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## VIRTUAL COLLABORATION IN THE BUILT ENVIRONMENT

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### Introduction

Throughout the 2013 to 2014 academic year, three institutions have been collaborating in the education of three cohorts of students through the BIM Hub project<sup>1</sup>; these are Coventry University and Loughborough University in the UK and Ryerson University in Canada. Students formed groups of six individuals, two from each university, including architects, construction engineers and project managers. The project was designed to create an authentic simulation of industrial collaboration and practices. At Coventry participation was optional (students had the alternative of forming collaboration with other Coventry students). At Ryerson and Loughborough participation was mandatory. They were set a project to design and plan a building for a particular site in Coventry through forming online collaboration, and reflect on their experiences. The study was funded by the Higher Education Academy in the UK with the intention of identifying which success factors led to effective online collaboration and is a follow-up to a previous project sponsored by the Hewlett Packard Catalyst Program (Soetanto, et al, 2014).

Focus groups were conducted with the students at the institutions, the following analysis focuses on the issues faced and solutions identified in terms of the technologies involved and the strategies for successful collaboration. The analysis focuses on two of the universities and offers reflections based on their experience.

### Coventry focus group

Five groups of students were asked a series of questions about their experience. Their comments are attributed to each of the five groups, labelled CUA to CUE.

### Technology

#### *Previous experience of usage*

All students except one had used Facebook previously. Reactions of students to the question as to whether they had used it previously indicated the degree to which Facebook is an integral part of the students' lives, with the students at Coventry laughing at the idea of someone not using it, and the students at Loughborough being able to identify the one student who did not. Some had used DropBox in previous projects; none had used GoToMeeting.

#### *Flexibility in use of platforms*

Students moved between platforms in order to optimise communication for example the one group who stated: "If we couldn't use GoToMeeting we would use alternative methods, Facebook anything and it would work it would be pretty prompt, (CUB)" Others switched from platform to platform when communication in one proved ineffective, such as trying Facebook when they got no responses from emails.

#### *Delineation of usage*

Students also were selective about the platforms they used for specific tasks. GoToMeeting was used for synchronous meetings as it meant they could all view applications simultaneously. They all used Facebook if there was a need to get hold of someone from another institution quickly. All also used Dropbox to share materials, apart from one group that shared their documents on Facebook because one of the collaborating partners "filled it up and haven't cleared it out".

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<sup>1</sup> <http://bim-hub.lboro.ac.uk/>.

### *Effectiveness of the platforms*

Participants had different perceptions of the effectiveness of GoToMeeting as a platform:

*GoToMeeting is the main meeting. It's working fine (CUB)*

*We can share the screens as well, and we can show them what we've done, our work designs and rough sketches we have. It's a bit better because everyone at the same time can see it. If we use Skype we can't have a multiple discussion. (CUA)*

The limitation with the videoconferencing was not in the software, but in the hardware that was being used. The hardware provision in each of the universities was held to be substandard on occasions.

*There should be standard stuff for hardware. If you're doing remote working then people need to have good microphones and good webcams because otherwise and better internet connections because some of them have been really bad. (CUE).*

From a software perspective there was also problems with lack of compatibility between packages.

*Compatibility across various products is a bit of a pain. The Ryerson students were using 2013 and I was using 2014 which was a bit of a pain. I had to downgrade. It was just a nuisance really. That's cross-working across different (institutions) (CUE)*

### **Virtual teamworking**

#### *Previous experience*

Although all the students had worked in teams before, none had experience of virtual teamworking before beginning the project.

#### *Rationale for participation*

As noted above, Coventry was the one of the three institutions that offered participation as an option for its students. The students offered these reasons for taking part:

*Interesting to do a project which is essentially the project we've done for the past two years but doing it by a different way. All the lecturers are always raving about you will be working in international teams when you move on into industry so it was a nice idea to see how that was going to work. (CUC);*

*at university we tend to work with the same people all the time, we don't tend to work with people we haven't worked with before if it works you tend to stick with it. (CUC)*

*It's a different experience more challenging. (CUA)*

*CV enhancement (CUE)*

*you get to be the leader, you get to be the secretary - you have different roles. So it's quite good because you learn how to do all kinds of work. (CUA)*

#### *Comparison with face-to-face teamworking*

The aspect of the project that the students felt was more effective than their regular project working was the opportunity to work with students at other institutions. This was felt to be a more realistic simulation of the working environment because this imposed the need to present themselves in an outward-facing professional identity to external people, rather than to friends from within their own institution.

*It's something different, it's new and you don't want to let down the university if anything else. ... it's important because it's not someone we're going to see day in day out at the university here, ... it's more professional we're not yet in the career but it's definitely closer to that than just being with pals at the university. (CUA)*

The disadvantage is the lesser efficiency in working with people that are unknown, compared to people with whom they have already built up a working relationship.

