INNOVATION CO-CREATION IN A VIRTUAL WORLD

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Abstract

The emergence of web-based technologies has radically influenced the ways in which individuals around the world communicate, represent themselves, share ideas, and otherwise interact with one another (Ward and Sonneborn, 2009; Rogers, 2003). In particular, these technologies allow people to communicate directly with one another and to share and shape their own experiences; as a result, customers and other organisational stakeholders are increasingly involved in the design of products and services (Ramaswamy and Gouillart, 2010, p. 102). During innovation co-creation specifically, customers take an active and creative role in the intentional and successful adoption and application of ideas, processes, products or procedures that are new to the adopting organization. *This study carries out six case studies of innovation co-creation in the virtual world of Second Life. Virtual worlds allow users to engage in highly active and participatory forms of co-creation that are difficult if not impossible to replicate in other environments. The study explores collaborative processes used for innovation co-creation in virtual worlds. In particular, the study presents an analysis of behaviours used to facilitate innovation co-creation in virtual world projects and the factors that affect it. The study leverages this analysis to derive practical recommendations for virtual world users and virtual world designers that can be used to stimulate and support innovation co-creation in virtual worlds.*

Keywords: Co-creation; innovation co-creation; virtual worlds

1 Introduction: from co-creating value to innovation co-creation

> The interaction between the firm and the consumer is becoming the locus of value creation and value extraction. As value shifts to experiences, the market is becoming a forum for conversation and interactions between consumers, consumer communities, and firms... Informed, networked, empowered, and active consumers are increasingly co-creating value with the firm.
>
> Prahalad and Ramaswamy, 2004, p. 5

Value creation is a core element of organisational growth and performance (Prahalad and Ramaswamy, 2004a). Value *co-creation*, in particular, is based on engaging customers directly with producers in the creation of value (Kambil and Friesen, 1999). More specifically, it refers to the process during which consumers take an active role and co-create value together with companies (Prahalad and Ramaswamy 2004b). Organisations' increased interest in value co-creation is driven by the recognition that consumers are an important source of competence in organisations (Prahalad and Ramaswamy, 2000).

Initially, the concept of co-creation was applied to the creation of "everything of value, from simple processes to new products and services to the organization's value chain or its role in its eco-system" (Ramaswamy and Gouillart, 2010). As practitioners have embraced the concept of co-creation, it has been extended so that it now refers to all stakeholders (employees, customers, suppliers, distributors, communities) rather than just customers (Ramaswamy and Gouillart, 2010). At the same time, scholars have increasingly focused on the manner in which innovation in particular is co-created in organisations (cf. Kohler *et al*., 2011; Ramaswamy *et al.,* 2010; Giovacchini *et al*., 2009). Innovation is generally defined as "the adoption of an idea or behaviour that is new to the adopting organization" (Damanpour and Gopalakrishnan, 2001; Dewar and Dutton, 1986; Daft, 1982; Aiken and Hage, 1971). More specifically, it is concerned with the "successful implementation of creative ideas within an organisation" (Amabile *et al*., 2006, p. 25) or with the intentional introduction and application of ideas, processes, products or procedures that are new to (a job, work team or) an organisation and are designed to benefit the (job, work team or) organisation (West and Farr, 1990). This transition is driven by the view that the capacity to innovate is "the most important determinant of firm performance" (Crossan and Apaydin, 2010, p. 1154). Recent scholarly interest in the concept of living labs, for example, is based on allowing users to contribute to the co-creation and exploration of emerging ideas, breakthrough scenarios, innovative concepts and related artifacts[1]. Innovation co-creation is defined for the purposes of this study as *a process during which customers take an active and creative role in the intentional and successful adoption and application of ideas, processes, products or procedures that are new to the adopting organization*.

