Evidence Supporting Guidance Notes

The guidance notes for online collaboration for design given on the BIM Hub website are based on qualitative data gathered from 18 months of data collection from students and staff from Loughborough, Coventry and Ryerson universities.

Data were gathered from three data collection methods.

Focus groups with the three universities. Two of these were structured conversations with students, those with Loughborough were structured conversations with additional feedback in the form of flipcharts.

Personal reflections from students. Students from all three universities were assigned the task of writing personal reflections. A random selection of these from Loughborough and Coventry were selected for analysis, all of the Ryerson assignments were analysed, as these were fewer in number.

Analysis of video recordings. Students selected one video recording of their GoToMeeting meetings for submission as a document of their process. These were viewed and analysed and observations led to guidance notes for online synchronous collaboration.

These three methods enabled triangulation of data of the experience of online collaboration, and indicated that all three methods were producing similar sets of data. The second and third analyses were done later in the process of the project, and so could be written with references to the specific guidance notes they led to.

The evidence is presented here so that anyone interested in the analysis that led to these pieces of guidance can view the students' statements. The original data are not available, as in their unfragmented form they may enable the students' identity to be deducible. Where, despite the fragmentation, individual students' identities are deducible, separate permission has been obtained to include the statements.

1. Analysis of data from focus groups

Introduction

Focus groups were conducted at the three institutions, with Ryerson University via GoToMeeting and face-to-face at Coventry University and Loughborough University. At Coventry and Loughborough, students sat in the groups in which they worked. The Coventry students were asked a set of questions and were engaged in a conversation as a group, the Loughborough students were asked to fill in flipcharts based on a set of questions, then fed back their answers to the group. Coventry groups are identified by the letters CUA to CUE , Loughborough students by the letters LU followed by B, G, L, P and R.

Coventry focus group

Lack of communication between staff at institutions

Students felt that the briefing they had received from their tutors was inconsistent, with different institutions having been given different instructions and different information. This was attributed to either breakdown in communication between lecturers at different institutions or misunderstandings by students.

> *some misunderstandings about the brief. Some misunderstandings because each group has a task to do and some people don't understand or they don't have the right information. CUA*

There was also a perception that there was a lack of clarity about what was expected from them as far as assessment and grading was concerned. Those students who felt they had worked effectively were surprised by how low their marks were. This also seemed to be a miscommunication between staff.

> *Everybody was expecting an A and because everything went so well and the calculations were spot on and the work was so good and it was a bit of a contradiction in marking with one professor saying it was complex and another saying you didn't have enough. It was a little but upsetting when we got the mark. CUB*

Communication between staff and students at the separate institutions was thought to be very efficient however

> *The communication in here was good, so every time we needed guidance he was giving us guidance and telling us which direction we should go and the people from Ryerson, Canada were saying that their communication with their supervisor is pretty good, so I don't know where the discrepancies are coming from. - CUB*

Matching of schedules

The difference in schedules of modules caused problems in planning and delivering workloads

> *We did actually just have a problem with just the timing of the project itself because the Canadians doing the architecture obviously it's the first part, but they had their midterms in the first couple of weeks so we couldn't really progress with the project until about a week ago, so it just held everything up because they're the first stage. We were at that stage but they had to study And now it seems like we have just over two weeks left before our deadline and we don't have any complete designs, we don't have any calculations. We're going to struggle to finish, basically and this is partly because they had exams and then coursework and couldn't come to meetings because they had other things to do. . - CUE*

Commitment of participants to the collaboration

There was a perception amongst some groups that others in the collaboration were not contributing effectively, although some students were self-aware enough to admit that they also were not contributing effectively.

> *It's mostly about commitment at this point. Not everyone is really committed to doing their tasks and following deadlines. This is Loughborough and me. – CUA*

> *For us it wasn't great to begin with but everything seems to have sorted itself out now. We couldn't get in contact with our Canadians. By any methods whatsoever, by emails by Facebook we couldn't get hold of them by any emails be it university or personal accounts. - CUC*

Other groups found that it was working effectively from the start and the collaboration was effective.

> *It all went smoothly from the beginning… Whenever we had an issue it was always easy to approach any of the teammates, whether from Loughborough or Canada, for us, and we would always get a response straight away. CUB*

As with previous projects, these failures in communication led to a breakdown in trust between the participants.

> *we couldn't get hold of them by any emails be it university or personal accounts. This went on for about a week and a half and then afterwards the Loughborough students complained to their supervisor and we complained to Steve but the Loughborough professor sent an email to the Canadian person and they got an angry email and one of the guys screenshot it and sent it to me and said you should stop complaining about it if you've got something to say you should say it to our faces – CUC*

> *you point it out to them and they don't get back to you and that's the problem we had - CUE*

Some students expressed dissatisfaction with the level of the collaboration due to the poor collaborative attitude of their colleagues

> *It's about them only caring about their own role rather than the whole team. The tasks have been allocated they're looking after themselves first and then the team second rather than focusing on*

> *achieving things as a team. They're just assuming we'll come up with a structure rather than us caring about how it's going to look. – CUE*

This was compared, by some of the groups, to the highly collaborative nature that the groups internal to the universities displayed.

> *clearly (working towards only your own goals) because they told you they're expecting you to do it. It's the same for us whereas splitting "you do something, we do something" we just sit down all three of us from Coventry, and look through each of the design and make it work.. – CUB*

There were also different attitudes to the nature of the collaboration that was intended, some students in the teams feeling that they should divide up the roles according to experience, others in other institutions thinking the roles should be divided along institutional lines. This also was due to different perceptions in the cultures of the different institutions and what were their relative strengths, discussed further below.

> *We tried being a bit more collaborative in the beginning, we split up the roles based on personal experience rather than what the intended role of each university is, but we were more than over-ruled. All of us had done a very similar project last year so we all had experience of all the different bits and pieces that were involved in different phases but our experience was just washed away. Loughborough decided that they had more experience in their degree of doing more of that so they assumed they would be doing more of that automatically and we wouldn't have a hand in it. Other than just spellchecking. We're the maths monkeys and they're the management. -CUE*

The lack of high levels of collaboration did not always translate necessarily to lack of consideration, merely that the groups had divided up the workload initially and thereafter paid little interest in the others' work.

> *They did consider when they did the design to make sure it's not too difficult in that we can do the calculations in one day or two days - CUB*

Management of meetings

Some groups did not use meeting management techniques effectively, for example, reflecting within meetings to clarify understanding and noting down action points.

> *Some students don't understand what they have to do exactly. Even if the information is somewhere from out of the meetings, they didn't write it down or they forgot it. CUA*

> *For example we posted on dropbox a shared folder we have an excel file with all the areas required for extension and we told them during one of the meetings but they weren't aware of that two weeks after. They did something similar but not as complete as we did. CUA*

Management of deadlines and matching to competing demands at the different institutions was made difficult by the different module schedules described above, but also was exacerbated by poor project management, with planning intermediate deadlines and workflow timing.

now according to the schedule that they (Loughborough)'ve got for us we've only got two days to do the calculations. How can we do the calculations in two days? - CUE

Planning workflow also revealed issues in lack of management skills, in that the sequence in which information needed to be set out was not fully thought through.

we've got to put together a materials list when we don't know how we're going to construct the building because no-one's given us feedback on our construction. - CUE

Others displayed poor management of the technology, for example not checking their emails regularly.

