

# An Online Immersive Reality Innovation-Lab

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**Abstract.** This paper introduces the concept of online ‘*Innovations-Labs*’ (i-Labs) as location-independent collaborative ideation spaces. We highlight the challenges and opportunities that disruptive innovations present to companies and society, and discuss how *Science Fiction Prototyping* and *Diegetic Innovation Templating* can provide a means to explore that space by acting as ideation process and a language for capturing and communicating innovations. A core hypothesis of this paper is that there are significant gains to be accrued from integrating *Virtual Reality*, *Science Fiction Prototyping*, *Diegetic Innovation Templating* and *Innovation Labs* to form an online immersive reality innovation-lab which both offers better affordances and access to people wishing to undertake innovation related activities. We present details of our initial implementation of an online innovation-lab (*Our HEX*) which takes the form of a virtual-reality space-station. We then conclude the paper by describing future directions of our work, principally, a venture which uses ‘*Our HEX*’ space-station platform, plus a supporting textbook published by Tsinghua University Press, to teach ‘*English, Computing and Creativity*’ to Chinese students. Finally the paper concludes with a summary and reflections on our work to-date.

**Keywords:** Virtual-Reality, Innovation-Labs, Ideation, Innovation, Science-Fiction Prototyping, Diegetic Innovation Templating, Creative-Science, EFL.

## 1 Introduction

It is generally agreed that innovation is an essential component for economic growth and productivity. A recent report by PriceWaterhouseCoopers, the largest professional services firm in the world, found that “*Five years ago, globalisation would have been the most powerful lever for growth and every business would have been talking about China. But now, the growth lever that has the greatest impact is innovation. Ninety three percent of executives tell us that organic growth through innovation will drive the greater proportion of their revenue growth*”[1]. Thus it’s hardly surprising to find that governments around the world place a huge importance on supporting innovation activities although how they do that varies widely, depending on various political and financial factors. While innovation sometimes appears to be rooted in the individual (eg Steve Jobs) from a government perspective it is a product of a *National Innovation System* (NIS) that includes all economic, political and other social institutions affecting innovation (eg education, financial structures, regulatory

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policies, labour markets; culture etc). For example, China operates a NIS derived from their 15-year national plan (2006-2020), the '*National Outline*', which contains a section that focuses explicitly on creating nation-wide structures favourable to innovation [2]. In contrast the USA has not adopted a centralized approach rather, being a country that grew out of the notion of free enterprise and thinking, innovation was more easily established as it was part of the underlying 'DNA' of American culture. That is not to say that government policy does not play a role in fuelling American innovation, just a lesser one than in most other countries. It is difficult to measure a countries innovation capacity but one metric is the number of patents that are registered annually. Those statistics place the EU, USA, Japan and China in leading positions, aligning well with their economic performance. Because of the importance of innovation to companies and national economies, there is a huge incentive for companies to find tools that can aid the process of innovation. Once such tool is *Science Fiction Prototyping*, an ideation and communication tool that was first proposed by Brian David Johnson while he was working for Intel Labs in Portland. The basic principle of the method is that the stakeholders of the innovation create futuristic fictions as a means of unleashing their imagination plus communicating and testing the ideas [3]. Another tool is *Diegetic Innovation Templating* which uses existing fiction as an inspiration for new innovations (eg the flip-phone being inspired by the Star-Trek communicator) [4]. Innovation works better with a group of people where they can spark ideas off each other and the limited knowledge of an individual can be supplemented by others. One popular group-based approach is the *Innovation-Lab* (i-Lab) which offers a specially designed environment that is conducive to creative thinking [5]. For example, i-Labs provide participants with a relaxed comfortable setting where they can contribute ideas anonymously during ideation sessions. Generally, i-Labs require the participants to be physically present in the same location. However, the advent of virtual-reality has opened up the possibility of an i-Lab being located online in a virtual space which allows participants to be located anywhere in the world, and to utilise tools that would not exist in the physical world. Thus, this is the aim of the work in this paper, to explore the potential arising from combining i-Labs, virtual-reality and science-fiction prototyping, diegetic innovation templating to create a novel online innovation facility which will be described in the following sections.

