligent teacher avatar” that “lived” in virtual reality ePod [35]. The SFP produced an advertisement shown in Figure 6. In terms of SFP deliverables, this marketing document can be regarded as a type of product or market specification.

## ADDITIVE TECHNOLOGY EPOD-4

In this increasingly competitive world, where knowledge determines success, your child deserves the very best education available and that is Addictive Technology's **EPOD-4**

Pioneering research by Benjamin S. Bloom in the 1980s (and supported by all work since) proved that students who receive one-on-one tuition learn at least an order of magnitude better than grouped students. If you want to give your child the best one-to-one education in the world, give them an Addictive Technology's **EPOD-4**

### Education:

- Super-Intelligent Artificial Teachers
- Personalised one-to-one tuition (the gold standard)
- Teacher's avatar has visualisation powers that don't exist in physical space
- Available 24 hours a day, 365 days a year
- Learning environment (avatar, surroundings, lessons) can be tailored for each student
- Unwavering attention and happy disposition
- Compelling content combined with contextual delivery
- Teachers available in different cultures, ages, sexes and form



### Technology

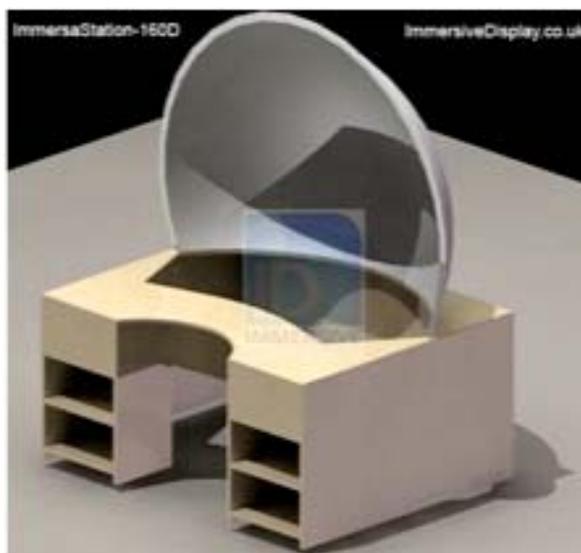
- **FREE-WILL 3 ©** - Quantum processor (upgradable)
- **MY-MIND 1.2 ©** - Evolving Persona Engine (customizable)
- **FLAME 5 ©** - EmotionWare
- **GET REAL 8.2 ©** - Mixed Reality Cocoon
- **REAL-TOUCH ©** iSkin & Haptics
- **GHOST 4.1 ©** - 3D Imaging & Audio
- **SENTINET ©** - Knowledge Engine

Addictive Technology, Zizhu Science Park, No. 880 Zi Xing Road, Minhang, Shanghai 200241, China

**Figure 6. An advertisement for the ePod in the “Tales from A Pod” SFP  
(Adapted from Callaghan 2010)**

In Figure 6 it can be seen that the SFP has considered, in equal measure, the business and technical aspects of the product. For example, the advertisement shows some knowledge of the market by presenting information on the educational benefits that would appeal to the parents, who would be the financial customers. For instance, it identifies some of the current market shortcomings by referring to real studies that have shown that children learn better with one-to-one teaching. In technological terms it specifies the types of technologies that would be needed, such as processors based on quantum physics [38] and systems that have an emotion sensing [39] and a self-monitoring capability [40]. One of the original driving forces behind the SFP methodology was Intel Corp, who manufactures integrated circuits, so it is not surprising that SFPs aim to deliver such electronics oriented specifications.

The next critical step in this SFP commercialization process was when the SFP was picked on by a small British (manufacturer Immersive Displays Ltd) of virtual reality environments who entered into a joint relationship to build a version of the ePod. However, clearly the nature of an SFP means that many of the technologies in the “Tales from a Pod” were beyond any manufacturing company and so it was necessary to take a pragmatic view on what could be produced. After some deliberation the idea for a desk, using a semi-sphere instead of a whole sphere emerged. A concept drawing for this is shown in Figure 7 [41].



**Figure 7. Concept Drawing of ImmersaStation (Courtesy of Immersive Displays Ltd)  
(Adapted from Peña-Ríos et-al 2012)**

In the SFP, the interactive surfaces were created with a paint pigmented with nano-computers [42], which are beyond the capabilities of current science, so, to realize the concept, projectors were used. Of course none of the intelligent agents are able to reach the capabilities that surpass the singularity, but some impressive effects are nevertheless possible. For example, it is possible to connect real and virtual environments together so that objects in different realities can be part of a single orchestrated and intelligent world.