*Those that didn't do it wanted to stay with their mates. They've created their own little group and that's what they want to do. They've stayed in that group for the past three years now. They work more efficiently this way by staying in their groups. (CUA)*

The added effort required by forming new groups for the virtual teamworking was seen as adding more authenticity to the exercise, as do cultural differences described above.

*I know when I struggle when I get a job so I might as well get used to it. I'm expecting it to help. (CUA)*

*At least when you get out into the real life you won't be shocked by what is happening. By what's happening now I'm like "I'm not used to this – oh I have to work with so many people. W so now you have this experience to actually work with someone who (has different practices) (CUA)*

## Loughborough focus group

At Loughborough students also were placed into their groups for providing feedback, these were given the group names LUR, LUG, LUP, LUL and LUB. Feedback was both spoken and written.

Technologies used by students according to written comments

	Listed by	Used for	Why used?	Issues with use
Facebook	three of the four group (LUL did not complete this part of the feedback)	Everything: file sharing, work updates, problem-solving, general arrangements. (LUR)	Easiest platform. Everyone uses it. (LUR)	People not using it enough (LUP). People reading comments but not responding (LUB).
GoToMeeting	all four groups	Meetings: Problem solving, designing – sketchup, updates (LUR). hosting meeting (LUG).	Module requirement (LUR). Told to use it (LUP).	Lagging. Visual issues. Sound issues – feedback. Screen share lag (LUR). Connection/ speed issues. Echoes. Poor use due to not knowing it. Made computer crash (LUP). Good but determined by strength of connection. When two meetings were arranged simultaneously. Determining the host (LUB).
Dropbox	All four groups	File sharing and organisation. Keep track of work completion. Single portal for work storage. (LUR). Used for shared storage space and all access to files (LUP).	Free. Easy. Everyone uses it, Keeps track of work. Good for "live" docxs (LUR).	Wrong formats. Got busy/ cluttered. Dropbox got full (LUR). Not everyone used it. Not enough storage space (LUP). 2 people editing one document simultaneously :-P (LUB).
Word	Listed by one	Used for writing reports		Slow or crashes with documents of

	group	(LUP)		that size (LUP).
Email	Listed by one group	Communication (LUG).		Time difference for response time (LUG)
Sketchup, AutoCAD, AutoRevit, ArchiCAD, Candy	Listed by three of the four groups.	Sketchup used for diagrams/ models at concept stage (LUP). All used for diagrams (LUP). All Drawing/ graphical communication (LUG).	AutoRevit used by Canada (LUP).	AutoCAD Not used by all. Difficult to use (LUP). AutoRevit not compatible with AutoCAD sometimes (LUP). All: Different preferences and competency levels (LUB). All: Compatibility. Training. Ability to use software within group (LUG).

Several things emerge from collecting together the students' feedback to the choice of technologies. The first is the high degree of digital literacy evident from the choices the students make, selecting appropriate technologies for separate forms of communication, for example, social networking sites for fast communication, a videoconferencing platform with application sharing for synchronous meetings and DropBox for sharing documents. The efficacy of their choices only encounters problems when one of the groups used several platforms for sharing documents (seen in the previous section). Similar problems occurred with the design software being used. Not all members of the teams used the same software and there were compatibility and training issues in sharing documents between the different programs. Selecting one program and training all in its use, and selecting specific platforms for different aspects of communication and keeping to them, would both be recommendations for future cohorts of students.

Problems also existed for most of the technologies the students used. The hardware used did not support GoToMeeting effectively, and the processing power of the computers used in some cases could not handle Word documents of the size the teams created. DropBox did not have the storage capacity some groups required, though this could also be due to the students cluttering the folders with too many documents. There is also an issue with the awareness of the constraints of the software used. DropBox does not support two users editing a document simultaneously and GoToMeeting does not allow two different meetings to take place simultaneously using the same account. Building in scheduling and turn-taking into the use of these platforms would overcome these issues.

### ***Learning from virtual teamworking***

The groups were asked about what they had learnt about virtual teamworking from the project. The answers are shown below.

Students said that they had learnt to check understanding at the start ensuring that everyone understands the brief (LUB) and also to check file transferability and ensure all people using same or comparable software(LUB). Teamworking can be improved by

- Getting all members involved by making time to ask each member for suggestions and providing encouragement (LUR). When project planning and forming group agreements keeping it short, simple and clear and doing it together with all person consensus (LUB). This was seen as an essential part of respecting team members; i.e. letting every team member have an input and express their views (LUG)
- Taking control and both showing authority early and defining roles early (LUP).

Students wrote that if they are working in multi-disciplinary teams they have learnt to make better use of the skills of the members of the team (LUR).

Where conflict arises, this can be addressed by

- going back to the brief and attempting to understand it, (LUR) and
- by the team leader by taking charge. (LUR)

### ***Meeting platforms***

Students had two comments about virtual meetings; one of these was that meetings would be more effective if there was a preparatory period of trial sessions and tutorials (described as "try before you buy it!" (LUR). Another

group was dissatisfied with the collaboration being entirely conducted remotely and suggested facilitating more face to face meetings with Coventry (LUL).

