

# “Crowdsense” – Initiating New Communications and Collaborations between People in a Large Organization

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**Abstract.** Crowdsense is a novel information and communication system, intended to promote and enable exploration and collaboration within large organizations. The system is designed with the aim of solving several of these organizations’ requirements. The first is to provide employees with information which is relevant to them dynamically, without requiring them to spend time logging onto intranet and internet sites. The second is stimulating communication between people with relevant expertise who may not know about each other. The third requirement is to provide a knowledge centre within the organization which people can both search and contribute to. The system provides an accessible layer which enables easy exploration, addition and correction of data by users. The contributions of this paper are the background to the project, system and trial description, feedback from user testing and discusses a central success factor – that of engagement.

**Keywords:** Collaboration, Social Media, Prototype, Concept testing, Engagement.

## 1 Introduction – Origins of Crowdsense

Crowdsense was inspired by Glass Infrastructure [1], a MIT Media Lab knowledge system provided via large touch screen kiosks designed to aid visitors and members to explore the relationships between projects, people and groups in the Media Lab. Sophisticated similarity analysis based on text analysis using Luminoso [2] is used to back up the recommender system for related projects. The original Glass Infrastructure has evolved since its initial implementation with the introduction of a series of “apps”, e.g. a map and route finding app that provides visitors with directions to an office, and a “lunch date” system that recommends a suitable colleague to accompany a user to lunch. Based on demonstrations of the Glass Infrastructure system and an evaluation of the system using the client source code and infrastructure designs a number of observations were made on the potential for implementation of a similar system in a corporate environment.

These observations are:

- The original system was underpinned by various databases in the MIT information architecture.
- The component parts of the system (displays, recognition/authentication components, operating system and implementation language) were enabled by their origin in an academic environment. For example the displays in the system were best in class and as such presented an obstacle to creating a viable business case for delivering a similar system.
- The underpinning purpose/objective of the Glass Infrastructure was to enable visitors to make links with an academic community.

The first two observations could be dealt with by re-engineering with cheaper components and a decoupled data back end. The final observation was more significant. The business issues that we believed could be potentially addressed with a system like the Glass Infrastructure in the workplace are the support of knowledge sharing and collaboration within and between working groups. These issues are elucidated and expanded upon in the next section.

## 1.1 The Business Rationale for Crowdsense

Previous studies [3] have highlighted the significant benefits of improving col-laboration and communication in the workplace in terms of both increased efficiency and employee morale. The existence of information “silos” within and between departments of large organisations cause problems such as duplication of project effort, loss of innovation, oversight of employees’ valuable skills and knowledge and time wasted searching for people and information. McKinsey Global Institute [4] estimates that use of social technologies which enable collaboration could result in a 20-25% potential improvement in knowledge worker productivity and that between \$900 billion to \$1.3 trillion could be unlocked by social technologies. We believe that the Crowdsense system or systems like it has the potential to be one of these social technologies.

Unfortunately, mass engagement within businesses is still problematic [5]. There have been previous studies related to micro-blogging in enterprises [6] [7] highlighting the particular issue of “attention economy break down” (in other words, the saturation of human attention by information from different sources) which can form a barrier for organisations to adopt new social medias. The Crowdsense project aims to solve this problem by presenting the most relevant content to individual employees in a form that is easily consumable and with minimum effort and barriers to access.

Crowdsense is differentiated from other communication systems designed for the workplace, such as Trello [8] and Yammer [9] - the system provides a surface for the exchange of information without proactive access by users. Some information is available without authentication or a registered device. More information is available to authenticated users and users that contribute content are rewarded by improved recommendation based on their contribution and activity.

Crowdsense offers fully open communication, together with personalisation/recommendation and integration of social and chain-of-command messages. Existing tools focus on collaboration on individual projects, and are designed for access via personal devices such as mobile phones and PCs. Crowdsense is designed to filter messages and other content using dynamic recommendation that operates on

many factors, therefore it is able to provide a single layer of communication that can in principle go across projects and span very large organisations. In addition, the primary point of access to Crowdsense is via large, touchscreen kiosks which also mark its differentiation from these existing personal-device centric systems.

## 2 What Is Crowdsense? An Overview of the Concept

Crowdsense is a platform designed to increase transparency and collaboration across an organization. It enables users to create and share knowledge about people, activities and projects and provides a system for sending information and requests across an organization to the right people. Messages and other new content are forwarded openly on the basis of relevancy creating open lines of communication. The primary mode of access is via physical touch-screen kiosks distributed in shared areas of the workplace. The kiosks are designed for rapid, ad hoc use and are placed in locations which encourage spontaneous interactions and viewing.