There were also failures in the basic management of international working with respect to working across timezones, particularly with daylight saving ending at different times in the different countries.

You have to remember to tell them that the clocks have changed. - CUE

Cultural differences

Discrepancies in the cultural approaches were seen in several capacities. One of these was in differences in approaches to conducting the work.

the Loughborough people are taking their long way round things now. They keep trying to extend it and we don't have much time left. – CUC

There were also seen to be differences in the way that they had been taught, which influenced their knowledge and practice.

they study almost the same things the same area sort of, but they have different ways of teaching, learning. We have different ways so we just try to combine. – CUA

Cultural differences between the disciplines was also being surfaced by the activity

With us the architects have been putting across designs where they really haven't thought about how practical it is for the structural side of it. And then when we put p some designs that suggested ways of getting around it no-one's responding they just seem to be interested in doing internal stuff they're not really trying to think about how it's going to look on the outside. We're tyring to get feedback on it but they're just "that's structure stuff so you guys do it and once you've come up with a way to do it then just show it to us". – CUE

Another difference in attitudes was perceived to be due to the virtual teamworking aspect of the activity being mandatory at two of the institutions and optional at the third (Coventry) as there the students had the alternative of working in collaborations with other students at the same institution. This led to the observation that this may have led to the students who were compelled to do it not being as motivated.

I feel that one of the main reasons was a lack of dedication to the task from the Canadians. That's how I felt. I thought it was because we were allowed to choose to be part of this and it was a part of their

course to be part of it whether they wanted to be part of it or not whereas we wanted to work on this project. I could have chosen to be part of it with my roommates but I chose to do it. –CUC

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 turning and laughing at the one student who did not (without him needing to answer the question – apparently his abstinence was a common source of amusement amongst his peers). 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

> *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, for example, 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".

Effectiveness of the platforms

GoToMeeting

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 limitations 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 webcameras because otherwise and better internet connections because some of them have been really bad. – CUE*

Students identified that each university had issues.

> *We still have the same issues with Loughborough students they still have really bad connection, Whenever we have a meeting, within 10 or 15 minutes either we lose the sound or the picture. … The computer that our Loughborough students are using they seem to it was breaking down, because it crashed half way through one meeting and it crashed every time they shared the screen it happens. – CUE*

> *here in the library for example we tried to have a meeting in one room in the library we couldn't make any sense of the conversation. I kind of expected the internet connection to be 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, one of the three institutions offered participation as an option for its students. CU 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. Every two weeks we decided to change, so someone is the leader someone is secretary someone else is something else or whatever. So everyone gets to experience how you have to act in these sorts of situations. - 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.

> *surprisingly (previous face-to-face teamwork) did not work as well as this. You have to do more work in your own office back at home but it feels like there is so much more information flowing through despite the fact that we don't see each other physically. I the previous years we had teamwork but we were seeing each other more often during the week but t wasn't as efficient in the project itself in delivering the goods. …. I think it's the extra motivation. It's something different, it's new and you don't want to let down the university if anything else. As in yeah ok if something is particularly expected from you, like they expect us to do the calculations and do the structural aspects of the project we want to make sure that we do that to the best of our abilities and at the same time contribute as much as possible in the other areas just to show involvement and just to show commitment to the project itself. And it just scores you extra points, and it doesn't matter for your grade but it matters for the way the teammates perceive you and it's important because it's not someone we're going to see day in day out at the university here, it's someone from somewhere and we assume they are just as well committed to the project as we are. It's just mutual respect, I suppose. 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 written feedback

A focus group was conducted with the Loughborough students in which they were asked to answer a series of questions (listed below) in groups on flip chart paper, then feed back their answers to the entire class, which generated a discussion. The data gathered from the students therefore comprises two forms, the written feedback from the flip charts – discussed in this section - and a transcription of the discussion – discussed in the following section.

Issues with the project

Loughborough students were first asked to list the issues they had encountered within the project. The responses were:

1	lack of coherence between lecturers at the individual institutions Poor communication between staff
2	information issues: lack of clarity in brief; disbanded info (the old brief) Unclear aims for module Conflicting coursework briefs Unclear brief caused confusion. People had different briefs
3	Peer assessment bias
4	Uneven timetabling, Ryerson started 2 – 3 weeks before Time zones and holidays including reading weeks
5	Submission problems
6	Lack of interest in lectures as they were monotonous
7	Technical communication issues: sound, visual, connection Software/ IT issues Software GoToMeeting crashing
8	Terminology
9	Completed documents disjointed. Some on DropBox, some on email + FB
10	Teams split to relevant competencies
11	Different work ethics between unis
12	Contradicting priorities in terms of ideas for working structure Conflicts/ differences of opinion
13	People failing to complete on time
14	Non-attendance at meetings
15	Punctuality Punctuality of team members
16	Claiming work is done when not.
17	1 way communication and lack of responses
18	Illness

Institutional issues (1 – 6)

The students' feedback reveals a range of common responses. Two of the most common observations were the lack of communication between lecturers (2 groups) and the confusion over the variation in briefs given to the students in the different institutions (4 groups). Other institutional issues students faced were peer assessment bias, that students were not accurately giving peer assessment marks but were unduly influenced by friendship or desire to mark down others, mismatch in schedules and complications caused by reading weeks, problems with submission of assignments and lack of interest in lectures as they were monotonous.

Ideas to resolve these issues were for lecturers to meet more regularly and thereby improve communication. An impractical suggestions to address the problems with scheduling were for all institutions to start at the same time, since institutions do not have this flexibility. A solution to the communication issues concerning the brief was to create a single portal where all information could be shared. This is eminently simple and practical, since all tutors and students would be viewing the

same materials and so therefore could observe where messages were going out that were different to their perceptions and could be challenged. This would also provide a common repository for all materials relevant to the students. This was also suggested as a resolution to the submission problems, everyone would know the date of submission and be able to have a single working place to submit them.

The suggested resolution to the problem of peer assessment was to "Remove PA – any issues go directly through lecturers" Indicating that their view of peer assessment was as a punitive resolution to issues of non-performance rather than to encourage reflection and support peer learning.

The monotony of the lecturer was seen as a lack of experience by the students, though they did not make the distinction as to whether this was lack of experience of teaching per se, or of specifically teaching virtually, which requires a different set of techniques and can therefore be difficult for even experienced (face-to-face) teachers.

Technical issues (7)

Four of the five groups said that they had issues with hardware and software issues. The sound, visuals and connectivity associated with running GoToMeeting meetings was considered to be one of the biggest problems. A suggestion on how to deal with that was to set up a single piece of equipment to host the meetings, and to ensure that it was working properly.