## 2 Related Work

### 2.1 Innovation Labs

An innovation-lab (i-Lab) has been described as an "*inspirational facility designed to transport users from their everyday environment into an extraordinary space encouraging creative thinking and problem solving*" [5]. The i-Lab concept was based on a model created by the UK Royal Mail's '*Futures and Innovation Group*' in 1997 for the purpose of helping their management teams brainstorm future possibilities. In doing this it became apparent that the interactions within the groups, together with the conversational and session management tools played a significant role in the effec-

tiveness of the sessions, leading to the idea for providing specialist environments to support these activities.

In transferring the i-Lab concept from the original Royal Mail environment to the wider world there have been three notable projects. The first was the '*Learning the Habit of Innovation: Harnessing Technology for Strategic Planning*' (LHI) which was a collaboration between the UK Royal Mail and the universities of East Anglia, Cambridge, Essex, Bedfordshire plus Anglia Ruskin University. It was operated out of the University of East Anglia from 2001-2004 and funded by the Higher Education Funding Council for England [6]. The project sought to transfer the i-Lab model created by the UK Royal Mail into higher education and involved formalising a template that would form a minimum set of conditions to recreate an innovation environment. In brief they deduced that an i-Lab required three interlinking components namely the *environment*, the *technology* and the *facilitation mechanisms* to make it suitable for ideation and innovation activities. Furthermore, they determined that an iLab session comprised some mix of the following activities (most electronically supported):

- Icebreaker and reviver activities
- Discussion & getting other people's perspectives
- Brainstorming & voting
- Headlines, cut & paste collages and PowerPoint presentations
- Wall activities (collaborative writing, doodling etc)
- Scenario building
- Role play

They emphasised that creative thinking was not necessarily a rational, linear process and that revisiting and refining ideas could be a productive way to progress. At the core of the process was brainstorming, a technique for unleashing a flood of thoughts driven by members sparking ideas off each other, or carefully injected external stimulus. Having generated sufficient ideas a group would go on to categorise, rationalise and vote on the suggestions. Implementing the ideas is more challenging and occurs beyond the i-Lab session.

The two other notable ventures were EU Leonardo da Vinci collaborations between educational institutions from Poland, Greece, Romania and Turkey, coordinated by the University of Essex in the UK around two projects, namely '*The European i-Lab Competences Development Programme*' (2006–2008) and '*The Innovation Laboratories for the Quality Assurance of Vocational Education and Training*' (2012-2014) [7]. These projects led to the establishment of three innovation laboratories in Poland, Turkey and Romania and the production of a standard guide for i-Labs, namely the '*Innovation laboratory – Good Practice Guide*' [8] all of which aimed at the promotion of i-Lab use throughout Europe which, today, has resulted in over 100 globally-located i-Labs (from social to technical) created by organisations as diverse as the Standard Bank, Walmart, John Lewis, the UK National Health Service, Ryan Air and government (eg New York's 'Public Policy Lab' or the 'Social Innovation Lab for Kent') [15]. In respect of this paper, one of the most significant i-Lab developments has been the introduction of web-based software which provides a much more efficient (and faster) ideation process together with providing an anonymity component [9]. Moreover, this computerisation has enabled i-Labs to move into Cy-

berspace, allowing participants to be freed from the need for physical co-location, a feature we build on in our online version of an i-Lab (*Our HEX*).

In our work, we use brainstorming as part of a product-innovation process called *Science Fiction Prototyping* that will be explained in the following section. In this we adopt a procedure called an *Imagination Workshop* which was first proposed by Wu in 2013 and is similar to the brain-storming process used in an i-Lab except it uses science fiction and fantasy ideas to extrapolate forward current technologies, business and social practices by ten-plus years [10]. These concepts will be explained in the following section.

### 3 Creative Science

*Creative Science* refers to creative methods for supporting science, engineering, business and socio-political innovation through various imaginative activities. For the purposes of this paper those mostly concern *Science Fiction Prototyping* (SFP) and *Diegetic Innovation Templating* (DiT).