Access is also available via a web browser app (accessible to authenticated intranet users) to accommodate users with different accessibility needs, such as screen readers, as well as those who are based off site.

Both registered individuals and anonymous visitors can actively search all assets including messages, user profiles and project pages; and explore relationships in the knowledge graph. The results of a search are a set of matching interactive nodes, each of which can be explored by touch and browse. The underlying graph layer (see below) provides connections between assets, so that users also can browse to related assets (for example from projects to related people, and vice versa).

The initial requirements for the trial system were distilled from desk research into Interactive Kiosks, a user requirements workshop with other members of the Human Factors discipline in our research department, interviews with employees and evidence from surveys which monitor organizational “health”. The requirements were then prioritized according to technical and logistical practicality and usability.

### Technical Implementation

The client user interface is browser based, and written in HTML5/JQuery. The server is a distributed system of Java servlets backed by PostgreSQL DB that communicate with the client and each other via a REST interface. Each kiosk has a local servlet to cache data and handle data processing with low latency. This provides a scalable architecture. The servlets contain the graph layer which manages the connections and metadata between different knowledge entities (such as user profiles, messages, projects and other general entities.) The system supports the definition of new types of entity on the fly, so that it is not necessary to anticipate every future node that could be added to the data structure.

### Identification of Users to the System

For the current trial, users identify themselves by either presentation of an ID card with unique QR code to the kiosk camera or by typing their existing corporate ID in combination with a new 4 digit pin. (Preferably, the method of identification should be passive to reduce effort by the user, and we are experimenting with facial recognition for this purpose).

### **User Interface – Controls and Content**

Each logged-in user is represented on the kiosk’s touchscreen by an icon/avatar which also functions as a cursor for the user’s interaction with the system. We call these avatars “Personicons”. They are both draggable icons with droppable targets and also have an associated context dependent menu [10]. The assets of the Crowdsense system are presented on the user interface as discrete components, which are also draggable and droppable. Logged-in users can perform actions such as bookmarking an asset, adding a connection (for example the logged-in user can link to a project), initiating a reply or sending a message of interest or introduction to an asset owner. These actions involve minimal, simple touch gestures. An onscreen popup touch keyboard allows text entry where required (such as search strings and message reply text.) We are also working on providing in air gesture control as an alternative to touch control [10].

The current kiosks provide a personalised interface to an identified audience of one (or more) users. When users are registered by the kiosk, the displayed messages and content are personalized using information about them extracted from their self-completed profile such as keywords and biographies. This provides the users with useful information, and the opportunity to become engaged with relevant discussions. Users can view passively, or can interact by posting further messages and responses.

When the system is dormant, i.e. there is no user logged into the system by the kiosk, the screen displays recent and general “floating questions” – open questions and requests for help posed by researchers to their colleagues which dynamically move and are presented in a rolling fashion appearing and disappearing at intervals of 30 seconds. The “floating questions” concept was identified in one of the early requirements workshops, as a way of engaging the research community, who we anticipated to be motivated to display their knowledge to a wider community for the reward of reputation and satisfaction – following the understood motivation of users for contribution to other knowledge systems such as Wikipedia [11]. (The “floating questions” interface has been broadened during the course of the trial to include any succinct message of interest to the research community, for example interesting news and events).

### **Multi-user Capability**

When an audience of greater than one is detected by the kiosk, the possibilities of interaction with the system become more complex. Users can exchange details with each other, or perform interactions which specifically relate to just one of the logged- in users. An example is that one user may show another user their list of stored contacts, and the second user may choose to send an introduction to one of the people in the contact list. This is done by dragging and dropping their Personicons to relevant action boxes on-screen.

### **Anonymous Use**

In addition to personalized use (involving user registration) we allow anonymous access to enable visitors to use the kiosks to learn about the organization. Unrestricted access to view the content is secure due to the kiosks being physically based within an access-controlled site, and being isolated on a firewalled intranet. This has meant that

the kiosks are never used for sharing data which might be sensitive or confidential. Also, we recognize that even basic information such as employee skills or the topics of discussions could have some commercial sensitivity in the wrong hands. We are now making decisions about restricting some data from anonymous users as the trial proceeds; particularly if kiosks are placed in areas outside our secure area. Our planned approach is to provide only a subset of search and browse capabilities to anonymous users, and to provide certain visitors with login accounts for increased functionality.