Co-creation in general and innovation co-creation in particular seek to take advantage of the increasing communicative affordances of web-based technologies (Giovacchini *et al*., 2009). The rise of online social networks, social media, and fully collaborative design environments, have led to the creation of a participatory web where consumer cultures give way to cultures of participation (Fischer, 2009). Here, the role of "the person formerly known as the 'user'" has evolved (Saunders *et al*., 2008) just as the traditional boundaries between 'producer' and 'consumer' have been eroded (Benkler, 2006). A variety of terms have been used to describe the kinds of co-creative processes that are enabled by these technologies; these include collective intelligence (Lévy, 1997), crowd sourcing (Howe, 2006), peer production (Benkler, 2006), produsage (Bruns, 2008) and open innovation (Chesbrough, 2003; Chesbrough & Vanhaverbeke, 2006).

[1] http://wn.com/Living_lab Accessed 27th November, 2011

This burgeoning literature is a tangible manifestation of current interest in net-enabled co-creation but is largely dominated by proponents of it. Thus, there is a need for empirical research to investigate its claims and to establish the potential challenges and limitations of net-enabled innovation co-creation. IS researchers have long been held that the "very idea of an information system is to provide a means and an environment for human communication" (Lyytinen, 1985, p. 61) and collaboration (Ågerfalk *et al*., 2008, p. 1). Therefore, IS researchers are particularly well-placed to inform current research and practice in technologically-mediated innovation co-creation.

2 Virtual worlds for innovation co-creation

The Internet and related technologies have "radically influenced the ways in which individuals around the world communicate, represent themselves, share ideas, and otherwise interact with one another" (Ward and Sonneborn, 2009, p. 211). Where 'cyberspace' was once only a metaphor for computer-mediated communication, a kind of notional environment, it is now possible to literally immerse oneself in net-enabled digital environments such as virtual worlds.

Virtual worlds represent "a frontier in social computing with critical implications for business, education, social sciences and our society at large" (Messinger *et al*., 2009, p. 204). Virtual worlds are computer-simulated, spatial environments that support communication among multiple users who are represented by avatars (Jung and Kang, 2010; Holmstrom and Jakobsson, 2001). Contemporary virtual worlds are defined as online, immersive, interactive environments that are based on community, content creation, and commerce (O Riordan *et al*., 2009) and are used by somewhere between nineteen and twenty million people (Jackson and Favier, 2008; Castronova, 2007, pp. 33-34).

Virtual worlds have excited practitioner and scholarly imaginations for a variety of reasons:

(i) From a *technical perspective*, virtual worlds can be used to create simulations of the real world and also to invent simulacrums of realities that could never actually exist in this world (O Riordan, 2011, p. 294). The interactive and immersive capabilities of virtual worlds allow people to "implement their thinking into actual actions, which helps them to evaluate the success of their ideas, at minimum cost" (Ip et al., 2008, p. 1). Virtual worlds are therefore a kind of *actable information system* that enable the performance of actions and "permit, promote and facilitate the performance of actions by users, both through the system and based on information from the system, in some business context" (Goldkuhl and Ågerfalk, 2002).

(ii) From a *communications perspective*, virtual worlds extend the possibilities for (i) communication (Fetscherin *et al*., 2008), (ii) interaction (Chaturvedi *et al*., 2011; Mueller *et al*., 2010; Messinger *et al*., 2009), and (iii) for collaboration and co-operation (de Freitas and Veletsianos, 2010; Giovacchini *et al*., 2009; Fetscherin *et al*., 2008; Kahai *et al*., 2007). Thus, they can allow users to experience heighted levels of presence (Dalgarno and Lee, 2010; Hooker et al., 2009; Barnes, 2007) or immersion (Childs, 2010; de Freitas et al., 2010; Tampieri, 2009). This in turn can lead to a heightened sense of 'flow' (cf. Csíkszentmihályi, 1975), which is positively associated with creative action (O Riordan and O'Reilly, 2011; Amabile, 1996).

(iii) From a *social perspective*, virtual worlds have the capacity to profoundly affect our sense of self; our relationships with others; and our actions and interactions (O Riordan, 2011, p. 294). Research shows that online environments in general (Benbunan-Fich et al., 2002; Nunamaker et al., 1991) and virtual worlds in particular (Schouten 2010; Goh and Paradice, 2008; Giovacchini, *et al.*, 2009) alter the dynamics of interpersonal communication and collaboration (O Riordan and O'Reilly, 2011). In particular, virtual worlds enable new kinds of electronically mediated social networks that are qualitatively different from traditional, real-world social networks (Kumar *et al.,* 2010).