Cultural difference (8)

Only one of these occurred and this was that of different terminology across the different institutions. Even clashes in terminology such as whether a floor is a second or a third floor can cause confusion. The students did not offer a way to resolve this.

Management (9 and 10)

Issues to do with management of roles and activities were also in the minority; how to divide up roles – whether along individual competencies or along institutional lines was a recurrent issue. The issue of storing documents was only encountered by the one group, all others only used DropBox. However, due to participants exceeding the storage restrictions in Dropbox this group began exchanging documents through Facebook and email, leading to a fragmentation of their documentation. Their solution was for the project to provide a centralised portal for students to store their work. There is also a teaching opportunity; to teach students to manage folders and documentation properly.

Collaboration issues (11 to 17)

The majority of issues were to do with the lack of collaboration between the three institutions. These were all basic failures of professionalism and displays of work ethics, including failure to complete work, non-attendance at meetings, lack of punctuality, failing to respond to communications and lying about completing work. Only two of the five groups (LUG and LUP) reported these issues however. The only suggested solution to these issues was to "improve communication". LUG and LUR reported disagreements about the work, their resolution was to

allow all people to express their opinion before compromising and moving on, but LUG noted that a member of the collaboration "consistently had different views".

Technologies used by students at Loughborough

	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 Bart's 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 group	Used for writing reports (LUP)		Slow or crashes with documents of 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.

Teamworking

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)

Some students had also found how to use Building Cost Information Service and recommended using this service early (LUP).

Managing meetings

The students had also learnt a lot about managing meeting. Comments along these lines included:

- Students learned several lessons about scheduling meetings, i.e. to plan in advance and share timetables in order to compensate to schedule a meeting across timezones (LUR, LUP)

- Importance of time keeping, i.e. turning up to meeting on time. (LUG)

- Ensure all parties have the correct information. (LUL)

- Ensure communication is clear by checking understanding through feedback from comments. (LUB)

- Not letting meetings drag on by agreeing what to discuss in an agenda. (LUG)

- keep records, and agendas and minutes for meetings (LUB)

- agree work to be completed by next meeting. At the end of the meeting agree work team members will complete for next meeting (which is then the agenda for the next meeting) (LUG).

Trust in team-building

Trust appeared to be an issue for some of the groups and they had developed different techniques for establishing it or maintaining it.

One of these techniques was to develop an instinct as to people's reliability when first encountering them (LUP). Another was to be selective about whom to trust (LUP).

Issues also arose because of failure to complete work, or it not being completed properly. Solutions to this was to check everything and have quality assurance (LUP) and to actually see the work rather than take others word that it is completed (LUP) as well as to do this repeatedly (LUL).

The students also recommended that group members set simple tasks at start to identify whether their team-mates are likely to have any issues with reliability or laziness (LUB) and so that these issues can be addressed early (LUB).

Because of the problems caused by delays in work completion cause problems it is also best to have a contingency plan (LUP).

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 lack of clarity in the brief (LUR) and in the technical issues (LUR), with students feeling that less trust should have been placed in untested software (LUP, LUG). The focus of the lectures as a purely information transmission model also was seen as a disadvantage, echoing a previous statement about their monotony (LUR) and some felt that aspects of the lectures had wasted their time since their role in the structure, design and planning had not been clear (LUP).

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.

Loughborough focus group feedback

Lack of communication between staff at institutions

The Loughborough students exactly echoed the opinions of the Coventry students with respect to the variance in the information they were getting from the different staff at the different institutions.

> So issues we have is lack of coherence between the lectures and the individual institutions. So I'm not sure that everyone experienced it – that one lecture was telling you one thing and at another institution were saying another thing. These are slight issues we need to iron out. Possible resolutions: possible ongoing meetings for the lecturers as we are doing ours.

The solution the students proposed was to have a single portal, so that any difference in the information would be highlighted, as everyone would see the same information, and therefore any conflicts would have to be resolved to the satisfaction of everyone reading the discussion board.

> the lack of clarity in the brief; we don't have the exact information of what was provided in the first weeks, we kind of lagging behind in what we need to know. Resolutions: centralized web based portal for all the information. What we are talking about is a discussion board, when one guy asks a question, we all find out the answer. So that it would come out to everyone and everyone is in the same boat.

Issues with scheduling of timetables

Like Coventry students, Loughborough students also took issue with the mismatched schedule, as Ryerson started earlier. They felt this put the Ryerson students in a superior position, as they were more familiar with the task although they had not begun it.

> Uneven time tabling: when we first came to starting the module, Ryerson had already done it for a couple of weeks. So they had good instruction and were ready to crack on, it meant that we were in the dark. It was easy for them to take control, while we were a couple steps behind. Resolution: start at the same time.

This also applied to matching the timetables for the tasks with internal timetables for lectures, in that these also were unsynchronised. The students felt that the content of lectures was important in helping them finish their tasks, so care should have been taken that these took place before they were needed.

> There were issues because we didn't have full information of what we were doing and we were waiting for the lectures and they were lagging so we lagged on

Issues with technology

Reliability of hardware

As with the students at the other two universities, the students at Loughborough found that the hardware available to them was not adequate, both in terms of the machines available and the bandwidth. Having a dedicated machine was seen to be the solution for this.

> *technical issues in communication, sound, visual and connection. One day we could hear them, one day we could see them, one day we had to call if off because the connection was rubbish. Resolution: guarantee optimized platform, chose one computer and stick to it*

> *What we found is that we used the same computer at the same place and we didn't have a problem on our end, but when we tried to connect with Coventry and they were using a different computer we knew that the meeting wasn't going to work. And we would ask them to stay on the same computer the one that worked and sometimes they did and sometimes they didn't. and when everyone used the same computer it was fine. it seems that Coventry has a bad connection. That's a location issue, not a software issue. .. but the entire point is that it shouldn't matter what computer you use.*

The final point is a good one; the project has thrown up the issue of the hardware support, and bandwidth available is not sufficiently reliable in universities to ensure communication can happen anywhere. Having dedicated machines is a solution in the short term, but this does seem to indicate a widespread overhaul of most facilities at universities is overdue.

Advantages and disadvantages of different software

The students used five main platforms for communication; these were email, Facebook, DropBox, GoToMeeting and Skype.

On the whole Facebook was used for communication, DropBox for storing files and GoToMeeting for synchronous communication.

> *We used facebook (**to plan meetings**) and it's easy to upload photos and documents and you know who's seen it. (However), there's no filing system so if you upload too many documents you lose track of them.*

The issues with organising documents led most students to use DropBox for this activity.

Students used both Skype and GoToMeetings as, although Skype was easier for basic communication, most of the meetings also required people to share desktops (the "computer takeover thing").