**Fig. 1.** Small kiosk in use browsing a user profile

### 3 Engagement

For the current trial, we are promoting the use of the touchscreen kiosks as smart message boards presenting messages and other new/interesting content – (ie the “floating questions” mentioned in the previous section) in a constantly updating cycle, to raise awareness in the office where they are located. In the initial phases we seeded the system with messages to stimulate interaction from the rest of the community. As well as posting messages at the kiosks, users emailed messages directly to the system, which automatically identifies and authenticates them from the email headers.

To further stimulate engagement with the collaborative aspects of the system, we sent a welcome e-mail to all 300+ members of the research community, inviting them to complete a profile for the system, which populates the database with their photo, skills, interests and keywords. Because each individual was sent a unique PIN code, the e-mail was sent from the Crowdsense system, using a third party domain which was not familiar to the participants. Despite using the department name in the email subject, and white-listing the e-mail address on the company servers, many recipients dismissed this e-mail as spam. As a result we re-sent the e-mail, after a preliminary e-mail from the director of the research group explaining and endorsing the trial.

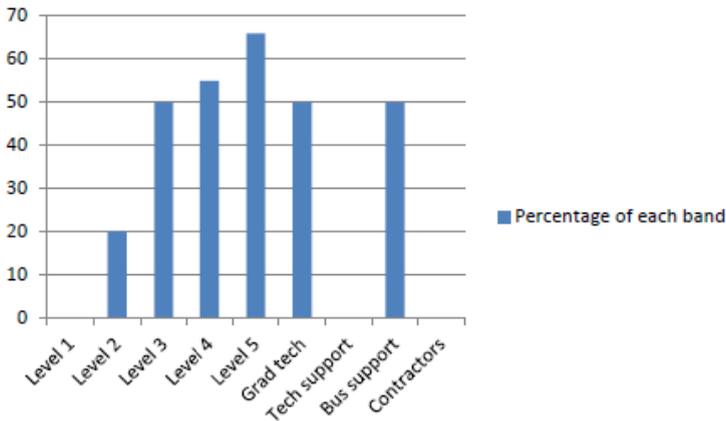
19 people originally completed a profile in response to the first e-mail invitation. After the director’s intervention and the incentive of a raffle prize this number had grown to 56. One month later a second invitation was sent out to people who had not completed a profile. Within a few days 110 people had completed a profile, roughly a 1 in 3 response, including those who work off-site.

We then analyzed those who had filled in a profile to discern levels of engagement against certain parameters - those being a) location and b) level of seniority within the department - which may affect a user’s willingness to take part. We did this to

identify the users most likely to engage with the system and for those who do not, to develop strategies to “nudge”[12] them towards participating. These analyses are covered in the section below.

### 3.1 Position in Company

First, we analyzed numbers of profiles completed by each level of management within the department, and the percentage of these against total numbers per level. Level 1 is the most senior position of management, descending to the non-managerial grades which are support staff, graduates and contractors. (see Fig. 2.):



**Fig. 2.** Distribution of engagement with Employee grade. Level 1 is most senior band, top level management, Level 5 is most junior band (with no staff management duties).

There is a gradual increase in engagement lower down the hierarchy with the most engaged being Level 5 (researchers with no team management responsibilities). This group constitutes the largest group within the research department. Researchers of this group have similar objectives and may be showing a willingness to take part in an exercise which enables collaboration and therefore contributes to the greater good. The highest levels of seniority are the least engaged, even though location is not an issue as these individuals are primarily office-based near to the kiosks (see next section). We can surmise that the nature of work at these levels are more strategy-focussed and less concerned with core research projects to be able to prioritize their busy workload to engage with the system, even for short periods of time, coupled with a resistance to opening themselves to another deluge of information[13]. Even with a prototype system such as Crowdsense within the vicinity, there is still reluctance from some these users to participate. In free-form conversations and from analyzing behavior within the office, lack of time is often cited as the most significant barrier to engagement among senior managers.

### **3.2 Location**

Equal numbers of employees based nearest to the kiosks were deemed to be engaged and disengaged with the system (44 engaged, 44 disengaged), but surprisingly, a higher proportion of those on the same floor, but further away from the kiosks were engaged than disengaged. There were a reasonable number of profiles completed by people located in different buildings to the kiosks and a high level of willingness to engage from researchers in the most remote locations such as London, Bath and the USA – suggesting that the system could play an important role in providing interaction between colleagues based at remote sites, for which full availability of the browser based version of the platform will be needed.