#### 3.1 Science Fiction Prototyping

As was mentioned earlier, *Science Fiction Prototyping* was proposed by Brian David Johnson, Intel's then Futurist, as a response to a particularly difficult innovation challenge Intel faced in designing new generations of integrated circuits. Their challenge was that it takes between 7-10 years to take an integrated circuit from concept through to production and, during that period, there can be as many as 6 generations of potential applications for it. For example, new models of mobile phone can be released as frequently as every 18 months. Thus, chip designers needed to anticipate applications 7 years' ahead of specifying a chip (and possibly longer as the applications may live on for another 15 or more years) which, in a rapidly changing world, presents a formidable challenge! Of course an even bigger worry is the risk of disruptive technologies coming along. Thus, there was a compelling case for Intel to find a creative-thinking process that might come to their aid. Their solution was *Science-Fiction Prototyping*. Essentially, the method involves writing short fictional stories that imaginatively extrapolate current practices forward in time, leaping over incremental developments, exploring the world of disruptive product, business and social innovations. Because *Science-Fiction Prototyping* adopts a rich story-based structure it was able to create high-fidelity analogues of the real world, enabling it to act as a type of prototype to test the idea. Moreover, being a story it was accessible to anyone (aka the old adage '*everyone likes a story*') making it a perfect vehicle for conversations between all the stakeholders of the innovation, including society at large (the customers of innovations). The outcomes of *Science-Fiction Prototypes* are used to create new kinds of products, businesses or socio-political structures etc.

### 3.2 Science Fiction Prototypes Style

The most common size for a *Science Fiction Prototype* is 6-12 pages (referred to as a *mini-SFP*) which is of a similar size to a conference paper [10]. However, 6-12 pages can take many days to write so for innovation sessions, that need to take place in less than a day, an even shorter form of *Science-Fiction Prototype* was developed; the *Micro-SFP* (or  $\mu$ SFP) [11] which will be described in the following section.

### 3.3 Science Fiction Prototyping Workshops.

Typically, science fiction prototyping based innovation sessions take the form of an *Imagination Workshop* [14]. It involves gathering together a group of participants, specifying a goal (eg a new business or product etc), providing a context (eg business, home etc), setting a timeline (eg usually 10+ years into the future) and offering support for brainstorming about possible futures. A World Café approach is adapted to stimulate brainstorming and discussion with participants being placed in small groups (eg 5-7 members). Most other aspects are similar to an i-Lab.

### 3.4 $\mu$ SFP- A Shorthand Innovation Language

There is no agreed specification for micro-fiction but, given the close relationship of *Science Fiction Prototyping* to technology perhaps it is not surprising to discover a popular size for a  $\mu$ SFP is one that fits mobile phone text (160 characters) or Twitter messages (140 characters) which, in English language, equates roughly to 25-30, words. Since  $\mu$ SFPs are short, they have the advantage of being quick to write, enabling users to capture and create many ideas in a short time period, in a similar time-scale to brainstorming. Thus,  $\mu$ SFPs are seen as being complementary to brainstorming, providing a means to wrap a brainstormed idea in a more story-like framework which provides added meaning. From another perspective  $\mu$ SFPs are an interim step between a raw idea and a full *Science Fiction Prototype*. By way of an illustration of the principle of  $\mu$ SFPs, consider the following example:

*Zoe, you've been my life-long friend on SentiBook; today the news feed reports most social network friends don't exist, are you real?* (22 words, 133 characters)

This  $\mu$ SFP extrapolates forward in time the current trend of companies adopting ever-more more automated customer call handling systems but explores the consequences of such technology reaching out more widely, for example into email and social messaging systems. It raises the question about whether we will know, or even care, if the parties we are communicating with are real or artificial. In this particular example the  $\mu$ SFP observes that our lives are becoming increasing virtualised through, for example, friendships on social networks with people we may never have met physically. As AI advances, machines will be better able to mimic real people, raising all kinds of new opportunities and conundrums.

Following the creation of a  $\mu SFP$  the next step would be to expand it into a *mini-SFP* (a 6-12 page version with a rationale and comments), followed by the usual product development cycle involving pre-production prototypes etc.

### 3.5 Diegetic Innovation Templating

*Diegetic Innovation Templating* (DiT) is a process of extracting creative ideas (eg innovations) from fictions created for the purpose of entertainment, rather than for technology, social or business innovation. Thus they are typically science fiction or fantasy movies or TV series such as, for example, Star-Trek that taps into the creative abilities of great authors and filmmakers as source of creative ideas. The term '*diegetic*' is borrowed from film studies and refers to things which are embedded into a fiction, playing an integral role in the story, such as the use of a gadget by one of the characters, and seen through their eyes. The artistic nature of such productions makes them particularly useful for non-technical applications or for situations where writing bespoke fictions is not a good option. For example it has been used by one of China's leading fashion design houses (Sunfed) where it leverages the advantage from popular fiction being embedded into socio-cultural contexts (ie the firms marketplace) aiding branding and marketing efforts [12].

