Implementing an ICE:
A methodology for the design, development and installation of Interactive Collaborative Environments in real world industrial settings

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Abstract
In this paper, we present a methodology for the design, development and implementation of ICEs (Interactive Collaborative Environments) in real world industrial settings. The approach is informed by lessons learnt from and research undertaken with the Edinburgh Napier ICE, a multi-user, multi-surface, multi-touch blended interaction digitally augmented space designed to facilitate local and remote collaborative activity. The methodology has been deployed and iterated with multiple industrial clients, and an example case study is presented for a project undertaken delivering a series of ICEs for AstraZeneca, the world's 5th largest pharmaceutical company.

Author Keywords
multi-touch; interactive environments; interaction design, CSCW

ACM Classification Keywords
H.5.1. Multimedia Information Systems: Evaluation/Methodology.

Introduction

The Future Interactions Group is a team of designers, developers and researchers (led by the Authors) within Edinburgh Napier University's Centre for Interaction Design. The focus of the groups work is the impact and implications of emerging enabling interaction technologies (such as multi-touch, gesture and speech recognition) on the activities of people in real world public, private, work and social spaces.

The ICE Philosophy

The first of these spaces was commissioned and designed in 2009, opening it's doors in January 2010. The ICE (Interactive Collaborative Environment), shown in Fig 1, is a unique environment consisting of a cutting edge hardware and software infrastructure. The ICE is a multi-user, multi-orientation, multi-screen, multi-touch environment for local and remote collaborative activities. It is intended to be a simple, powerful and intuitive space where the technology doesn't drive the applications, rather the needs, wants and activities of the people using the space do.

Figure 1. The Edinburgh Napier ICE in action

The design philosophy is driven by the belief that collaborative environments must allow the free flow of ideas between people whilst maintaining a browsable history and formalisation of any process that takes place. Constraining people to one-at-a-time interactions in a crippled space has no place in the 21st century. Be it a door a wall or a tabletop, all aspects of an environment should help the people within it fulfill their activities and do so in pleasurable intuitive ways [2,3].

The purpose of the ICE is to provide a new space for interaction, a new physical space and a new digital space. From these new spaces, people would find a new conceptual space where they would be able to undertake new activities, or undertake traditional activities in new ways that would lead to new insights. We describe these as blended spaces [2,3,4,5] because the aim is not simply to mix the physical (or the analogue) and the digital, but rather to design a space that brings the physical and the digital together to enable new user experiences. The blended space has new properties that emerge from the right physical-digital blend and people will do things in new ways and get new insights into situations.

The ICE combines the analogue and the digital in a natural way, drawing on people's knowledge of tables, pens and whiteboards and augmenting this with interactivity and internet connectivity. We expect people to come to the ICE with their own laptops, phones and tablet computers. We expect people to take notes in notebooks and on paper. The philosophy of the ICE is to remove function from the *contents* of discrete objects (screens, laptops, mobile devices) and instead consider them as *portals* to function and content, enabling and facilitating real time, concurrent, local, and remote collaboration. This is facilitated through the

use of cloud-based services such as Dropbox™, Evernote™ and wireless internet.

ICE Hardware

The space utilises bespoke, commissioned industrial strength hardware to ensure for a robust future proof technological platform. The ICE features 5 HD multi-touch LCDs surrounding a custom designed 110" multi-touch table which forms a fully interactive, orientation independent, multi-user surface which allows for total room control as well as interactivity with all other screens, web and file browsing, interactive maps and multiple other applications. The table can recognise and interact with objects placed on its surface such as smart phones, tablets or books using infra red fiducial markers.

The table serves as the room hub and has a patch panel on either side for people to plug in usb flash drives, cameras or their laptops for display on any screen. The ICE surfaces can also be controlled by wireless keyboards and the display of any laptop, iPhone or iPad can be easily and wirelessly sent to any screen as well as the room's surround sound system. Every wall surface within the ICE can be written on and serves as a whiteboard with a twist, anything written on them is automatically digitally captured for easy storage and distribution.

Remote participation in a collaboration session is designed to be effortless and powerful with 3 HD webcams, 6 ceiling mics and 5.1 surround sound providing high quality video and teleconferencing capabilities plus interactive screen-sharing for up to 16 remote participants via cross platform and device services (eg Skype, GoToMeeting, Webex), enabling shared experiences of reviewing documents, plans, websites and presentations.