Overall, it appears the most engaged users are those based on the same floor as the kiosks, who are researchers with no team management responsibility. This accounts for around one third of the research community. Future development of the system must try to increase engagement on all levels and all locations and avoid creating a silo around the system (the very issue it is attempting to address). Senior managers in particular would benefit from the personalization features of Crowdsense which minimize time and effort and need further encouragement to engage with the system.

## **4 User Interaction**

### **4.1 Completing Profiles at the Desktop – User Experience**

The completion of a user profile is an essential first step in a user’s journey with Crowdsense. The profile editor deliberately avoids any reference to hierarchical position in the company or job title (this information is held elsewhere in static directory services). Crowdsense consolidates this data from the business directory, and does not need the user to re-enter data that is obtainable from other sources. Indeed the Crowdsense profile does not require the user to specify even which department they belong to. The UI of the profile editor is deliberately simple to complete and very basic at this stage. The elements required of users in the profile were to upload a photo, add interests, bio, “working on” and keywords.

A survey was conducted to assess the subjective experience of the profile completion, using Survey Monkey<sup>TM</sup>. This was sent to the 110 people who had completed a profile. There were 24 respondents (representing 1 in 4.5 of the total). Of these the vast majority of respondents found the profile completion process “easy” (on a scale of – “Very Easy”, “Easy”, “Not Easy”, “Unusable”), which we considered to be a positive result.

In addition we conducted 4 in-depth user journey analyses of the profile completion exercise which highlighted behavioral details which need considering in future iterations – e.g. many employees do not have photos of themselves on secure work-provided computers, meaning sometimes the image they used to represent them was random (4 penguins, a lab coat, cartoon characters etc). Security features also need development – the current system of 4-digit PINS can add to the cognitive load for people who already need to remember PINs for credit cards and network and building access etc.

## 4.2 Operating the Prototype Kiosk – User Experience

Subjective user testing of the kiosks has been, and continues to be conducted in two steps. First, we captured user experience of the participants carrying out simple tasks<sup>1</sup>. Second, we conducted interviews with the participants to understand their motivation, or lack thereof, to use Crowdsense. For both, semi-structured questioning was used. The simple tasks evaluated in the first step included reading messages, sending messages, and searching for people and projects. The questions covered in the interview included deeper questions such as how the participant feels about using Crowdsense in a public space.

All concept tests were video recorded for purposes of analysis. The 27 inch touch screen was set up in a closed meeting room so as to a) not disturb colleagues in the vicinity and b) to allow participants to speak freely about their opinions. This created an environment slightly dissimilar to that intended for the system ultimately, in that the participants were sitting and were not “just passing”, but allowed us to ask more probing questions.

### Participants

For the overall trial, the participant group entirely comprises of employees within BT’s Research department. This participant group was selected as a) many are physically located near to the test kiosks, b) this represented a diverse community of small groups who could benefit from greater collaboration and communication across projects and c) participants in user tests were presumed to be easier to engage and willing to help as fellow researchers. We acknowledge that participants within the research domain have a technical, well-educated bias and are “knowledge workers”[14], but in other respects are diverse in age, gender and specific skills (which range from network analysis to optics to business-modelling), with very few of the researchers involved in any aspect of usability.

From this participant base, we recruited 9 participants to take part in the user experience tests. All were employees but not all were from technical backgrounds. The age range was between 24 and 52, with 7 male and 2 female which broadly reflects the gender difference of the department. One had a physical impairment in the form of a tremor of the right hand. All participants were familiar with touch-screen technology.

### Key Findings

On the whole, the participants found completion of the tasks simple to carry out. Logging on, either using QR code or Employee number and PIN was easily achieved by all. All experienced the system logging out after a short while which was welcomed as a security feature, considering our intention to have the system operating in a public space.

Sending messages, replying and searching were all achievable with little intervention from the researchers. UI features such as dragging and dropping were intuitively handled by all participants.

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<sup>1</sup> This is not a full usability test involving the timing of set tasks, but more of an exploration of the user journey and the users’ overall opinion of the concept.