**Figure 8. The Immersive Displays Ltd version of the ePod**  
(Adapted from Peña-Ríos et-al 2012)

The same university (Essex), together with colleagues at the Shanghai Jiao Tong University's eLearning Lab have considerable experience in online smart classrooms and immersive learning that they brought to bear on developing this table. [43] The product is at the stage where a prototype has been built as shown in Figure 8. In this, the immersive table is running a version of a mixed-reality teaching software called "Mixed Reality Teaching and Learning Environment" (MiRTLE) and an interactive intelligent environment software platform (this is the core source of intelligence in the system) [27]. This system has applications beyond education and could, for example, be used by dispersed laboratories (or team members) of international companies who need to collaborate on R&D without being present in the same physical environment. In terms of a business models for education, the originators envisage a leased model whereby an eLearning institution would buy a number of these units, and rent or lease them to their students (so each student only pays a fraction of the cost, as they only use it for a fraction of its working life). Another business model is to use the units in clusters whereby, for example, there may be 10 units in a room, with each student attending 10 different remote lectures, without interfering with each other, thereby making better use of centralized space (i.e. moving from one lesson per room, to many lessons per room).

#### 4.2. SFP Example 2: BuzzBoards

In 2012 a start-up called FortiTo ([www.fortito.com](http://www.fortito.com)) began production of a novel new product, which they labelled "*BuzzBoards*" [44]. The founders, University graduates and staff, were inspired by the general concept of SFP and identified a need to allow people to prototype aspects of their ideas that may be realisable now, in the real world (as was the case of the ImmersaStation). BuzzBoards allow this by providing a "Plug & Build" concept (ie modules can be simply plugged together with minimal engineering knowledge to build complex "Internet-of-Things" technologies); see Figure 9.



Figure9 - *Buzz-Board* Examples (Adapted from Callaghan 2012)

These boards have many novel ideas such as that, unlike regular modularised electronic systems where the plugging together is to facilitate electrical connections; with *BuzzBoards* the plugging also enables different physical forms to be assembled. In addition the boards have been designed to work inside mixed reality environments where they have both physical and virtual forms. Moreover they have a unique system of communicating between virtual and physical manifestations enabling, for example, teams of physically dispersed developers to assemble mixed reality systems based on plugging together real and virtual *BuzzBoard* objects. In this respect, notice the Buzz-Board robot on the desk of the virtual reality classroom desk shown in Figure 7 [41]. A bigger view of the desk robot, assembled by plugging together BuzzBoard modulus is shown in Figure 10. Thus, it can be seen that, *BuzzBoards* provide an engineering prototyping tool for follow-on product innovation activities that might arise from Imagination Workshops dealing with the Internet-of-Things.

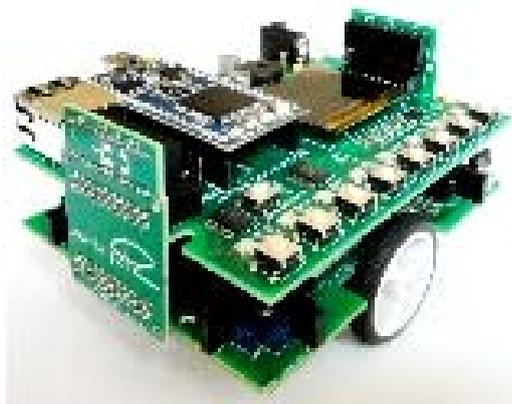


Figure 10. Mixed-reality *Buzz-Board* modules assembled as a mobile robot (Adapted from Callaghan 2012)

#### 4.3. Summary

In this section, the potential of the SFP method for driving commercial innovation has been illustrated by describing two companies, *Immersive Displays*, an established SME and *FortiTo*, a new start-ups formed by University students and graduates. All these commercial enterprises are somewhat nascent but, in part, that is a consequence of the embryonic nature of SFP methodology, which was only introduced to the world in July 2010. During the intervening period of time, only two small workshops have taken

place. It is an achievement for this method to have already driven entrepreneurial activity in two companies. Clearly, with such little time having passed since the inception of SFP, there is limited opportunity for longitudinal studies. Therefore, as SFP matures, a fruitful line of research will be to study the SFP process from conception through to business innovation.

## 5. Discussion

According to Johnson (2010), the SFP methodology is a tool to design scenarios, to exercise ideas for business and technology innovations, set within a social context, in a future world (eg. 10+ years ahead). The article has argued that there is a need for a business variant of SFP to support those people wishing to use it to explore future business, service, or product innovation ideas. Technological innovation is strategic to future businesses as it both challenges business managers by introducing new types of products to sell, as well as changing business tools and models. Successful businesses of the future will be those that both anticipate such changes and are able to design new frameworks to efficiently support the change. Chermack used the process of disciplined imagination to link building scenarios and building theories from organizational change perspectives. He argued that “scenario planning is an intervention aimed at individual and organizational change” in order to reveal, analyze, share and reconstruct mental models of how the world works. [18] He quoted the illustrations of ‘disciplined imagination’ from Karl Weick, “*When theorists build theory, they design, conduct and interpret imaginary experiments. In doing so, their activities resemble the three processes of evolution: variation, selection and retention*” (p.519) [45]. In terms of our discussion on imagination, SFP and the “Imagination Workshop”, they provide tools of ‘disciplined imagination’, as defined by Chermack and Weick. In the beginning of the paper, a new evolutionary model of the SFP creation process termed Cyclic SFP was proposed; see Figure 2. A vehicle for applying this process to business innovation was presented; the “Imagination Workshop”. Previously, it has proved difficult to bring people lacking a technical background into a discussion on technology-based innovation. SFP helps such people as a) it doesn’t require in-depth knowledge of technology (rather it focuses on imagination and the application of social and ethical issues) and b) it provides a method of tapping into people’s imagination which is necessary for successful innovation. In this sense, the Cyclic SFP, embedded within an Imagination Workshop, functions as a practice of ‘disciplined imagination’. However, one might ask, how can SFP turn out to be a real innovation. To answer this, a broader definition is required, whereby entrepreneurship or new enterprises are also included in the formula needed to bring real product and services to the market. For this a combined technology and business strategy is needed but that is beyond the scope of this paper, and is left for future study.