> *Skype was smoother. We didn't have too many issues with it. (GoToMeeting was better) because you can do the computer takeover thing and you can only do that with the Skype Professional version which no one has because you have to pay for it. We used it (desktop sharing) 2-3 times but it worked really slow when you do the takeover thing*

The students also reported some problems with learning to use the desktop sharing aspect of GoToMeeting, suggesting that they should be given some training or a short guide to its use.

> *For the GoTO meeting it would be helpful to have like a quick introduction that tells you how to use it. Like, I'm quite good with Skype and I know how to use it from work. But not quite understanding the sharing your screen and stuff. It would have made it easier. just an introduction of how to do it. have something simple like 2 minutes.*

They also reported the problem with echo, indicating that the use of headphones to prevent this is not a normal part of their use of videoconferencing, and had not occurred to them.

> *I think the problem is having speakers on full blast right next to the microphone because you have an echo.*

Loughborough students also focused on the problems with lack of compatibility of the different software used at the three sites. Their comments very closely compare to those of Coventry and Ryerson students although they also note the lack of compatibility where they had expected different packages to be interoperable.

> *We used Sketchup, and AutoCAD and Revit, guys in Canada use Revit and they said they wouldn't be able to do some drawings. I was using AutoCAD and I was trying to get them to put it into Revit but they said they couldn't because it wasn't compatible. So this was a bit of an issue since I've never used it before. I had an understanding was that everything in AutoCAD was like Revit and was more updated and an extension. So they should have been able to take the standard AutoCAD and open up in Revit. But if you had told me that in the beginning I would have done everything on Revit and learned how to use with a bit of help from the university so that you can then use these files rather than the day before you say it's not compatible. It was .. things were not … so it looked uniform .. so you spend the next 4 hours to make it look the same when you didn't know whether you were using the same program.*

Issues with collaboration

Communication problems

The Loughborough students identified problems with communication with other team-members.

> *We've had problems in communication and unclear aims.*

> *One way communication was a problem. Like we said things and we didn't get much back.*

Commitment to deadlines

The Loughborough students identified issues with other students not providing their work on time. The Ryerson students were identified as more problematic in this regard than the Coventry students.

> *People complain about things being done on time. Mainly Canada. That was a bit of an issue. So we put immediate deadlines.*

> *The difference in work ethics was a bit of an issue, we found that we worked a lot harder than Canada did. I don't know if Canadians are really good, just between students we didn't know how to solve it.*

> *Claiming work was done when it wasn't was a problem.*

However, in this regard (see later) Ryerson students stated that the tasks were initially loaded heavily on them as they were design tasks, which may have contributed to this impression.

Opinions differed as to whether it was Ryerson or Coventry students that were most different in their commitment (none identified Loughborough students as the least committed). The consensus was that generalisations about standards at other universities may not be appropriate, this was more a factor of individual differences of students.

> I think everyone's standard of work is different. And we found that Ryerson had similar level of work to us whereas Coventry was disrespectful. So maybe that shows the difference in how they and we are taught and the different level of standards. (*Is that across the board or the people you were with?*) I think it might be slightly, because our C. students were better than Ryerson students.

As an aside, it appears that far more collaborations in this study encountered problems with collaborations than in previous studies (which involved only two sites). This is numerically accounted for simply by the factor of more students being involved in the teams, and so the likelihood of teams including non-performers is raised. Other factors may contribute however.

The students were asked if meeting the final deadlines would have been easier if there had been interim deadlines for the intermediate tasks. The students agreed that this would have made scheduling and completing on time easier, but resisted the idea that these interim deadlines should have been set by tutors, insisting that this area was their responsibility.

> I think that's something we should be able to organize by ourselves, which we did. It was a bit of an issue because we would set deadlines and then people would just miss them. Like, you know, we managed to set them up but it would be people not doing the work as promised and missing the deadlines. (*So you think this should be an integral part of what you do?*) Yes

Attendance / working across timezones

There were issues with attendance at meetings. This could have been a problem with lack of engagement with the task, or, it was suggested by one student, that this was a continued confusion about timezone differences. Familiarity with working across timezones is therefore a skill that is not to be underestimated in its importance and difficulty for students.

> our meetings would be at 4. But because of the time zones there was a bit of issue in that so just improving communication.

> Nonattendance to meetings and say that we are all going to meet up at 4pm on Thursday and someone would not show up again, again and again.

> Same with the punctuality problems.

Issues with assessment

Weighting of marks

One of the reasons attributed to the difference in motivation between the three sites was the differences in weighting of the module. The Loughborough students felt that they were less motivated to contribute because the final marks were worth a smaller fraction of their overall marks for the year.

> *Another thing that affected that was the actual weighting for this module between the universities was different. I think this is work a 1/3 or 1/6 of their entire year while for us it is only 1/12. That, in terms of work, and their view on people's input affected that massively. And I think for Canada their commentary was worth 20 comments.*

> *The marks were not reflective of the tasks that were being asked of you. The structure analysis was worth practically nothing, for instance. So they were not reflective of what we were doing. So that needs to match up.*

Peer assessment

Students felt that the peer assessment part of the process was inherently unfair, since students could unfairly bias the marks by voting for the students at their own location, and voting up those at other locations if there had been conflict. The trust issues that can arise within collaborations could therefore manifest themselves in the grades they receive.

> *Peer assessment bias: it's difficult because we, in our group, said to Canada will give everyone 100% because everyone put as much as they can, no matter if anyone let down, we gave full marks. But we definitely didn't receive thing from Canada or what not. So remove the PA system, that's my advice because it's easy for someone to get on the computer and because they didn't like him they marked him down.*

> *even if someone is there 100% they can still click 0% for them. And that happens a lot. (Interviewer: really? So they actually lie?) Yeah that happens in all peer assessment.*

A proposed solution for this was for peer assessment to be a group exercise in which all the participants in the group jointly identify a mark each person in the group deserves.

> *The group should come together and be like – he deserves 90, he deserves 100%, and amongst themselves they decide. And if they have any problems then they go to the lecturers and say to them "we've got issues; we'd like to give this person 100%, this one 105%, etc."*

An alternative means to judge each individual's contribution was to track their contribution to the shared drive where materials were stored. Although this takes away from the concept of a shared group submission, resentment about peer assessment from some students was strong enough for them to consider this as an option.

> *When you hand in your work you hand in what group X has done. It's one group's work. But it would better if you could get each place to upload the work they've done so you can see how much each*

person has contributed and that will take away from the peer assessment. So lecturers can see that 90% of the work was done by these 3 and 10% by this person.

Issues with task allocation

The problems with allocation of marks described above also factored into a sentiment expressed by the Loughborough students that the assignment drew unevenly on the separate skills of the constituent members of the team and that this left them at a disadvantage, and often without a clearcut role in the project. This meant firstly that there were more marks allocated to the design aspects, which were not seen as their remit, either by the students themselves, or by other members of the team.