In terms of supporting innovation co-creation specifically, virtual worlds are seen as a "'blank slate' within which individuals and organisations can bring about novel, custom situations" (Berente *et al*., 2011). The built-in tools encourage users to "iteratively and interactively create almost anything

imaginable, while sharing the act of creation with others" (Kohler *et al*., 2011). Fundamentally, virtual worlds are co-created digital environments (Cahalane *et al*., 2011) and the capacity of virtual worlds to stimulate creativity in thought and action is therefore qualitatively different from that of other kinds of digital environment (O Riordan, 2011, p. 294; de Freitas and Veletsianos, 2010). For these reasons, real-world companies have been exploring how they might apply virtual worlds in open innovation processes whereby customers and companies work jointly on new products (Giovacchini *et al.*, 2009). Yet whilst the majority of existing research focuses on the potential of virtual worlds, scholars have also identified a number of challenges associated with virtual worlds relating to: (i) virtual world interoperability (Mennecke *et al.,* 2008); (ii) platform scalability and stability (Mueller *et al*., 2011; Warburton, 2009) ; (iii) the user interface (Mueller *et al*., 2011); (iv) security (Mueller *et al*., 2011) and privacy (Boulos *et al*., 2007) issues; (v) legal (MacInnes, 2006; Noveck, 2004) and economic (Noam, 2008; Papagiannidis *et al*., 2008) issues. Therefore, there is a pressing need for empirical research to further explore the nature and impact of virtual worlds and to investigate the extent to which virtual worlds can be used to support (net-enabled) innovation co-creation.

3 Research objective and study design

Artifact design is a key IS research theme or objective (Benbasat and Zmud 2003; Orlikowski and Iacono 2001). In particular, highly dynamic, synchronous, and evolving nature of user-generated environment like virtual worlds "calls for special guidance on the design and management of the actual processes or activities that occur within these settings" (Kohler *et al*., 2011; Nambisan, 2009). Therefore, the purpose of this study is to contribute to research in this area by *investigating innovation co-creation in virtual worlds*. In particular, the study seeks (i) to investigate the manner in which innovation co-creation currently takes place, (ii) to establish the extent to which virtual worlds can be used to support innovation co-creation, and finally (iii) to use these findings to derive a set of practical recommendations that can be used to stimulate or support innovation co-creation in virtual worlds.

In order to achieve the research objective, a qualitative approach underpinned by a pragmatist perspective was selected. There is growing interest in pragmatism in organisational and information studies (Goldkuhl, 2004) and in IS research specifically (Ågerfalk, 2010). Pragmatism views thought as being intimately interwoven with action in a purposive context (cf. Scheffler, 1986, pp. 8-9) and "considers practical consequences or real effects to be vital components of both meaning and truth" (Hevner, 2010, p. 91). It is suitable in the context of this study given that innovation co-creation in virtual worlds is based on (avatar-mediated) action and interaction. A qualitative approach is appropriate given the exploratory nature of the study and because little is currently known about designing co-creation experiences in virtual worlds (Kohler *et al*., 2011). More specifically, a combination of participant observation and case study methods were used. A case study approach is considered appropriate as it is well suited to understanding the interactions between information technology-related innovations and organizational contexts and is the most widely used qualitative research method in information systems research (Darke *et al*., 1998). Participant observation was useful in allowing the researchers to experience Second Life as the participants do (cf. Marshall and Rossman, 2006, p. 79). The combination of participant observation with case study research was an especially powerful tool in terms of corroborating, validating and triangulating data in the unfamiliar research context of a virtual world.

Second Life® was chosen as a suitable research site for a number of reasons. First, Second Life meets with the definition of non-game oriented virtual world presented in Chapter Two. That is to say, Second Life is an online, immersive, interactive environment that is based on community, content creation and commerce. Furthermore, Second Life has a number of unique features that were designed to stimulate user-driven innovation. These include Second Life's (i) marketplace, (ii) currency exchange service (the LindeX), and (iii) terms of service which grant users real-world intellectual property rights on their virtual creations (Ondrejka, 2004). Thus, Second Life is a particularly good choice for creative expression (Ward and Sonneborn, 2009). Finally, Second Life has become the de

facto virtual world for commerce (Kim et al., 2008) and most virtual worlds studies in the IS field to date have therefore focused on Second Life (O Riordan, 2011).

