

A Responsive Templating Model for Online Immersive Collaborative Business Innovation Spaces

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Abstract. The business world is a competitive world and the success of entrepreneurs and businesses today is linked to their ability to be innovative which, in turn, means that innovation has become increasingly important for businesses. One response to this has been the introduction of special environments, tailored to supporting innovation, namely Innovation-Labs (i-Labs). Research has shown that creativity thrives in spaces that are playful and customizable, rather than in the somewhat sterile environments of most workplaces. In this paper, we describe a Responsive Templating Model (RTM) for an online immersive collaborative business innovation space that can be customized and dynamically adapted to the needs of individuals and specific business innovation sessions. In creating this model we have been inspired by earlier pioneering work in innovation Labs, virtual reality, HCI and the World Wide Web. This paper presents the RTM as a model that allows space and task reconfigurations by a facilitator using template interfaces that are dynamic and extensible to provide human-machine and machine-machine interactions thereby creating personalised business innovation spaces to support various innovation activities.

Keywords: Innovation-Labs, HCI, Templating, Reconfigurable Spaces, Personalization, Business Innovation Spaces

1 Introduction

This research describes an approach to developing online immersive collaborative business innovation spaces using a Responsive Templating Model (RTM). Business innovation spaces/innovation labs (i-Lab) should be well designed to support innovation activities within the space and should also be reconfigurable for different innovation purposes. An i-Lab is a space that is conducive to creative thinking. An important feature of an i-Lab besides from facilitation techniques and cooperative ways of working is a dedicated space characterised by multiple media for working and a distinctive design of

layout (Callaghan, Davies et al. 2016). An innovation-lab (I-Lab) has also been defined as an “*inspirational facility designed to transport its users from their everyday environment into an extraordinary space encouraging creative thinking and problem solving*” (Susnea, Pecheanu et al. 2014). Human-Computer Interaction (HCI) principles focus on users and how to design interactions and implement interfaces that are easy to use, efficient for the task and lead to a correct implementation of the task (Kim 2012). We believe this is important for business i-Labs and thus explore how HCI ideas can be extended to their design. We have chosen i-Labs because it is an exemplar of almost every facet of a user space from psychological factors through information to physical structure.

Also, the Internet, information and immersive multimedia technologies have had a huge influence on businesses in our world today, particularly its ability to interconnect people in different geographical locations to share resources and perform various tasks. Globalisation, and the intensive competitive forces that it introduces has meant that innovation has become increasingly important in business. I-Labs are used to produce innovative ideas for developing new products and services to cater for various societal needs.

According to a recent report, PricewaterhouseCoopers, the world’s largest professional services firm, stated 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 have reported that organic growth through innovation will drive the greater proportion of their revenue growth” (Susnea, Pecheanu et al. 2014). We believe that part of the goals of businesses is to be able to produce products and services that would give them an edge over competitors. To achieve this, especially in our ever changing world, businesses need to be creative and innovative and hence the need for well-designed business innovation labs. We next discuss some affordances of immersive multimedia, innovation activities and some innovation methodologies, the RTM and how it can be applied to online immersive collaborative business innovation spaces.

2 Affordances of Immersive multimedia

Advances in Immersive multimedia technology and its affordances have led to its application in areas pertaining to enhancing active and collaborative experiences. A conceptual framework for understanding and defining immersive learning environments is described in research by (Gardner and Elliott 2014). They also highlight immersive education laboratory research themes. This includes understanding the affordances of the technology to build more effective environments. A constructivist view of education was described. This approach focuses on supporting users in the performance of tasks that are targeted at engaging them in a way to achieve active conceptual manipulation, questioning and problem solving. The use of Virtual Reality (VR) has also been explored in connecting smart spaces (Peña-Ríos, Callaghan et al. 2014). This research explored the development of an architecture to interconnect smart spaces. This was achieved by creating a 3D graphical user interface where real and virtual users can communicate and collaborate on programming tasks on an emulated virtual and real intelligent environment. Also, the results of the programming tasks that were performed were visualized in real-time. Research performed by Alzahrani et al. (Alzahrani, Gardner et al. 2015) demonstrates how remote students could collaborate within mixed-reality environments using an augmented reality approach.