> *We felt that we had little input, and most of the marks were on the design and none of us are designers. (**and it was mainly the Ryerson people doing that?**) Yeah, and we have to find a way to motivate ourselves to get into the design aspect of things and some people found that motivation and others didn't. And some people were not allowed to by the way.*

> *Yeah, and also the mindset that we should be involved in the design but we wouldn't go into the architects' office and tell them what to do. So you work together collaboratively but to a certain degree and we wouldn't be responsible for it.*

The difficulty faced by the students was particularly that their specific skill set was to project manage, and to have enacted this would have given them a leader role in the team, which was seen to be against the preference of the other members, which was to share in this role (see comments by Coventry students above).

> *Our discipline is management rather than design. I know we should have the insight, but they are architects and they've been doing it for 5-6 years. And designers design, and contractors construct, and we feel that we were overseeing it and we were also organizing the group and that is effectively what we are going to do in the future*

Loughborough students also resisted the role of having to supervise the others' work as it was either outside of their experience *"Another issue, was checking work – we are not engineers and we get a whole sheet and a calculations breakdown. I don't know what's right or wrong."* Or they saw it as outside of their remit *"Simple things, I found myself spell checking Ryerson's work. Why should I have to waste my time doing that?"*

Learning about teamworking

The students were asked to summarise what they had learnt from the exercise. Their responses were:

- Teamwork: we learned how to schedule a meeting, pretty basic but makes sure to ensure a time works for everyone.

- How you use PCIS and it was pretty late when we learned to use it but we think it's a great software for producing an average price for everything
- How to use Adobe Pro
- Don't assume anything, make sure you check everything. Make sure you have quality assurance checks.
- Trust, choose wisely who you trust. In general, there are few people who will meet you at your expectations and are at the same wavelength as you
- Show authority early. You expect someone else will do it, but in the end we will have to control things. I think there are no definitions of roles in the projects. So in the future, perhaps, we should include that and that will improve the project and say 'you are the project manager" and you say when you want things and by what deadline.
- Contingency deadline; if there is a delay in work make sure there's a contingency plan which we didn't have.
- First impressions are usually correct. Develop your instinct. If you think someone is lazy, he might be lazy.
- Progress meetings; in a progress meeting don't take peoples' work as solid set in stone because generally people lie. So I have to say the word. We all lie but make sure you chose wisely.
- Project group planning; the group plan we did – it would be better to do a 2 page document. You end with a 12-15 pages risk assessment document; no one cares about it. But if we had 2 double sided A4 which everyone had committed to it would have been easier and you would have a shared agreement and consensus.
- We had laziness and attendance – we said address the issue early. Maybe start with simple tasks to make sure everyone is committing something so you know where to stand, like a 10 minute task and see who does it and who doesn't
- File transferability: ensure everyone is using the same compatible software.
- Understanding the brief; maybe sit down as a group – share more and try to create something – like a tangible output and a group understanding of the brief.
- Ensure that communication is clear – check understanding and have records.
- Keep records and meeting meetings and agendas and the more regular that becomes the easier it is to be accountable.

Ryerson focus group

Issues with technology

Ryerson students also experienced issues with the technology in terms of the hardware and bandwidth not being suitable.

> *So far so good. More technical issues than anything. We just experienced it ourselves with you. With GoToMeeting not being able to hear each other and lag. Screen-sharing*

The differences in the software that was being used at the different universities also caused problems, as it meant that they could not revise each other's files, or advise or be advised about how to use the software.

There are tools on a PC that are able to be used but they're not on our Macs. The drawing tools are on our macs are not on PCs so some people can use them and some people can't.

> *we only know the programs that we're using. They can't even try to help us because they aren't familiar with other programs. They haven't got the same software so we can't really explain to them so it's really hard to show them exactly.*

Issues with the structuring of the assignment

A particular problem for Ryerson was the structure of the task meant that a lot of the initial work fell to Ryerson students, as this required design elements. This was not seen to be due to a lack of commitment from the other universities, simply that this fell to the Ryerson students as it was their specialism.

> *If there are issues between the teams it would be I think that because we're focusing on design it's heavy on what Ryerson's having to do right now. Loughborough and Coventry are supportive of the project. It's just that's what's needed for the project at the start there's a lot of design work that needs to be done as opposed to structuring, costs, It just takes a lot more effort to do a lot of the work that the groups are expecting Ryerson to do on the design point of view.*

This actually then led to a lack of time to complete other tasks at the other institutions.

> *We've been assigned partners and within the teams we've divided the workload. In my case we've decided that everyone works on their specialty but we're still stuck on the design part, wo they're saying, "we've got nothing to do, we don't know how to help you and as time comes it's not going to be well done". Because we only have a week left to get everything else done after we get the designs finished.*

> *because it's linear I can't give the design parts to the others because they don't know how to design and I can't take their parts because I don't know how to cost analysis. Because they're waiting on us and we're waiting on them that's the biggest issue that we're wasting time when really we shouldn't have to.*

This overload was also exacerbated by having to do three designs in parallel.

> *On top of that we're doing three times the work because there's three different things we're doing. I think it would be a lot better if we only focused on one.*

Conclusions from the data collected from the focus groups

The above study only accounts for four of the data sets that are being accumulated from the project (i.e. numbers 1 to 4 from the list below). In total the project has gathered data from

1. Focus group with Coventry students – transcript
2. Focus group with Ryerson students - transcript
3. Written feedback from focus group with Loughborough students
4. Focus group with Loughborough students – transcript

5. Quantitative data from surveys with all three universities
6. Observations of GoToMeetings with all three universities
7. Personal reflections of students submitted at all three universities.

These documents are available elsewhere on the website and provide further triangulation between these conclusions.

1. Problems with the module design.

The issue that cropped up most frequently from the data was the issue of the students at the different institutions having different versions of the brief. Although this was observed as a learning point for some of the students, in that it taught them to always check that everyone in a project had the same information and instructions to start with, it was the area where the students felt there was biggest room for improvement.

One solution offered by students was for all information to be shared within a single portal, so that not only students would all have access to the same information, but also where there were discrepancies between staff perspectives these would be picked up. The lack of a single portal for communication and sharing documents is one area where the exercise could be largely improved.

There was also a discrepancy, from the point of view of the students, in the awarding of marks in that, despite getting positive feedback and perceiving they were doing well, the marks awarded did not reflect this.

The mismatch in schedules was also seen as a problem, with students suggesting that this be amended, not realising the impracticalities of this. Ryerson students also found that the assignments were front-end loaded with a lot of design work, which meant that they were inundated with work at the beginning, while students at the other universities had little to do. This then meant that their opportunities to contribute were delayed and schedules squeezed as the Ryerson students took longer to produce their work. This also undermined the sense of trust between team members as this was perceived by Ryerson students as placing too high a demand on them, and Loughborough students as the Ryerson students underperforming.

It may make sense for the mismatch in schedules to be taken advantage of and the linear nature of the task lead to the design students beginning their work before the other students join, although the comments of the Loughborough students about being in a more passive position because Ryerson were more familiar with the task at the start may indicate that, though a sensible action, other students may feel disadvantaged by starting later.