Given that large-scale virtual communities consist of large numbers of sub-communities (Hagel and Armstrong, 1997), it was necessary to focus on a particular sub-community within Second Life. In qualitative research, the "validity, meaningfulness, and insights generated" are largely based on the information-richness of the cases selected (Patton, 1990, pp. 184-185). Therefore, Second Life's educational community was chosen for the study. This decision was based on preliminary observations which indicated (i) that a large number of educational institutions actively use Second Life; (ii) that educators have been instrumental in creating many of the innovations in virtual worlds; and (iii) that this community is particularly eager and willing to engage with researchers.

The study's focus on innovation co-creation suggests the need to be able to sample innovative cases. For this reason, the study adopted *innovative educational virtual world projects* as its unit of analysis. In this perspective, Linden Labs are the 'producers' of Second Life and university educators 'consume' Second Life. Innovation co-creation is therefore seen to take place when university educators use Second Life to develop innovative educational projects within Second Life[2]. The researcher used a criterion sampling technique (cf. Patton, 1990) in order to identify innovative educational projects carried out in Second Life. More specifically, the researcher evolved a list of qualitative criteria (together with a points system) which was used to 'rank' projects in terms of their suitability for the study. Six case studies were carried out (summarised in Table 1).

CASE	DESCRIPTION OF THE PROJECT
BOF	Bring students into a virtual world; an intrinsically cybernetic and artificial cultural landscape, born of science fiction and inhabited by the virtual human in order to explore the implications of scientific and technical advances for the future of humanity
TEX	Leverage the unique affordances of Second Life to create educational materials that could not feasibly be created using other technologies and to package those materials by means of a Machinima video so that they could be published online for future use
IRT	Use Second Life to create demonstrations and simulations of animation algorithm concepts that are difficult or impossible to create in the real world
GAL	Use scenario-driven and problem-based learning to improve nurses' skills in taking patient histories and undertaking physical examinations in real life
ZOM	Follow a structured and formalised research agenda over a three year period in order to incrementally develop and use a virtual laboratory in Second Life to teach lab and experimental skills to science students
OLY	Improve students' chances of being hired as border control officers by allowing them to rehearse the role of a border control officer in a virtual border setting

Table 1. Summary of the case studies

Data collection and data analysis activities overlapped. Data collection was carried out between January and June 2010. Inworld site visits were made to each project. Guided interviews (cf. Patton, 1990) were carried out inworld and lasted an average of 90 minutes. Project participants in each case were classified as educators, developers or project facilitators and interviews were carried out with at least one educator, one developer and one project facilitator in each case. Interviews were recorded and transcripts were created to facilitate data analysis. Participant observation was carried out both prior to and during interviews; this was primarily focused on the activities of the educational community in Second Life but also involved more general explorations in Second Life. Its primary purpose was to more fully probe the possibilities for innovation co-creation using virtual worlds.

[2] In this context, students taking part in educational projects in Second Life are not seen to be centrally involved in the co-creation of innovations in virtual worlds and students are therefore not the primary focus of this study. Rather, students are seen as end users of innovations that have already been co-created by university educators working with Linden Labs in Second Life. This study's point of departure is therefore quite unusual in comparison with existing research on education in virtual worlds (a review of which is outside the scope of this paper).

Data was analysed in accordance with Miles and Huberman (1994). This approach has enjoyed widespread use and is considered both elegant and systematic (Denzin and Lincoln, 1998, p. 40). Its core strength lies in its capacity to readily facilitate the customisation of (i) data reduction techniques, (ii) data displays and (iii) techniques used to draw and verify conclusions. Detailed case summaries, field notes, field memos, pattern codes, and methodological memos were produced during the early stages of the study and were repeatedly reviewed and revised during the study. In the latter stages of the study, case data was coded according to Miles and Huberman (1994) and these codes were used to construct a series of within-case and cross-case data displays in an emergent fashion (cf. Lincoln and Guba, 1985, p. 225). These displays constitute a tangible, traceable and explicit means of addressing the study's research objective.