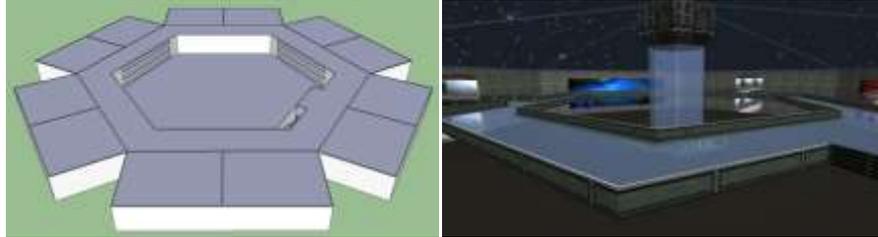
### 3.6 Out of the Box and into 'Our HEX'

By way of a summary of this section, we introduced *Science Fiction Prototyping* and *Diegetic Innovation Templating* as tools to support the early ideation phase of the innovation process by providing a means to engage people's imagination in thinking '*out of the box*' about future possibilities. *Science Fiction Prototyping* also allows the ideas to be tested within a plausible narrative and provides a way of opening dialogues, independently of specialist domain knowledge, with all the key stakeholders. In the next section we will describe '*Our Hex*' a virtual spacestation which provides an online facility to host i-Lab activities based around the *Creative Science* concepts we have presented above.

## 4 The Virtual Spacestation (on online Innovation-Laboratory)

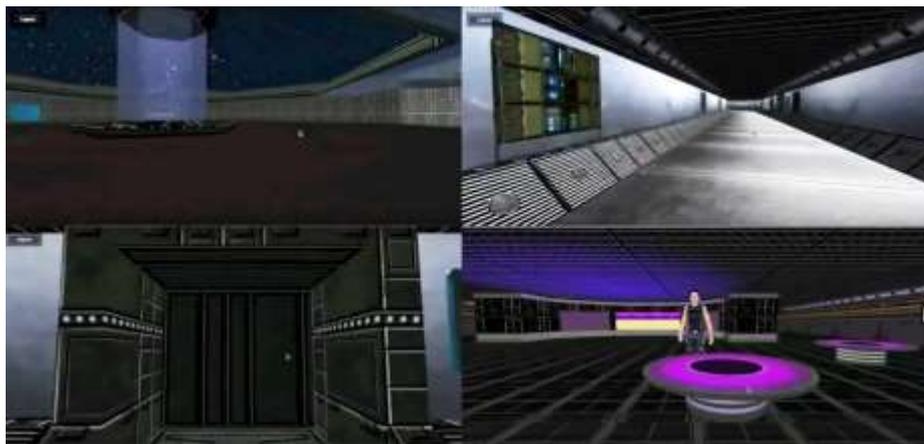
### 4.1 A Spacestation Based i-Lab

Since *Science-Fiction Prototyping* concerns thinking about high-tech futures, the idea to base the online i-Lab on a simulation of a spacestation was born. The first version was funded by the *Creative Science Foundation* as a way to explore the concept of '*free will*' raised in Brian Johnson's original *21st Century Robot* science fiction prototype [13]. Our current online innovation lab is a modification of that early virtual-reality spacestation and consists of a large central arrival area (Social Deck) leading to an, essentially, unlimited number individual rooms, each outfitted to resemble an i-Lab.



**Fig.1.** 'Our 'HEX' Spacestation (Layout & Prototype Interior).

The spacestation structure was inspired by the *Hexagon Restaurant* (affectionately referred to as "Our HEX") at Essex University (now defunct) which is shown with 6 pairs of i-Labs (Fig 1) but, in practice, since i-Labs are simply software instances, there is no fixed number as they can be created on-the-fly, as required. In keeping with the list of functionalities listed earlier, each simulated i-Lab includes a communal electronic white-board, a set of anonymised editing stations (so ideas and comments can be written to the white-board without identifying the writer) and facilitator tools for managing and archiving the sessions.



**Fig. 2** – The Unity 3D Prototype iLab space station (clockwise from the top left there is the Social-Deck, one of the radial connecting corridors, an i-Lab entrance and a view of an i-Lab)

With reference to figure 2, each user who accesses the virtual world (ie logs in) first appears in the central arrivals area (the Social Deck). From that location they are free to walk around the environment; interacting with any displays they encounter (eg display boards showing outputs from earlier science fiction prototyping, diegetic innovation templating sessions, or interactive display boards where they can participate in competitions to evaluate innovation outputs, or just read notices of other events). The central area has corridors leading to each of the different i-Labs. In each i-Lab, users are able to participate in Imagination Workshop sessions (described earlier). Teachers and facilitators are able to observe, assist and rate student work.