Moving Beyond Academia to Industry

Since it's launch, the ICE has proved a powerful and useful resource for University faculty and staff for both real world functional meetings as well as a research resource. It has subsequently garnered a lot of interest from external parties from a wide variety of industrial domains as a potential solution to common business problems. The compelling problem that is addressed by this technology is the need for business to collaborate effectively and efficiently. Collaboration is key to improved business development and organizations are striving to become global entities by working together across time zones, distances, and organizational and business boundaries to improve the utilization of their resources [1].

Businesses have a real and present need to improve their ability to collaborate effectively while paying heed to the requirement to decrease costs, become more sustainable and reduce their carbon footprint. ICEs address this market need. Remote collaboration can be difficult, typically using the limited collaborative capabilities of traditional video conferencing, email or shared websites. ICEs enable true interactive, shared environments distributed across local and remote participants and across multi-touch enabled devices such as iPads, large multi-touch screens and interactive tables, thus eliminating the need for costly travel.

A Practical Methodology: Phase 1

We are not hardware resellers. We are experts in interaction design, software development and appropriate technological solutions. Every use case and

potential client is different as are their needs, wants and budgets so we steadfastly remain software, platform and hardware agnostic. We do this to ensure we implement the best and most appropriate products and solutions to meet a clients and contexts needs not simply the ones we get the most profit from.

The 5 maxims to our approach

- Be people not technology led.
- Be design not engineering led.
- Design for simplicity, elegance and joy.
- The end product should be fun, productive, engaging and effortless.
- Robustness and ease of use above all else.

To this end we have developed the following methodological protocol when consulting for external clients:

1. Identify and understand the purpose

- Of function: what does it need to do?
- Of installation: why is it being done?
- Of impact: what problem is it expected to overcome?
- Of audience: who's using it to do what?

2. Examine the current practice

- What is not happening that the space is meant to make happen, what's stopping/inhibiting that currently?
- How do people currently work? Not what people say they do, rather what they really do.
- Undertake ethnographically informed studies of real world activity.

3. Determine the location of deployment

- What are the "unchangeables" and what are their impacts? For example, physical factors such as window light direction, door locations, heating considerations etc.

4. Identify and specify the restraints

- For example, the installation timeline, budget, legacy software/workflow requirements, hardware support and maintenance, environmental factors.

5. Determine appropriate technologies

- What is the appropriate software-hardware blend, requirements for mobile and remote integration, bespoke vs turn-key solutions, etc?

6.Model and map the space

- From the big details (layout, furniture and lighting options and impact).
- To the smaller details (environment control e.g. lighting, power and cabling outlets and architecture).
- Right down to the tiniest detail (e.g. what screws are used, how big should the shadow gap be between screens to ensure symmetry).

These first 6 stages are considered the consultancy and design phase and naturally have an iterative nature with multiple collaborative sessions with the client.

Importance of an Ethnographic Approach

If there's no buy-in from the people who will actually be using the space then we've fallen at the first hurdle. It is often easy to impress the "higher-ups" with sexy kit but it's critical that what is deployed actually helps people who will use these spaces and doesn't prove to

be another headache or problem to negotiate which poorly thought through technology can often be. This is why we're resolute in determining a period (or ideally periods) of ethnographic observation and discussion as part of the design phase.

For example, when developing an ICE for Redlands Police Department in California 2 days were spent with each of the 4 departments (Patrol, Metro-Gang, Narcotics & Detective) so as to attend and observe briefings both at the start and end of shifts, attend stakeout, arrests, interrogations etc and generally understand the real world workflow and crucially the communication and information flow. All while talking about the real world desires, needs and concerns of the people who would actually be using the space.

A Practical Methodology: Phase 2

Subsequent to completion of the first phase a series of deliverables are completed:

- A design document with detailed schematics, hardware-software recommendations and rationale used to tender the installation process.
- Advice documentation or hands on oversight of installation and initial setup (usually budget dependent).
- Training, both hands on and in the form of dispersion materials (manuals, videos, website).
- Ongoing maintenance and support strategy document.

The choice of which phase 2 services are provided (and the level to which they are delivered) is really determined on a case by case basis dependent on the organisations internal facilities and tech support, installation capabilities or existing relationships with AV companies. It's perhaps best to think of this approach as analogous to the role of architects in building projects which is often determined by the scale and budget of each project as well as the expertise, experience and resources of the client.