4 Presentation of research findings

This study's research objective is to *investigate innovation co-creation in virtual worlds*. This section presents the findings of the study in relation to co-creation in six innovative educational projects carried out in the virtual world of Second Life. In particular, the section consists of two main components. The first component is a detailed *etic* or 'outsider' analysis of the actual behaviours of innovation co-creators in the cases. It begins by identifying and classifying 15 distinct behaviours that were used in the cases. At a higher level of abstraction, the analysis also identifies three distinct patterns of behavior ('archetypes') across the cases. This analysis reveals that despite the social, communicative and collaborative affordances of virtual worlds, most teams favoured a self-reliant approach. The second component of the analysis presents an 'insider' or *emic* analysis of the main factors affecting innovation co-creation in the cases. In the final section of the study, the two components of the analysis are then combined in order to derive a set of practical implications for those seeking to stimulate or engage in innovation co-creation in virtual worlds and indeed other electronic settings.

4.1 Co-creating innovations virtually: a behavioural analysis

This section presents a detailed *etic* or 'outsider' analysis of the actual behaviours of innovation co-creators in the cases. The analysis is based on Table 2, which presents a numerical analysis of innovation co-creating behaviours in the cases. The table identifies 15 distinct behaviours and classifies them into four types. The columns list each case, showing how many individuals used a particular behaviour in each case. Individual behaviours are defined in Appendix A. These behaviours are conceptually similar to real life behaviours but are carried out in fundamentally different ways in Second Life. For example, the unique spatial and communicative properties of Second Life means that it is possible to carry out these activities more quickly than in real life and in some cases multiple behaviours can be carried out simultaneously.

Endogenous exploratory behaviours (opportunistic and open-ended behaviours carried out internally within teams or within teams' locations in Second Life) included brainstorming, self-directed learning and DIY/practice. Real world brainstorming was typically used in early design stages and would often involve the use of a whiteboard to literally sketch ideas out. Inworld brainstorming typically took place once development work had actually commenced. Inworld brainstorming differed from real world brainstorming in the sense that the moment an individual had ideas, they could start to interactively experiment with them inworld. B.DEV explains that the big difference is that inworld, "you can start playing with it the instant you have ideas". Self directed learning tended to be carried out on an individual basis but participants typically had colleagues or inworld contacts to turn to for advice and assistance. In terms of DIY / Practice, many participants had developed the earliest elements of their islands as a way to familiarise themselves with working in a virtual world. These earliest builds were often kept on the islands for posterity.

Endogenous exploitative behaviours (purposeful behaviours carried out internally within teams or within teams' locations in Second Life) were the most common class of behaviours, manifesting in

thirty seven instances across the six cases. The analysis suggests that whilst other kinds of behaviours were carried out on a discretional basis, these types of behaviour were necessary to complete projects. In particular, endogenous collaboration was the most pervasive type of behaviour found in the study. Endogenous collaboration typically took the form of more experienced team members supporting more junior members by answering questions or providing input. Formal meetings were also commonly used. However, these meetings were held in the real world unless it was necessary to meet in the virtual world. Finally, pilot projects gave team members an opportunity to engage in experimentation and to practice the necessary skills to create in Second Life. These projects also served to provide educators with something 'tangible' that could be demonstrated to stakeholders.