Some criticisms were levelled at the quality of the lectures, with some students critical of the alignment between content and their roles, and others critical of the mode of the lecture; being largely instructional and monotonous. This may be a reflection of the different learning approaches at the different institutions, but is more likely to be the need for more awareness of the differing techniques required for teaching at a distance through videoconferencing. Research indicates that the alienating effects of observing a lecturer on a small screen for extended periods of time requires the students to be more frequently engaged in activities and for themselves to experience a stronger social presence than would be the case in proximal teaching activities (Childs, 2011). Training teachers in some of these techniques may overcome this issue.

The problem with the miscommunication between institutions regarding the brief is to be dealt with in follow-up iterations by the scheduling of more regular meetings between the staff involved. Although the scheduling conflicts cannot be addressed, making the students aware of the constraints with timetabling, and providing more information about the module schedules at the participating institutions would lessen this anxiety amongst students.

The communication between staff and students within institutions was highly praised however, with students being complimentary about the levels of support they received from their lecturers.

Loughborough students also took issue with the peer assessment, seeing it as a means to address problems with collaboration and non-performance that would be better handled by direct intervention by a lecturer. They felt that there was also a problem with possible bias either in favour of friends or for being penalised if they had had a poor collaborative experience.

2.   Problems with collaboration

As with previous research into virtual collaboration (Soetanto et al, 2014), the experience of the students varied, depending on the effectiveness of the collaboration, due mostly to the work ethic of the other participating members of the teams. Where all members of the team were contributing effectively, students were positive about the exercise. A higher proportion had a negative experience this time, but this may be simply due to a three-way collaboration introducing more opportunities for the inclusion of a non-performing section of the team than a two-way collaboration.

Also the breakdown in trust observed previously took place, with failures to communicate in response to emails and to complete tasks in time leading to caution about sharing tasks and dissatisfaction with the exercise as a whole. Delayed deadlines placed parts of the collaboration under greater stress, and more meticulous planning throughout the whole exercise could have avoided many of these problems.

Dividing tasks between the groups was also a contentious issue for some groups, with collaborations assigning roles according to the perceived specialisms of the universities rather than the individual specialisms of the students.

Suggestions were that the difficulties in meeting tasks, and in the conflicting schedules, or allocation of roles, could be alleviated by these being set out in the brief to the students, e.g. that tasks could be broken down into subsidiary tasks that the separate parts of the collaborations would have to complete by a specific time. However, the students were resistant to this as an idea, expressing the opinion that establishing these tasks and identifying deadlines themselves, was a key learning experience for the module.

In response to the list of learning points the Loughborough students iterated at the end of their focus group (see above) these were so predominantly negative they prompted the interviewer to comment "It sounds like it's completely destroyed your faith in humanity" to which the response was.

> *It has*

Although evidently the students felt they had experienced problems, this was offset by the quite extensive list of learning points that had preceded the comment. The students themselves recognised this process, that the problems encountered in their collaborations had actually led to a wealth of learning opportunities and provided them with a useful set of employability skills.

3. Management of meetings

Students struggled with the basic elements of meeting management, at first, learning as they went many of the techniques that make meeting online or face-to-face more efficient. Writing down actions from meetings, questioning to establish understanding, checking timezones (for example being aware that North America puts their clocks back at a different time to Europe), these were all techniques that the students could have been instructed to put in place as part of an induction to the exercise.

4. Cultural differences

Cultural differences occurred both between the disciplines and in the different ways that the institutions teach. This could be seen to be intrinsic to the nature of the collaboration, and not something that can, or should, be avoided. However, preparing students for these differences in approach, and providing them with strategies to address them, may make these conflicts more productive learning opportunities.

Another unavoidable difference is that the exercise is a mandatory one for Ryerson and Loughborough and yet an optional one for the Coventry students. Coventry students attributed this to the perceived lack of dedication from some other students.

Differences in terminology were also raised as an issue by the students.

5. Technology

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.

6. Experience of teamworking

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

The perceived disadvantages were also common to both those who were doing the virtual teamworking as an option and those for whom it was mandatory. These included:

- Frustration about lack of clarity of the brief
- Difficulties with the hardware and compatibility of the software
- Lack of quality and alignment of lectures
- Problems with the quality of the collaboration.

On this last point however, the problems with collaboration had two sources, one was the lack of commitment and poor work ethic from the collaborative partners, the other was a general lack of knowledge of project and meeting management strategies. Both of these sets of problems were valuable learning exercises for the students and all reported having learnt a great deal about structuring meetings, noting minutes and action points, knowing the extent to which trust could take place between partners, and strategies for developing it. Working across timezones, awareness of clocks going back and creating agenda are all basic time management techniques and yet students developed these throughout the exercise. A point to consider would be the extent to which students could be trained in these techniques or whether it is more valuable to learn while doing. Possibly by taking them part of the way through the skills they would be more prepared for the tasks and so progress further in building up project and time management skills.

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, this 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. Although a minority of students resisted the idea of solely working virtually.

Where there were issues in collaborative practice most students learnt readily from these problems and, as a learning exercise in project management, was successful, even if some of the collaborations were not. Some of the more basic issues, such as creating minutes and agendas, and checking for understanding and inclusion, could be addressed through basic training in conducting meetings and in project management. Strategies for addressing non-performance and non-attendance would also be helpful for the students.

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.

The biggest issue was with conflicting versions of the brief. More communication between staff members, and a single portal for sending out and submitting documents would address this issue. 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. In the mean time the experience could be improved by selecting a single software for design across all institutions.

Students identified issues with the quality of lecturing. There may be a case for instructing lecturers on the specific techniques required for lecturing at a distance.

A proportion of students in the mandatory cohort showed the same resistance to virtual teamworking as noted in previous studies.

2. Analysis of personal reflections of students

Introduction

The project consisted of a collaboration between three universities; architecture students at Ryerson University in Toronto, and *structural analysis students at Coventry University and construction management students at* Loughborougsh in the UK. The project ran over two semesters. Stage 1, was to develop a plan for a building in Coventry; after evaluating all 3 designs, a chosen concept was proposed. In Stage two, the students produced a design report along with structural drawings for the chosen concept. The Coventry and Ryerson students were constant across the whole project. At Loughborough the original collaborating engineering students ended their involvement and MSc students from Loughborough came in at the second semester as Sustainability Consultants to analyse the concept design and to facilitate its success under BREEAM assessment. This enabled the project to observe the impact of bringing new collaborators into a project at a midway point.

The analysis of the experience was conducted across five different sets of data; these were:

1) Focus groups at the first semester with all three universities
2) Videos of the videoconferences that took place to enable collaboration
3) Focus group at the second semester with two of the universities.
4) Pre- and post-questionnaires
5) Analysis of the personal reflections of the students.