3 The Importance of customising space

Earlier research has pointed out the importance of being able to customise built-environments and the tasks they support. According to Bentley (Bentley 1985), a built environment should provide its users with flexible settings and opportunities to maximize the choices available in their environment. Such an environment, with these affordances, are said to be “responsive”. A key design parameter for such a space is its ability to support personalisation, which will enable users to put their 'stamp' on such spaces. Research by Chin et al. (Chin, Callaghan et al. 2008) also explored how non-technical users can creatively construct functionality based on networked appliances within the home by using a programming-by-example approach. The research carried out by Sailer et al. (Sailer, Pomeroy et al. 2015) proposes the use of data-driven design as an emerging design approach for spaces. Our research also

aims to explore these emerging space design methodologies. Some research (Kemp and Livingstone 2006, Azhar, Khalfan et al. 2015) have explored the automatic customisation of rooms, creation of spaces from architectural plans and integrating virtual worlds with information systems and learning management systems. In this work, we are more concerned with the elemental creation of the space and its associated HCI issues. We propose a templating approach in which interactions occur between users and template interfaces and between computational components, leading to more personalised business innovation spaces which are specifically tailored to support their required innovation activities.

4 Innovation activities and methodologies

I-Lab activities include a mix of discussion and getting other people's perspectives, icebreaker and reviver activities, headlines, cut and paste collages and PowerPoint presentations, wall activities (doodling, collaborative writing, role play, brainstorming, voting, scenario building etc. (Gill and Oldfield 2007). At the core of the process is the brainstorming activity described by Wu and Callaghan (Wu and Callaghan 2016) as "a technique for unleashing a flood of thoughts by members sparking ideas off each other, or from carefully injected external stimulus".

Some methodologies have been developed to encourage the generation of creative and innovative solutions to user problems. These include Science Fiction Prototyping (SFP), Diegetic Innovation Templating as described by Callaghan et al. (Callaghan, Davies et al. 2016) and Scenario-based User Needs Analysis (Van Helvert and Fowler 2003) among others. SFP 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 innovation*" (Callaghan, Davies et al. 2016). The technique aims at creating high-fidelity analogues of the real world adopting a rich story-based structure enabling it to serve as a type of prototype to test ideas. In following sections, we use an example task scenario based on SFP to explain how our proposed Responsive Templating Model can be used to reconfigure online immersive collaborative innovation spaces for teams working on developing a product or service.

5 Responsive Templating Model (RTM)

The Responsive Templating Model (as shown in figure 1 below) consists of facilitator user interface(s), machine processes and a virtual reality view. A user (facilitator) first interacts with template interfaces that has dynamic and extensible fields (shown in figures 2 and 3) to configure the virtual i-Lab spatial layout and tasks (more details of the configurations options are explained in section). This template then serves as input specifications for the i-Lab adaption engine(s) which then finally creates the virtual space and guides users on tasks to be performed within the space. We have initially implemented the space template in Figure 2 as a tentative approach with the aim to develop visual interfaces users can interact with. We have also initially considered a situation where the virtual world objects and tools are obtained from virtual libraries and at fixed positions in the i-Lab.

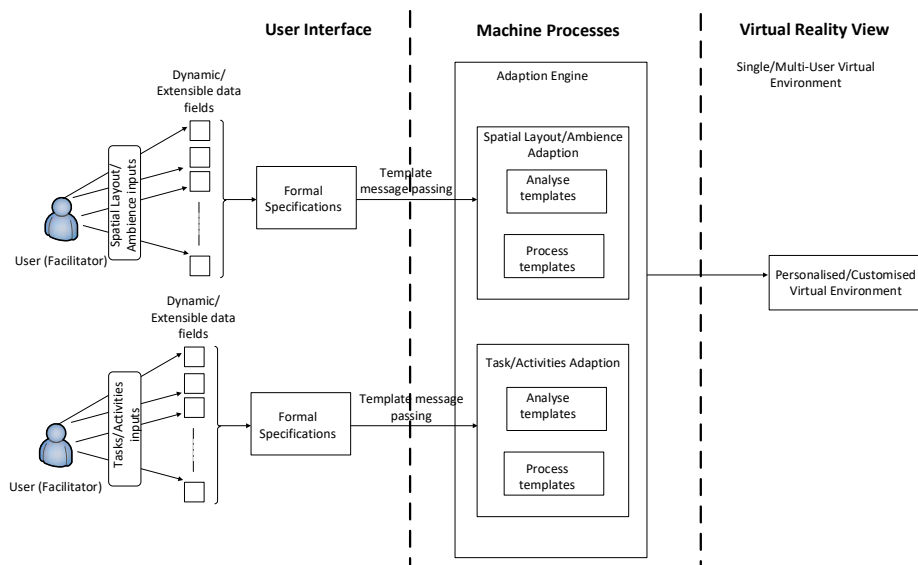


Fig. 1. Responsive Templating Model (RTM)