TYPE	DESCRIPTION	CASES						TOTAL
		BOF	**TEX**	**IRT**	**GAL**	**ZOM**	**OYL**	
(i)	Brainstorm	2	3	2	0	0	3	10
ENDOGENOUS	DIY / Practice	2	1	1	3	1	1	9
EXPLORATORY	Self directed learning	0	1	1	2	1	1	6
BEHAVIOURS	***Subtotals:***	***4***	***5***	***4***	***5***	***2***	***5***	***25***
(ii)	Endogenous collaboration	3	3	3	3	3	1	16
ENDOGENOUS	Meetings	3	0	0	0	2	0	5
EXPLOITATIVE	Development methodology	1	0	0	0	2	2	5
BEHAVIOURS	Pilot project(s)	2	0	0	0	2	2	6
	Experiment	1	1	1	1	0	1	5
	Subtotals:	***10***	***4***	***4***	***4***	***9***	***6***	***37***
(iii)	Community participation	1	0	1	2	3	1	8
EXOGENOUS	Opportune inworld exploration	2	1	1	2	0	1	7
EXPLORATORY	Research	1	2	0	1	1	0	5
BEHAVIOURS	***Subtotals:***	***4***	***3***	***2***	***5***	***4***	***2***	***20***
(iv)	Exogenous collaboration	1	0	0	1	2	1	5
EXOGENOUS	Purposeful inworld exploration	0	1	0	1	0	1	3
EXPLOITATIVE	Imitation	1	0	0	1	0	1	3
BEHAVIOURS	Formal training	0	0	1	2	0	0	3
	Subtotals:	***2***	***1***	***1***	***5***	***2***	***3***	***14***
	Totals:	***20***	***13***	***11***	***19***	***17***	***16***	***96***

Table 2. Analysis of innovation co-creating behaviours in the case studies

Exogenous exploratory behaviours (opportunistic and open-ended behaviours carried out outside of teams or teams' locations in Second Life) were considered vital in terms of allowing study participants to gain new insights into how Second Life could be used. Yet even though much could be learned simply from visiting other educational locations in Second Life, participants suggested that it was also important to interact with other educators in Second Life in order to understand what educators *intended* to do as well as what they actually managed to accomplish. The table shows that exploratory exogenous behaviours were less commonly used than exploratory endogenous behaviours. Time constraints were frequently cited as an explanation for this. In addition, the analysis reveals that despite the communicative affordances of Second Life, study participants tended to rely on real world colleagues rather than on members of the broader Second Life community.

Exogenous exploitative behaviours (purposeful behaviours carried out outside of teams or teams' locations in Second Life) were least commonly used in this study. The analysis suggests that it is difficult to collaborate exogenously (outside of one's own team) in Second Life. Whilst educators in Second Life are happy to share resources, it seems that a number of study participants (e.g. G.EDU) had unsuccessfully attempted to identify and partner with potential collaborators. There was a strong recognition in Second Life (and amongst study participants) that the ability to stimulate effective collaborations in Second Life is a skill in itself; both B.FAC and B.DEV described this as "community building". This sentiment suggests that virtual world users face similar challenges to individuals working in distributed teams: they must work hard to overcome the challenges of communicating

without face-to-face cues so that they can develop "collaboration know-how" in order to work effectively with others (Majchrzak et al., 2005) in the virtual world.

At a higher level of abstraction, three distinct behavioural patterns ('archetypes') appear in the cases:

(i) **Purposeful self-reliance** occurred where teams were primarily engaged in exploitative endogenous behaviours. This archetype manifested in three cases (BOF, ZOM and OYL) but is most clearly in evidence at ZOM. Here, the team deliberately built upon the previous experiences of ZOM in Second Life as part of an incremental and explicitly stage-based approach. Whilst BOF and OYL were also primarily focused on exploitative endogenous, these teams also maintained a secondary focus on exploratory (endogenous) behaviours.

(ii) **Opportunistic self-reliance** occurred where teams were primarily engaged in exploratory endogenous behaviours. This archetype manifested in two cases (TEX and IRT) but was most pronounced at TEX where multiple individuals within the team utilised these behaviours. At IRT, the team was primarily engaged in exploratory endogenous behaviour but maintained a strong secondary focus on exploitative behaviours. Despite an opportunistic rather than purposeful approach, these teams (TEX and IRT) engaged in fewer behaviours overall than purposefully self-reliant teams (BOF, ZOM and OYL).

(iii) A **balanced approach** occurred at GAL where the team's behavioural configuration was balanced with a slight skew in favour of exploitative exogenous behaviours. This configuration of behaviours represents a significant departure from the other cases where the emphasis was primarily placed on endogenous and exploitative behaviours.