This document is an analysis of the personal reflections of the students, from Coventry and Loughborough these were assignments set at the end of each semester, so for the Coventry students these were done twice, the numbering therefore is from CA to CE with a number to indicate which of the semesters is being discussed. For Loughborough the students are different for each tranche of reflections, therefore these are numbered L1 and L2, with a letter assigned to distinguish the different students. Five students were chosen at random from the Coventry cohort to analyse their responses in depth, five each from each tranche of student reflections from Loughborough. More may be analysed if time permits. Additional information was provided from summaries provided by colleagues from Coventry and Loughborough.

For Ryerson, the personal reflections consist of one written document and a transcript of interviews conducted with students.

Motivation

The students at Coventry were self-selected. This was possible because of the large cohort there; only a fraction were able to take part in the online collaboration with other universities, other students worked in similar collaborative projects but in a face-to-face context with other Coventry students. The involvement of the Ryerson and Loughborough students was mandatory. The Coventry students stated that their reasons for volunteering to do the online option of the collaborative project were:

1) To stretch themselves. As one student stated:

I chose to be part of this task in order to be able to step out of my comfort zone. At university, I have worked with many students on numerous projects and it has worked well and we had no major difficulties. I feel I was getting too comfortable and that I wasn't putting myself out there. I therefore decided to sign up to this project because I strongly believed that it would be a positive experience. (CA1)

2) To get experience of working in an online environment
3) To work alongside students in an international multi-disciplinary group,
4) To build up their CV.

Task design

A few students had issues with the design of the task. These were:

1) 2.4 Staggered starts. Because the Ryerson students began their work early, this meant that they had a better idea of the task than the others and, this student felt, put them in too powerful a position.

   Uneven coursework hand-out dates, meant Ryerson were more informed than the other two universities at the beginning. This put them in a position of power as they had more of an understanding of the brief. This is slightly unfair because it meant that other universities were less able to contribute towards the early stages of the project. As a result, we didn't discuss the brief thoroughly, which later resulted in problems. (CC1)

2) 2.6 The tasks in the project design mapped very closely to the three subject disciplines of the students. This led to a direct assignment of roles to students according to their degree course and meant a more limited opportunity to learn. This student suggested the inclusion of additional tasks to provide opportunities for the groups to collaborate on new, unfamiliar areas.

   The natural solution to this task was to allocate the most familiar task with the subject group undertaking modules on the task requirements. The tutor's vision for this task was for the components to be split equally between all disciplines; however firstly this is not a realistic to task operations in the industry, and secondly it wasn't practicable in this situation due to the training requirements in such a short timescale. A recommendation for improving confusion would be to include tasks that didn't identically relate to the student background subjects.

Suggestions for changes to task design

Some students felt that there were inequities in the system, in that

1) Only the Coventry students were self-selected. Some interpreted this as indicating that there was a greater chance of unmotivated students coming from Ryerson or Loughborough and that making participation optional at all universities would overcome this problem.

I believe that students should have the option to be part of this project as the Coventry students were; this should ensure that only those who are truly dedicated and genuinely committed to it take part. Strategies should be implemented in future to prevent unmotivated and uncommitted students from taking part in this type of project as this caused a number of problems for our group. CA1

2) 2.3 Another perception of causes of difference in commitment from students from different universities was that there were varying levels of rewards in place on the courses.

One aspect that should have been changed was the rewards/outcomes of the project since it varied for each university and it meant we had differing levels of commitment, which did cause some antagonism. LA1

Allocation of roles

4.2 This division of roles was a particular problem for the students. The division specifically along subject specialisms was felt to sideline those students who were not specifically "management" students from management decisions.

My Coventry colleague and I were both forewarned by our project tutor that we should be prepared to tussle over the project roles early on with the other students, as there was always a chance that the students from the different universities would be "stuck" with work specifically for their study discipline. That is to say that across both Ryerson and Coventry students there is significant industry experience and management experience to be found, yet this was consistently overlooked by our Loughborough colleagues as their field of study is management itself. This was a slight and I felt it hampered effective relationships early on due to the lack of acknowledgement of mine and other colleagues' experience. Though unconfirmed, this is likely to contribute towards resentment later on in a team, as certain members took on many more roles than others, potentially leaving other members feeling a lack of worth and more like a consultant than(an) equal partner in the project. CD1

When this division of roles occurred it also led to fragmentation of the project as those students divided tasks into separate areas and then continued with little overlap between the tasks. This seemed to arise from a lack of awareness across the whole team concerning how inter-related all parts of a building design are, both from the perspective of those expecting input and not getting it:

when issues were found with design layouts and structural issues, the decisions towards these matters was viewed as "just an engineering" problem. The idea that solutions to structural problems have an impact on the way stakeholders use the building was little acknowledged. This went both ways, as neither my Coventry colleague nor I had much or any input into the "softer" tasks, like programming or preparing site documents. CD1

And from the perspective of those expecting to give input and not having opportunity to.

After the planning stage it was time to commence with designing and creating a set of criteria to base all of our designs on. Due to the fragmented leadership at this point, the importance of this stage in the process was last with our colleagues in Ryerson and they went ahead with creating concepts and drawings without having a set of criteria. This requires someone in the group to take full control and analytically step back from the group and tell specifically the Ryerson students to slow down; although this was suggested by myself, but as I wasn't 'leader' for that specific week I think the thought got

overlooked, to the disappointment of myself. This action meant that when we did decide on our criteria, 1 design had been finalised. Needless to say that this design was not our preferred design. L1B

Other teams worked more democratically, sharing leadership roles, and also more collaboratively, planning ahead the opportunities for providing input to each other's work.

We, as a team decided to not nominate one leader for the duration but split it up weekly so that everyone had the chance to do so. … we all felt like we had control of the brief and structured a well thought out programme for the design of three buildings. We had delegated well the work to be done and decided that Ryerson Students would manage and produce the drawings and designs with input from all other institutes, upon completion of this Coventry where to structurally analyse these designs and notify of any required changes to feedback to Ryerson, once this process was finalised the designs would be passed over to Loughborough students who would create all support documents. It is important to point out that at all levels … there would be absolute communication and each institute had a say in what the other produced. L1B

2.7 To an extent, the fragmentation into separate roles is driven by disciplinary difference, but also because, despite the authenticity of the tasks set, the unavoidability of this being set within the context of degree courses can lead to students being strategic about their efforts from a desire to obtain marks rather than complete the project.

When aiming to make our plan we immediately split up the work rather than attempting to discuss the objectives and the best way to achieve them. … These were then completed in isolation, produced into one document and submitted. There was no agreement or group consensus, it was merely an excise to gain marks for that section. In practice this meant we had a fragmented plan that no individual had brought into.