The prototype of ‘*Our HEX*’ was implemented using Unity-3D, an online gaming engine. Being an MMO cloud based virtual world, users are able to log into the environment via a link from the website of the Creative Science Foundation (CSf). The spacestation’s i-Lab server resources are provided by a cloud based system. The execution-engine currently supports a Java runtime environment structured in a modularised client / server arrangement to facilitate future expansion. While a working prototype of the spacestation has been built (a video walkthrough is available at <http://www.youtube.com/watch?v=-i6ki5YHGZc>) there are a number of aspects that require completion before the system can be publically deployed, most notably creating a full gamut of i-Lab facilitation tools plus completing a formal evaluation with students. In addition the platform’s user-guide needs to be integrated with the Tsinghua University Press textbook. Thus, ‘*Our HEX*’ is a ‘work-in-progress’ task with functionality being added continually in response to user needs. To provide an insight to our immediate work-plans, the following section describes our next steps.

## 5 Deployment Plans

Currently ‘*Our HEX*’ is being operated with a closed group of students at Shijiazhuang University, China, who follow a *Computer English* course [17] based on a carefully crafted Tsinghua University Press textbook [18].

By way of some background, in China it’s mandatory for universities to teach “*Public English*” to all their students as this is seen as a necessary skill for them to thrive in a global business environment. For computer science students this requirement is translated into the provision of a specialized English module called ‘*Computer English*’ that is usually delivered to students in their 3rd or 4th year [19]. By combining English Language with Computer Engineering, the course is made relevant to the student’s studies [20] [21].

Beyond learning English, another vital skill for a workforce with aspirations to compete in global markets is an ability to innovate, which *Science-Fiction Prototyping* supports. Thus the proposition to integrate learning English Language, Computer Science and Innovation via an engaging new course was born, leading to a pilot trial being conducted by Zhang at Shijiazhuang University during the period 2014-2016 [16]. Following the success of this trial (student motivation and performance were demonstrated to sharply increase, with one student even publishing his SFP in an international workshop [22]) the team worked with Tsinghua University Press to produce a textbook that has been made available across China [18]. In support of this venture, we are planning to use the ‘*Our HEX*’ spacestation platform as a means to widen access to innovation-lab facilities across China and the rest of the world. As part of this vision, in the longer-term, we plan to address other languages such as Spanish.

Thus, “*Our HEX*” functions as an online school to teach ‘*English as a Foreign Language*’ (EFL) based around Creative Science, which brings the additional bonus of training students in creative thinking and innovation. In terms of the potential for this venture, the market for teaching English is estimated to be worth some \$5 billion or more. In China alone there are an estimated 250 million English learners, increas-

ing by 20 million per year, with a requirement for 1 million English teachers, which has led to the emergence of a plethora of enterprises seeking to satisfy these needs. Examples include *Ivy League English*, founded in 2009 by graduates of the Massachusetts Institute of Technology, which provides an app that connects students with USA-based business coaches for real-time roleplay activities ([www.ile-china.com/](http://www.ile-china.com/)), the 2013 Kickstarter funded start-up, *Influent*, that created a video game designed to introduce foreign vocabulary to learners by them exploring an interactive 3D environment filled with hundreds of selectable objects ([www.playinfluent.com](http://www.playinfluent.com)) through to full blown MOOCs learning platforms such as the Shanghai based *Hujiang* which has grown to over 90 million registered users since starting in 2001 ([www.hujiang.com/](http://www.hujiang.com/)). Hence, this venture joins a fairly crowded marketplace but differentiates itself by offering a novel combination of science, creative-thinking and language learning, especially tailored for university based Computer Engineering students through a supporting Tsinghua University Press textbook.

From the earlier sections it can be understood that creative science exercises English language by requiring students to read and write short stories plus undertake group work via brainstorming and presentations (and, as a by-product, getting other useful skills such as creative thinking and product innovation). Because, this involves group-work there is a space issue since, ideally, each group would have their own dedicated space (room). Clearly, in most situations that is impractical. For example, in the case of Shijiazhuang University's '*Computer English*' course, their 160 students would require some 23 rooms (assuming maximum group sizes of 7 students). Thus, '*Our HEX*' overcomes these space limitations as well as broadening participation to students, independently of their geographical location. In addition, given the virtual nature of the space, it is simple to outfit it with simulations i-Lab tools (ie an electronic white-board, anonymised editing stations and computerised facilitator tools) making it a virtual innovation-lab that can be replicated with little cost.