Overall, endogenous behaviours were more common than exogenous behaviours. This finding seems to contradict existing research which advocates the social, collaborative and communicative affordances of virtual worlds. Yet the balanced approach adopted at GAL is a kind of proof-of-concept of virtual worlds, illustrating that exploitative exogenous behaviours *can* be effectively leveraged in virtual worlds even if there may be difficulties associated with doing so. In the final analysis, there were marked behavioural differences across the cases and whilst these differences may be partly explained by contextual differences in the cases, participants argued that there was no consensus on what could be effectively achieved in virtual worlds or on the best way to achieve it. This meant, in turn, innovation co-creation was non-formalised and resource-intensive.

4.2 Factors affecting innovation co-creation in virtual worlds

Though Section 4.1 indicates that study participants relied primarily on endogenous behaviours, this section presents substantial evidence that the utilisation of *exogenous* behaviours in a virtual world is uniquely conducive to supporting the co-creation of innovations but that particular barriers to collaboration must be overcome if these benefits are to be maximised. Table 3 identifies three key factors thought to affect innovation co-creation by study participants based on observations made during the study. Each factor is explained in terms of an *emic* or 'insider' analysis of participants' interpretations of each factor.

Factor	Observation	Explanation	Impact
1.Sourcing inspiration	Participants underlined the idea that the work of others in Second Life was an important source of inspiration and motivation. O.DEV explained that he needed to "see the state of the art" in order to be able to do his best work	I.FAC explains that an awareness of the work of others is particularly important for creating understanding and meaning in a virtual world. This is because it is necessary to fully understand the technical constraints that may limit what can be created in a virtual world. Rather than limiting the imagination, I.FAC argues that "you become more open [as] the limitations of your own understanding go down". This is especially important at present where virtual worlds remain an emergent and partially understood phenomenon. Similarly, O.FAC argues that one must understand how the virtual environment itself works but for him, it is particularly important to be aware of what others have already created in the environment if one wishes to innovate with(in) it. In this regard, innovation in Second Life is much like musical improvisation: "You need to know the script before you can break away from it" (O.FAC). (*continued on next page*)	(+)

Factor	Observation	Explanation	Impact
2. Opportunities for emulation	Emulation or imitation is an effective means of co-creating innovations in virtual worlds. At OYL and GAL, for example, teams generated new ideas by looking for "serious examples" (G.DEV) in Second Life and then adapting and refining those ideas	In Second Life, it is possible to visit, inspect and experience projects that have been created by educators from all over the globe at the click of a button. At the same time, digital goods can be readily bought inworld and in virtual marketplaces. For these reason, O.FAC explains, it is remarkably easy to adapt and quickly "emulate great projects" in Second Life. O.FAC argues that "it takes longer if you wish to invent something completely new". Study participants at GAL and ZOM suggested that it was important not to focus too much on what already is: the trick is to stay focused on "what is possible". For this reason, innovating with(in) a virtual world is "less to do with what you can do than with what you can imagine" (G.PM)	(+)
3. New communicative affordances	The capacity to create interactive objects grants users the ability to engage in non-linguistic communication.	Many of Second Life's most successful educational projects allow users to 'live' different moments in space and time or to literally experience sensory and perceptual distortions that are not otherwise easily simulated (e.g. UC Davis' Virtual Hallucinations project). G.EDU explains that "there is an element of seeing is believing and certainly when you're trying to get people to use it, if you can take them to other places and say 'look, this is how they've used it here'".	(+)
		The trade-off is that it can be difficult to reach virtual world audiences with these innovations as it requires them to navigate to particular locations inworld. These projects are well known largely because of the efforts of Second Life users to promote these projects (often by word of mouth)	(-)

Table 3. Analysis of factors affecting innovation co-creation in the case studies

5 Conclusion: stimulating innovation co-creation in virtual worlds

This research project has yielded a wealth of rich observations on the topic of co-creating innovations in virtual worlds. In particular, this paper presents a detailed analysis that combines *etic* (Section 4.1) and *emic* (Section 4.2) perspectives on the factors and behaviours that lead to the successful co-creation of innovations in virtual world educational projects. Whilst open research designs effectively allow for the collection and analysis of rich observations in settings about which little is known, they bring with them significant difficulties in terms of deriving definitive conclusions (Nutt, 1984).