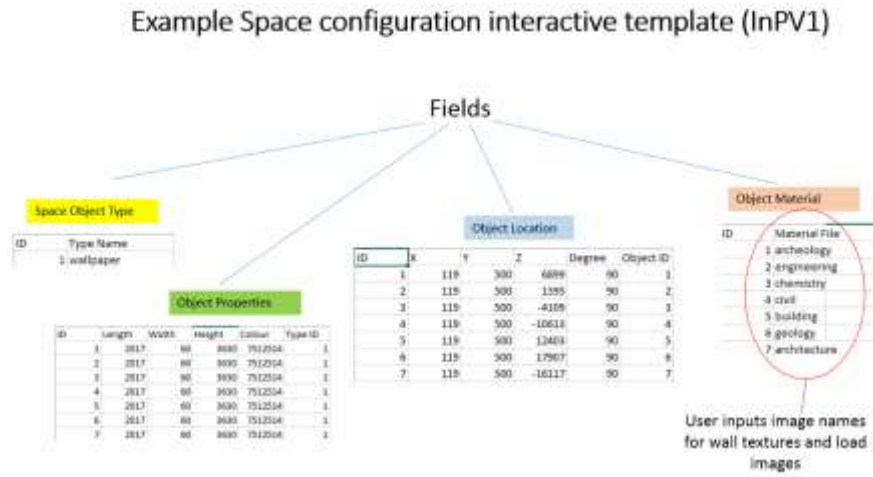


Fig. 2. Example space configuration interactive template

```

1 <?xml version="1.0" encoding="utf-8"?>
2
3
4 <!-- Innovation Protocol Version I (Task adaption template)-->
5
6 <!-- Task 1 -->
7 <task>
8 <!-- Task 1 ! -->
9 <name>Task 1 - Introduction </name>
10 <tutorial> View display board content for session theme </tutorial>
11 <object name="Chattool"> Chat tool - Task 1 </object>
12 <object name="Ideationboard"> Ideation board - Task 1 </object>
13 <object name="Votingboard"> Voting board - Task 1 </object>
14 <object name="Displayboard"> Display board - Task 1 </object> -->
15 <finaltext> Introduction Complete </finaltext>
16 </task>
17
18 <!-- Task 2 -->
19 <task>
20 <!-- Task 2 ! -->
21 <name>Task 2 - Group Chat </name>
22 <tutorial> Use chat tool to discuss theme </tutorial>
23 <object name="Chattool"> Chat tool - Task 2 </object>
24 <object name="Ideationboard"> Ideation board - Task 2 </object>
25 <object name="Votingboard"> Voting board - Task 2 </object>
26 <object name="Displayboard"> Display board - Task 2 </object>
27 <finaltext> Chat Complete </finaltext>
28 </task>
29
30 <!-- Task 3 -->
31 <task>
32 <!-- Task 3 ! -->
33 <name>Task 3 - Ideation </name>
34 <tutorial> Submit your idea in ideation board </tutorial>
35 <object name="Chattool"> Chat tool - Task 3 </object>
36 <object name="Ideationboard"> Ideation board - Task 3 </object>
37 <object name="Votingboard"> Voting board - Task 3 </object>
38 <object name="Displayboard"> Display board - Task 3 </object>
39 <finaltext> Ideation Complete </finaltext>
40 </task>
41
42 <!-- Task 4 -->
43 <task>
44 <!-- Task 4 ! -->
45 <name>Task 4 - Voting </name>
46 <tutorial> Vote on ideas </tutorial>
47 <object name="Chattool"> Chat tool - Task 4 </object>
48 <object name="Ideationboard"> Ideation board - Task 4 </object>
49 <object name="Votingboard"> Voting board - Task 4 </object>
50 <object name="Displayboard"> Display board - Task 4 </object> -->
51 <finaltext> Voting Complete </finaltext>
52 </task>
53 </levels>