One aspect to bear in mind is the requirement for bespoke software development versus utilising 3rd party and turn-key solutions. This is very dependent on the functional requirements as well as any existing legacy infrastructure. The various options and their associated costs would be mapped out during the initial design and consultancy phase.

Implementing the Methodology

AstraZeneca is the world's 5th largest pharmaceutical and biologics company with annual revenue exceeding $30 billion and over 57'000 staff operating predominantly in the US, UK and Sweden. They approached the Future Interactions Group in early 2012 for consultation and design services for the implementation of a series of ICE test-beds at their Alderly Park campus near Manchester in England.

Central to the brief was the functional capability of hosting on-the-fly video conferences with screen sharing capability and remote participants using mobile devices with cellular connections. This was of particular importance due to the enforced reduction of company travel imposed acrossall sites in 2012. Additionally, many of AstraZeneca's over 750 traditional meeting rooms and vid-con suites had a very high technical failure rate (eg inability for users to connect devices to projectors, loose/unconnewcted wiring etc) plus a low

user satisfaction rating (which are understandably linked).

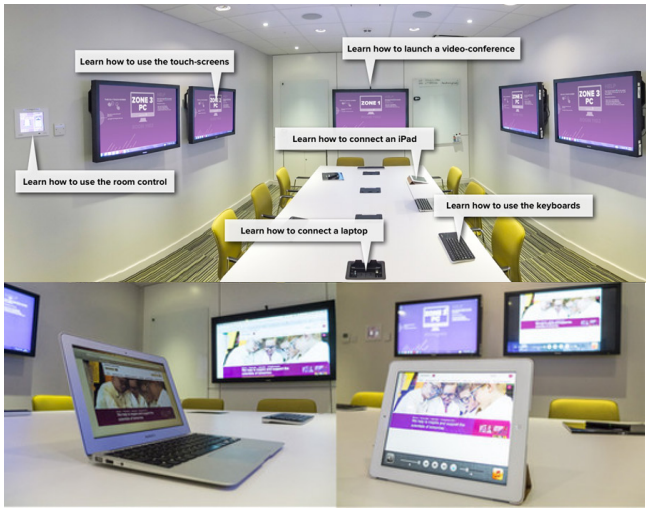

Figure 2. The first ICE at AstraZenca.
Top image is the instructional interactive image shown when using the wall screens. The lower images show a laptop and iPad wirelessly screen sharing with the wall zones.

Through the deployment of the outlined methodology a design and implementation strategy was delivered to enable the critical functionality whilst maintaining a simplicity, ease and elegance of use central to the ICE design philosophy. The first space was completed in July 2012 and can be seen in Figure 2. It has scored extremely highly in an independent internal user review, particularly in areas of ease of use.

Reflections & Lessons Learnt

Developing and maintaining an ICE for use within an academic setting was and remains a challenge as it serves a dual purpose as a real world blended interaction space for use by none-technical staff for local and remote collaborative activities, whilst also providing a technological platform for a variety of interdisciplinary research activities. The technical maintenance of the ICE at Edinburgh Napier is handled by the Future Interactions group, however such an approach is not available to an industry situated ICE and the maintenance (and related robustness) requirement has quickly emerged to be central to the ongoing independent use and success of such spaces. Therefore a critical requirement to have emerged is the capacity to "reboot" the space to a ready state, a feature that occurs at the end of each use of the AstraZeneca ICE (triggered via the integrated Crestron System), thus ensuring a consistent and familiar experience fro every user. This is also available as an onsite "installation package" to enable the legacy facilities management resources to ensure a rapid response to any technical failures.

References

[1] Ackerman, M. (2000) The intellectual challenge of CSCW: the gap between social requirements and technical feasibility *Human-Computer Interaction* 15 (2-3) 2000 pp 181 – 205

[2] Benyon, D. and Mival, O. (2011) Physical, Digital and Conceptual spaces: Interaction design for a multi-touch meeting room. *Interacting with Computers*

[3] Benyon, D. and Mival, O. (2012) Blended Spaces for Collaborative Creativity. Proc. Workshop on Designing Collaborative Interactive Spaces AVI2012, Capri

[4] Benyon, D. (2010). *Designing Interactive Systems*. Harlow: Pearson Education Limited.

[5] Hoshi, K. and Waterworth, J. (2009) Tangible Presence in Blended Reality Space. *Proceedings of Presence 2009*.