Therefore, Table 4 identifies three practical recommendations for innovation co-creators that arise out of a synthesis of the analyses presented in Section 4. Given the paper's space constraints, it is difficult to express the exact linkages between the study's findings and its recommendations. For this reason, the table's second column clearly shows whether or not each recommendation is supported by the *emic* and *etic* analyses. In addition, the third column briefly describes the rationales underpinning the linkages between particular findings and the recommendations derived from them. Finally, the fourth column extrapolates some of the implications of each recommendation for virtual world designers. Taken together, the recommendations presented in the table direct innovation co-creators in virtual worlds to ensure that sufficient resources are invested to support ongoing inworld exploratory activity. In so doing, virtual world users can develop the practical knowledge necessary to fully understand the actual technical affordances and limitations of virtual worlds.

Overall, the analysis supports the view that virtual worlds are attractive for innovation co-creation. In particular, the analysis supports existing arguments in literature regarding the communicative affordances of virtual worlds. Yet as I.FAC observed, teams were "fumbling around in the dark" and as a result, innovation co-creation was a non-formalised and resource-intensive process. Whilst the recommendations presented in this section represent a starting point in terms of guiding future innovation co-creation efforts, there is a need for further research on fully leveraging the collaborative affordances of virtual worlds.

Recommendation	Derives from	Rationale and discussion	Design implications
1. Ensure that sufficient time is taken to fully explore virtual worlds	☑ *Emic* analysis - Section 4.2 - ☒ *Etic* analysis - Section 4.1 -	In Section 4.2, study participants underline the importance of exploring Second Life by means of exogenous exploratory behaviours in virtual worlds (particularly in terms of stimulating creativity and innovation), but the analysis in Section 4.1 demonstrates that these behaviours were least commonly used in the cases	Virtual world designers should try to ensure that there is effective support for inworld exploration. For example, information about particular projects in Second Life is often shared inworld by word-of-mouth. This is because existing search and navigation mechanisms in Second Life remain *ad hoc* and are a difficult to use (particularly for inexperienced users). One possible means of stimulating the diffusion of innovations and information through inworld communication channels would be to develop new (inworld and/or online) community-level mechanisms
2. Ensure that sufficient practical knowledge of virtual worlds is available	☑ *Emic* analysis - Section 4.2 - ☐ *Etic* analysis - Section 4.1 -	Study participants underlined the need to remain tightly focused on what is possible in virtual worlds (rather than to focus specifically on what already is or on what is theoretically possible but infeasible given the environment's technical constraints. For this reason, numerous participants emphasise inworld skill development. G.DEV explains that it can be "difficult to get involved in the ideas of virtual worlds" when people "don't have the time or the interest or the skill… [when] they struggle with the technology". Conversely, where this can be accomplished, the rewards can be substantial: O.FAC argues that people can learn "certain skills very effectively in a virtual world and those skills translate into a real world testing situation"	Virtual world designers should attempt to minimise the effort required to acquire practical knowledge of virtual worlds, particularly for new users. It may be possible, for example, to accelerate learning by developing and promoting high-quality inworld training courses.
3. Continue to focus on tools and techniques that support self-reliance in teams	☑ *Emic* analysis - Section 4.2 - ☑ *Etic* analysis - Section 4.1 -	Study participants argue that effective collaboration in virtual worlds can stimulate synergies within teams. For example, G.FAC argues that each person at GAL discovered different things but they learned much more as a group. However, participants also acknowledge that it is difficult to create truly effective collaborative relationships in virtual worlds especially with other groups. Thus, fully self-reliant approaches to innovation co-creation were adopted in five of the six cases.	In the short term, virtual world designers should continue ensure that individuals and teams can effectively work autonomously, because of the unique challenges associated with fully leveraging the collaborative affordances of virtual worlds. In the longer term, virtual world designers must develop a robust understanding of the barriers preventing fully collaborative approaches to innovation co-creation in virtual worlds.

Table 4 Practical recommendations to support innovation co-creation in virtual worlds

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