```

Fig. 3. Example Task configuration interactive template

We consider a typical scenario of team members of a company X consisting of a group involved in developing products for the company. The team members are located in various geographical locations and have to discuss and brainstorm about new ideas to have a competitive edge in the market. Usually, the team would have a chair who would preside over the brainstorming session and serve as a facilitator for guiding other users through the session. As earlier pointed out, earlier research into innovation labs has shown that the nature of the space and the role of facilitators and facilitation is important in enabling i-Labs to work effectively. In the following sections we explain the Responsive templating model and how it can be used to support a product development team by creating a personalised environment.

6 Example task scenario based on SFP

A product development team is set up by an IT company (say company F) and is made up of five experts (A, B, C, D and E) located in the different geographical locations. They are to come up with innovative products/services the company would provide soon for consumers so as to have a higher competitive advantage in the market. The leader of the team, A, is to facilitate and chair the session as he guides others through the various activities. Their innovation focus themes are internet-of-Things, smart homes, smart cities, smart businesses and technological singularity. Specifically, the experts are to come up with short science fiction stories to describe their innovation ideas such as:

Jack falls asleep in the sun. His smart sun protection sensor woke him up with an alarm & soft vibration. He avoids sun strokes¹.

As the team leader, session facilitator and chair, A first configures the online i-Lab in preparation for the session. We next explain how the responsive templating model can be used by A to configure the online i-Lab for their specific session using template interfaces which serve as specifications for the space. The facilitator A can configure the following features in the i-Lab

¹ From 'New Creatives 2014' <https://twitter.com/CSciFoundation/timelines/748798811787579392>

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- I. **Room ambience** – this includes changing side wall textures to give the environment a different look and feel



Fig. 4. Snapshot showing the i-Lab prepared for an innovation session using the space template with orange wall textures



Fig. 5. Snapshot showing the online i-Lab prepared for their innovation session using the space template with green wall textures

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- II. **Display board contents** – this includes changing the content of display boards accessible to users. The boards can contain images, slides, videos or other information content relevant for the session



Fig. 6. Snapshot showing the online i-Lab prepared for their innovation session using the space template loading contents on the display boards



Fig. 7. Snapshot showing the i-Lab prepared for their innovation session using the space template changing the content of the display boards

- III. **Spatial layout** – This includes changing the position of walls and displays, increasing/decreasing size of walls and display boards,

introducing additional walls, displays etc. which can entirely change the spatial layout of the space



Fig. 8. Snapshot showing the i-Lab prepared for their innovation session changing the spatial layout by introducing an additional wall partition in the centre of the room (coloured green)

IV. **Tasks to be performed** – this involves specifying the number of tasks to be performed in the space, order in which they are performed and the triggers (actions users in the space perform to indicate a task completion) to create transitions from task to task. Each task has its associated properties that can be edited by the facilitator to drive the session's tasks (as shown in the task adaption template in figure 3 above). These are:

- **Name** - stating the name of each task
- **Tutorial** – stating facilitator instruction indicating the tool to be used for each task
- **Object name** – stating all tools accessible to users for each task
- **Final text** – containing a message to indicate successful completion of each task as each of the users perform the specified actions to denote ending each task.



Fig. 9. Snapshot showing the task adaption engine at work using the example template configuration in figure 3 by the facilitator

- V. Task Triggers** – A particular trigger can be specified by the facilitator in the task adaption template across all tasks. This would be performed by the users to indicate end of an activity in order to proceed to the next specified activity. For instance, a facilitator can specify collision triggers for all tasks such that each user has to walk into a fixed object placed (e.g. a door at a corner) in the space and this object is used for the purpose of making users trigger the collision event. Other triggers in which users perform an action (e.g. button press from keyboard input) to cause a transition to the next task controlled by the task adaption engine could also be used and this would serve as a transition method from task to task for all tasks in a session.

Figure 10 below shows the various team members (W, X, Y and Z) connecting to the system that has been setup by the facilitator. It also details components of the i-Lab's underlying model and activities involving

human and machine agency interactions. We have initially implemented the system so as to be accessible to users via a screen-based interface.