In section 3, the operational process of the Imagination Workshop was introduced to illustrate how it works. To aid this explanation, an exemplar workshop was described. There were two purposes of this Workshop; first facilitating business-oriented writers and second, exploring the effectiveness of Cyclic SFP methodology. However, in this trial, due to the time and budget constraint, the sample of participants are somewhat homogeneous. To increase the effectiveness of the Imagination Workshop process in producing techno-business innovations it is suggested that technology and business personnel are intertwined as follows:

- (1) Business managers take the initiative to work with people from science or engineering who have domain knowledge on technologies in their SFP;
- (2) Participants with specific technology domain knowledge take the initiative to propose collaboration with business managers for co-creating SFPs to explore and exploit the business potential based on particular technologies;
- (3) Business managers adopt SFP methodology to create new business models;
- (4) Business managers follow up existing SFP stories to discover new business opportunities (they may even consider working with Universities to set these up as projects).

Another interesting research area is scenario planning and foresight in which, in terms of cultural differences, assumes two main styles. The first, the “Intelligent Machine” model, a name coined by Raimond (1996), is the Western model of foresight, which focuses on a predictive and reactive style. The second, “Creative Imagination”, is an Eastern model which is both “creative and goal-oriented”. Raimond also claimed “foresight has to be both predictive and creative” (a combination of the Western and Eastern approaches) [46]. Responding to Raimond, Tevis proposed the “goal-oriented scenario planning” model in which he argued that most organizations should do more than react to the future and should, rather, create the future [19]. In respect of SFP, the Tevis’ approach could supplement the way of determining and mapping actions to achieve the future within a more structured thinking. This could be adapted in the later phases of Cyclic SFP, which involves planning business exploitation and deployment. To some extent Johnson’s ‘Expanded Consumer Experience Development’ model [1][47] in Intel incorporates some of these ideas by incorporating consumer experience into product development process which has synergies with SFP.

To sum up, the Cyclic SFP model goes a step further by linking the original SFP process to entrepreneurship and business development. Thereby it is better engaging with the broader needs of business processes.

## 6. Conclusion

### 6.1. Summary

This paper has introduced a methodology for improving the effectiveness of the SFP process in product and business innovation activities. The core idea in this paper is the use of a modified evolutionary model of the Science Fiction Prototyping creation process (cyclic SFP), which, instead of being linear process (as in earlier approaches), is based around a series of feedback loops in the form of an iterative evolutionary co-creative process. Another differentiating feature of this approach is that it can include a greater variety of deliverables (eg. product specification or business model). This core iterative process is wrapped in a pool of supporting activities including brain-storming, skilled guides and selective use of illustrative SFPs which collectively are labelled “*The Imagination Workshop*”. The use of an Imagination Workshop was illustrated by describing a three-hour workshop that was given to 45 NTU e-Commerce students in spring of 2012 describing based around the theme “*The World in 2050*”. To broaden the understanding of the methods, the article also describes entrepreneurial activities that have resulted in new product innovations in two small UK companies. Science Fiction Prototyping and its cyclic variant described in this article is at an embryonic stage having only been in the public domain since 2010 and 2012 respectively and it is

clear that this work is only the first stages of exploring its potential to entrepreneurial business activities.

### 6.2. *Limitation and Constraint*

The limitations and constraints of the SFP method lie in its qualitative nature. Since it provides a vision of the future but not a concrete numbers or statistics, for those concerned with prediction it will always embody high degrees of uncertainty. The winner can only be proved by time and investment of specific programme or trajectory. However, the methods presented in this paper are not concerned with prediction but rather are about promoting innovative thinking that can lead to product or business innovation. Thus it is not important what precise innovation occurs, rather that some innovation occurs.

### 6.3. *Future Work*

To take this work forward a number of topics and studies are suggested, such as:

- Investigating methods of SFP visionary forecasting such as qualitative and quantitative methods of visionary forecasting tools and techniques for facilitating discussion and creation.
- Exploring Business Model Generation Techniques for SFP Methodology
- Undertaking longitudinal studies that track SFP usage from conception to business innovation
- Organising business-oriented SFP Workshops (based on Cyclic SFP) and gathering more experience to refine the structures and rules.

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