The consensus was drawn that the on-screen keyboard involving touch interaction was too wide, with the keys too far apart to be completely usable. This infers that the public kiosk is more suited to discovering, tagging and bookmarking. System data indicates that trial participants are using their desktops to e-mail messages to the large screen as a workaround.

Many participants requested the ability to “send” details about messages (such as events, papers or items of interest) to their own e-mail accounts. A web (desktop accessible) version of the system was considered by all to be an important complementary feature to the kiosks.

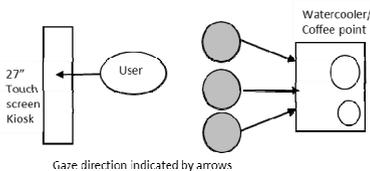
A common point of view was that the system had the potential to address problems experienced in everyday life within the organisation, those being the lack of sharing of knowledge and understanding more about what each others do (a new graduate commented that he did not even know who the people on the next “island” of desks in the office were).

The number of messages displayed at any one time (6) was considered appropriate for the size of screen itself. This is broadly in line with previous research conducted on the presentation of recommendations for TV recommendations which showed this number was between 5 and 7 [15].

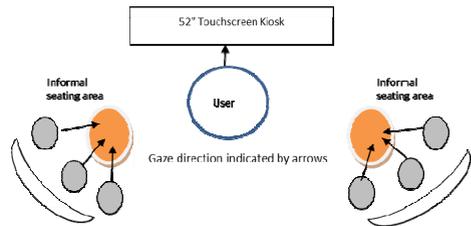
### Size and Position of Screens

The size and position of the Crowdsense kiosks was also discussed in the interviews in the context of how users feel about operating the kiosk in a public space. One kiosk (a 52 inch touch screen, right, Fig. 3.) is located in the middle of a small seating area where people tend to sit for informal meetings and to eat lunch or drink coffee. The other (a 27 inch touch screen, left, Fig. 3.) stands on a raised surface at a kitchen area where there are no seats but where people informally chat while making drinks.

i) LOCATION OF SMALL KIOSK



ii) LOCATION OF LARGER KIOSK



**Fig. 3.** Locations of large and small kiosk

According to user input, for the small screen in the kitchen area, people making coffee are facing the other way, so it feels slightly more private. One user felt as if their shoulders “block” the view – it is “*open and secluded at the same time*”. The larger screen was seen as most useful for the display of important messages, or for multi-touch (multi-user) function, whereas the smaller one was seen as one a single person could use while waiting for tea to brew. We will need to test these ideas further in subsequent iterations.

### **Suggestions for Improvements to the Prototype**

The participants were encouraged to give their ideas for improving the system. These included methods for differentiating different kinds of messages in terms of the message’s age or genre, constraining the message field to be similar to Twitter in length, implement complementary “ticker”-style news feeds for the desktop or Smartphone, and ensure the UI consistent with other touchscreens allowing “swipe” as well as drag and drop. A “network” view which connects nodes (projects) to other projects and people was particularly mentioned as being useful for navigation.

## **5 Next steps**

The authors are implementing the refinements and improvements revealed during user testing with a view to trialing the prototype in other contexts and with other user groups such as field engineers and call centre operatives for whom the sharing of information within the peer network is important.

We are continuing to analyze data on the overall level of interactions with the system to infer patterns of behaviors based on day, time of day, location, level of seniority in the company to make suggestions for enhancing engagement.

## **6 Conclusions**

Our testing indicates a growing awareness of the possibilities offered by Crowdsense, i.e. the breaking down of internal barriers and the opening up of new collaborations. We extended our research into domains such as behavioural analyses (realised by engagement analysis), prototype testing and exploring novel UI features (such as in-air gesture control in related experiments [10]). This we believe gives a more rounded view of the issues and opportunities presented by Crowdsense not covered by usability testing alone, especially with a view to eventual implementation more widely across the organization and beyond.

During the trial of the prototype, we have found high levels of interest and engagement among working researchers, who have persisted with the system despite some technical teething issues in the prototype implementation. There has been great interest from some remotely-based researchers, who see the personal device version in particular as a way of becoming less isolated from the team. The most senior members of the department were less engaged and this is a critical issue to address. We will do this by further exploration of their requirements which will be used to increase “stickiness” of the system and remove barriers to adoption.

Ultimately, with development, we envisage Crowdsense to offer a method for breaking down internal barriers to maximize the power of knowledge and therefore commercial success of organizations, by engaging all its members – which remains one of its most significant challenges.

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