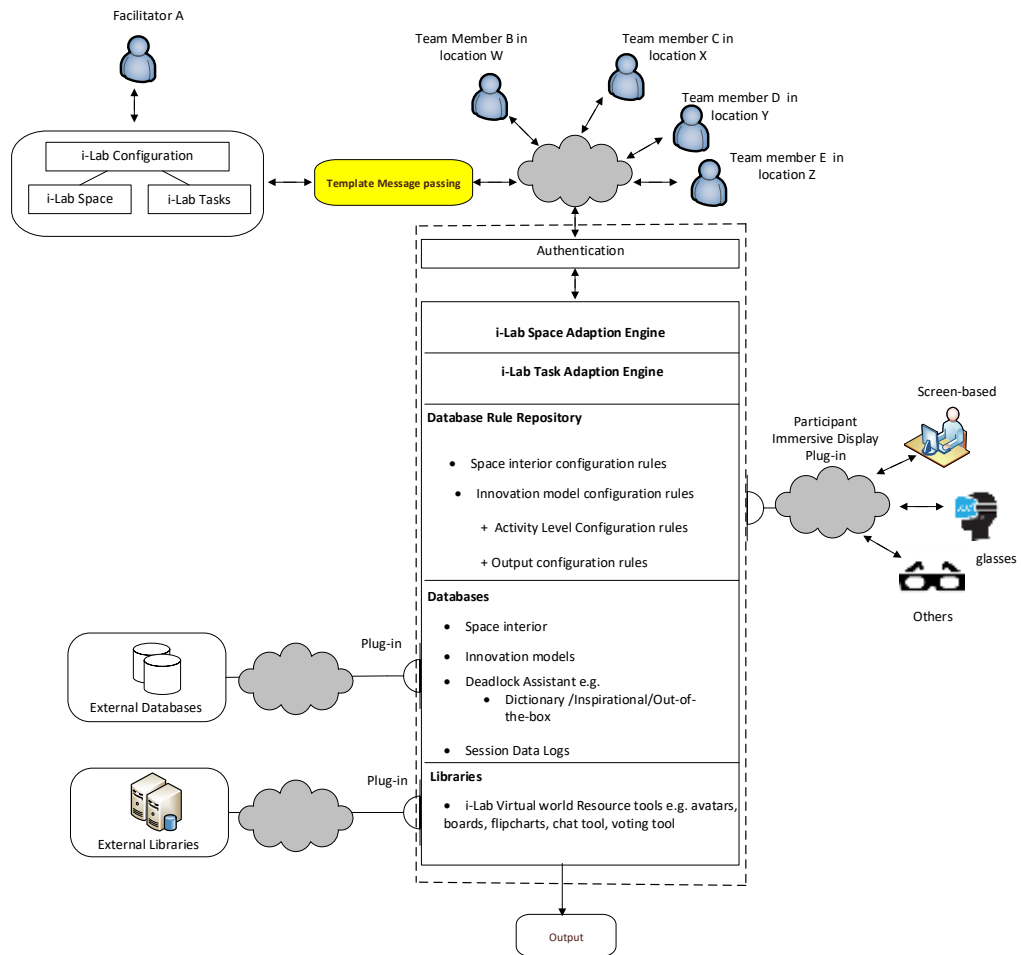


Fig. 10. Multi-agency (human and machine) interactions in the business innovation lab

7 Summary and Future directions

In this paper, we have introduced RTM as a model supporting reconfiguration options for online immersive collaborative business innovation spaces. This model allows users (facilitators) to interface with templates that possess dynamic and extensible fields which also serve as

input specifications for machine processes that adapt to the templates to create virtual innovation labs suited for specific innovation sessions. We are inspired by earlier pioneering research about i-Labs, the affordances of immersive multimedia technologies, HCI and the World Wide Web. The World Wide Web has a flexible model with defined protocols enabling various users with different plug-in architectures thereby satisfying the various needs of these users. We have implemented the RTM for online business i-Labs with respect to ambience, spatial layout and task reconfigurations. As shown in figure 10 above, our vision is to make the model more flexible so as to allow users to access the online i-Lab space and resources exploring other immersive views and platforms besides screen-based which we have initially implemented in this paper.

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