While our current focus is on creating an online "*English as a Foreign Language*" school we have been considering other longer-term possibilities for '*Our HEX*'. In terms of language training it would be possible to enrich the activities by including online role-play [23] [24]. Beyond language training, clearly one major application is as an online Innovation-Lab which would aim to satisfy the growing commercial demand for innovation services and we are working with a Taiwanese start-up, LivingPattern Technology Inc to explore these possibilities [25]. Other possibilities include collaborating with the Creative Science Foundation to host an online version of their vacation '*Entrepreneurship Schools*' (<http://www.creative-science.org>) or working with FortiTo Ltd to create online '*Maker Schools*' ([www.fortito.mx](http://www.fortito.mx)).

## 5.1 Deployment Platforms

A key issue is the cost of accessing this service. As a consequence we developed the system to work with a range of technologies to better fit the user's resources. These range from commonplace technologies such as mobile phones, pads, laptops and desktops, to more sophisticated devices such as virtual and augmented reality glasses (see figure 3).

Being a virtual-reality environment, 'Our HEX' has the potential to simultaneously offer a number of different user experiences, depending upon how an individual chooses to interface and interact with the world. For example, whether the world is viewed from a first or third-person perspective can significantly alter the relative experiences of individual users, especially when working with others in team-based exercises. Furthermore, technologies such as VR headsets, (e.g. the *Oculus Rift*, or *HTC Vive*) could be used to generate a more immersive experience in the minds of users, allowing them to move around 'Our HEX', with the impression of actually being transported inside the artificial world. Mixed reality interfaces, such as the Metavision's *Meta-2* or Microsoft's *HoloLens* system, could also potentially be used to superimpose fragments of the spacestation onto the real world, effectively turning a physical room or other location into an extension of the 'Our HEX' environment. Such an arrangement could facilitate interaction between groups of people where several are sharing the same physical space but wish to interact with other remote users present elsewhere in 'Our HEX'.



**Fig. 3** – Some platforms for “Our HEX” (picture courtesy of Dan Chen)

As mentioned earlier, 'Our HEX' was implemented using *Unity 3D*, a professional tool used for the creation of computer games. The decision was made to use a game engine as an implementation platform in order to take advantage of some of the available graphics, physics, networking and other technologies developed by advancements in the computer games industry. Another reason was to give users some familiarity via a common interface, with many of the controls being identical to those used in PC games, (e.g. WSAD movement controls). By making the user as comfortable and immersed as possible in the 'Our HEX' environment, their user experience should be enhanced and hopefully create a more productive innovation or education session. Other computer games technologies that may be beneficial to a learning/innovation environment are also being explored for potential integration with the 'Our HEX' system. For example, live streaming services, such as *Twitch*, could be invaluable for a teaching experience, as users could both visually see a live representation of their teacher and provide feedback or ask questions via the text chat feature. From a business perspective, live streaming services could have potential benefits such as revenue

generation from advertising and subscriptions or tips from users. Recordings of past broadcasts can also be played back on-demand by users.

## 6 Summary

This paper has described how we developed an online creative space which integrated *virtual reality*, *science fiction prototyping*, *diegetic innovation templating* and *innovation-lab* concepts to create a novel shared ideation space. We argued that the synergy derived from this linkage introduced significant new opportunities for those seeking to undertake innovation activities. For instance virtual reality both provides a more engaging and functional space, together with widening participation. We also argued that the inclusion of creative science tools provides a particularly good approach for exploring disruptive innovations as it levers people's imagination through the use of futuristic science fiction to offer more radical perspectives on the future. We also explained that a story based narrative provides an effective way to facilitate communication between professionals and lay-members of society, who frequently lack a shared vocabulary to converse (articulated by the mantra "*everyone likes a story*"). Finally we described how, in support of the book we have published with Tsinghua University Press in China, we are exploring the application of the '*Our HEX*' spacestation platform as an aid to students learning a combination of English language and innovation. Clearly this work is at an early stage and we will look forward to reporting on further progress in later conferences.

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