### *Value of the exercise*

Finally, students were asked about the benefits and otherwise of taking part in the exercise. On the positive side, the groups said that this was an opportunity to work in multidisciplinary teams and that this enriched their work (LUR, LUP, LUG) and also that it gave them experience of international working (LUB, LUP). The project also gave them a chance to learn management techniques (LUB) particularly with larger groups (LUR) requiring clear communication (LUP) to a higher standard of work (LUR). This last point was also identified by one group (LUB) which echoed a statement by the Coventry students above, that they were working in a more professional environment because they were not working with their friends.

Finally students overall found the module forward-thinking and exciting (LUR) with benefitting their CVs (LUG). On the negative side, students felt frustrated both by the technical issues (LUR), with students feeling that less trust should have been placed in untested software (LUP, LUG). Issues were also raised about the problems with having to rely on other students that were not reliable (LUP, LUL, LUB) and the waste in time due to meetings not being conducted properly (LUP). Some felt if they'd been able to choose the students they formed teams with, this would have been an improvement (LUB).

Finally two of the groups (and in a quick poll, this was the opinion held by about half the students in the class) stated that "SCREENS ARE NOT ENGAGING (LUP)" and "I still believe face to face meetings are key to success (LUL)" i.e. that conducting teamwork entirely virtually is not effective in itself and that effort should be made to enable face-to-face activity to take place.

### **Conclusions from the study so far**

The above study only accounts for two of the data sets that are being accumulated from the project. Of these data sets the following conclusions can be drawn about the use of technology in virtual collaborations.

- The students showed high degrees of digital literacy, selecting specific platforms to achieve specific tasks, and moving fluidly between them to achieve the desired results. For quick communication all of the students used Facebook, of which all but one of the students was a user. Some had used Dropbox for previous collaborations at university. None had used GoToMeeting before.
- GoToMeeting was successful as a platform for holding meetings from a functionality point of view, however the hardware on which it was run was not robust enough to be reliable, with audio, video and connectivity problems being common. Using Dropbox to share documents only led to a problem when it became filled up due to lack of effective clearing out from partners. The digital literacy demonstrated by the students only broke down for one group in that they used multiple platforms for sharing documents which led to fragmentation and confusion.
- In future, it appears that students have the literacy to make their own choices concerning which software to use for communication. Facebook works effectively, as would GoToMeeting if hardware was available of a competent specification. One student suggested having dedicated machines for videoconferencing that could be optimised for audio and video and made available specifically for the module. The other issue is booking more than one meeting simultaneously on one account leads to problems. Booking one machine and one GoToMeeting "room" for meetings would avoid both of these problems.
- The other common issue across most of the groups was the lack of compatibility between different software packages. Ideally the highest standard and most recent version of the design packages would ideally be used, and students at all institutions trained in its use. This however will shortly be less of a problem if all design packages move towards a single industry standard.

All of the participants had experienced teamworking before, but none had experienced virtual teamworking. For both the students for whom the exercise was optional and those for whom it was mandatory, the same benefits and issues were perceived. These were:

- Working in international teams
- Working in larger groups
- Working in multidisciplinary teams

- Working with people from outside the institutions and therefore having to present a “professional” persona.
- Working in different roles (in those collaborations which enabled this).
- CV enhancement
- Greater authenticity of the exercise

Finally, the resistance of half of the Loughborough students to the notion of virtual teamworking at all is of interest. As observed in previous studies (Childs and Peachey, 2013) resistance to virtual teamworking is not observed when students volunteer for the task, however, when the exercise is mandatory the cohort will include many participants for whom the idea of working solely at a distance is an anathema. It is frequently observed that there is a minority of people for whom experience on screen is not seen as authentic or sufficiently engaging, and the question remains to the extent to which this preference is accounted for in the design of learning activities.

## Summary

Overall the exercise was seen as an extremely valuable one in terms of providing an authentic experience of multidisciplinary international working and the following observations can be made:

- Students showed a high degree of digital literacy in selecting appropriate technologies for appropriate tasks.
- GoToMeeting was adopted successfully by the students, but hardware failures prevented its full use. Having a dedicated and specifically set-up piece of equipment with which to conduct the meetings which has undergone thorough testing may address this problem.
- A single portal for sharing documents may also address some of the issues that students had with storage limitations of Dropbox.
- Compatibility of software was a problem. This may be alleviated by all software adopting an industry standard.
- A proportion of students in the mandatory cohort showed the same resistance to virtual teamworking as noted in previous studies.

The study will continue to gather data on the students’ experiences and these will also be presented at the EDEN conference in June. The long term goal of the project will be to develop these findings as guidance to the conducting of online collaboration to the education sector as a whole, and to draw together the students’ experiences as a user needs analysis from which to develop a technical specification for a platform to support virtual collaboration in the education of building engineering students, and perhaps the industrial sector as a whole.

## References

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