Constraints

2.4 Issues raised by students that limited their ability to participate in the project were scheduling the meetings and workload against several different schedules in two different timezones. Students mentioned

1) Clashes with other work

   The reason why sometimes I couldn't give 100% of my effort is that I had other tasks to finish for other modules and in particular for my dissertation. (CB1)

2) Clashes with exams

   There was also a small issue with obtaining the designs from the Ryerson students, due to their having had exams during the early stages of the design phase, which in turn delayed our tasks, as we were unable to analyse structures we did not have the designs for. (CE1)

3) 7.5 Different weekly patterns of work, and timezone differences which meant that usually the only timeslot that worked was lunchtime for the Canada students which equated to early evening for UK students.

   for my group, timing and scheduling was the main issue because of the different time zones we are in it was really hard to coordinate. RQ

the problems faced were minor. The largest issue experienced was scheduling meetings which all group members could attend, due to the time difference and the varying timetables of the different group members. CE1

Due to there being three universities involved in this project there where effectively three conflicting timetables which needed to be work around. This meant that meetings where rarely at the same time and in the same place so plentiful and regular communication was required... LC1

7.6 Where students had issues making the synchronous they were more dependent on asynchronous communication, and effective use of these in parallel with the GoToMeeting meetings was essential.

… plentiful and regular communication was required, we achieved this through various online platforms where everybody was always looking out for updates and announcements. This was not only key in organising meeting times but also in terms of file and document management when working on submissions. LC1

There were no issues with the Time difference. Most meetings were held at 6pm in the evening when everyone was free. Any problems in attending the meeting or any other issues were resolved through Facebook. CC1

Not all groups found planning the GoToMeetings difficult however

The time difference made little difference to us as a team as we were able to work around this and the needs/availability of everyone in the group. LB1

Working across time zones was less of an issue than it might have been – this we avoided by agreeing meeting times well in advance and communicating those dates and times in advance of upcoming meetings. This we pulled off well, even during the overlap week where DST and UTC are an extra hour off. CD1

Experiences of collaboration and teamwork

4.1 The experiences of the collaboration and teamwork varied enormously between the groups. Some students had very negative experiences.

this project has been the most negative experience of group work I have ever had. (CA1)

Others found the process of collaboration a problem, with other team-members failing to produce work on time, and this having an impact on the ability of others to meet their deadlines.

From early on in the project we encountered issues with group performance. Even as early as Task 1 members of the group ended having to do work that other had said they were going to do but never produced. This was frustrating but forgivable. The issues didn't go away. The two that didn't submit failed to show for the next two meetings. At this point it maybe could have been an opportunity to review our plan and our approach but we carried on. Group performance didn't drastically improve. The two were often late and still missed meetings. The real problem lay in the fact that they were to produce the drawings. This was an output central to the rest of the project. Let me be clear I am not trying to say that they did not work at all, they produced two solid enough sets of drawings and a small write up to accompany one, but these came so late in the process that there was little room for

development, idea generation and improvement to the design concepts. On top of this there was also an issue around how we had to produce a lot of the supporting information in a very short space of time. LE1

7.1 Also collaboration problems were due to simple failures of communication,

Even though all group members have contributed to each task in particular ways, sometimes we had problems communicating with each other, in terms of understanding the tasks or understanding everyone's point of view. At some point we had to make some changes for one of our designs and it was our duty, structural engineers, to announce the other team earlier and it was too late. In that particular situation I felt bad because even if my colleague maybe did forget to tell the other guys about this, I should have done something. CB1

or lack of effort by students – failing to attend meetings or complete work on time.

These problems were often simply due to lack of clarification of task, or where (as above) some members of the team were waiting for input from colleagues that they were not aware they were expected to give.

Some delays weren't because of the lack of dedication, just simply circumstances where confusion has arisen over some tasks. But again, these situations sometimes get a bit out of control because each individual has to make sure that he/she understands what the project requires and to ask for help prior to actual start. CB1

4.7 Teams however generally found that teamworking improved over time, with communication becoming easier and reduced confusion over task allocation. Students tended to also became more aware of the need to not only produce the materials they were expected to, but also produce ancillary information about their expectations of the others' work, and rationales for their own.

Towards the end of the project everything came together well, and there was a good amount of communication. Every group member knew exactly what they had to do, and work was submitted in time for everyone to check it over and give feedback before the final hand in. During the final phase of the project especially, while we were expected to provide more than we were expecting, the team functioned well together, work was completed promptly and everyone was aware of how their work fit into the group, as well as what the others were completing and the reasons behind it. CE1

Use of collaborative technologies

6.4 The students used a range of technologies, switching between them in order to best use the different functionalities of each to meet the different requirements for information sharing. The main technologies used were DropBox, for collating files, Facebook for asynchronous communication and GoToMeeting for the synchronous meetings.

Communication I feel was fairly effective, oftentimes due to the software available. The software used ranged from high end desktop sharing to the more routine, such as Facebook messaging and DropBox. GoToMeeting, from Citrix, was a particular help, with the ability to displace concepts and live files between colleagues rather than having to play civil engineering charades over voice comms. CD1

Meetings were set regularly, and a clear rota of group leaders and secretaries week by week was established and followed, with meeting minutes promptly completed and uploaded to the group Dropbox. File sharing and communication was effective, and various media were used. Facebook was used in order to reschedule meetings and discuss any small problems or issues with work, Dropbox was used in order to collect useful files and upload work, and GoToMeeting was used for all of our meetings. CE1

5.7 Students responded differently to the experience of using GoToMeeting for meetings. Some found the use of the platform difficult due to the more limited ability to read the body language of others in the meeting and to hear others. Overall some students were not comfortable with videoconferencing at all.

I be honest I didn't enjoy meeting online, it was a lot harder to communicate and I don't enjoy seeing my face when talking to someone. I will turn off the webcam of myself in future. CC2

5.1 Other students found the tool effective for hosting meetings.

I personally felt that the primary communication tool worked efficiently throughout the process and the functions it could perform were practicable for the tasks we were completing. Most importantly I would recommend this communication tool to industry professionals completing modern design projects based on my experiences. L1D

(GoToMeeting) was very useful, allowing us to share screens and communicate at the same time, as well as allowing other users to take control of the screen and use it to highlight sections. This was especially relevant when the Ryerson students presented their design proposals, allowing us to examine what they had done and have them talk through all of their designs, as well as allowing us to highlight any issues with the structure, or areas which would prove difficult to construct. CE1

6.6 Facebook was useful as an asynchronous tool, not only useful for exchanging information, but also for building up a sense of group cohesion.

Within the initial stage of the project, I set up a Facebook group to establish connectivity within the group. My motivation came from knowledge that communication is vital in the early stages of team development and Facebook is a good facilitator of this; Facebook apps allows almost 24/7 communication. CC1

Facebook had provided some sort of camaraderie. CD2

6.7 Although DropBox is an easy to use platform for storing documents collectively, its use requires some thought and experience regarding the curating of the documents that the groups stored.

For the largest submission (Task 2) there where hundreds of individual files that all needed to be collaboratively worked on and updated by multiple parties. This meant setting out a filing system / working plan early on (Task 1) to ensure that there would be no confusion with older drafts of files or naming etc. An online file sharing website has been used throughout all the tasks so every group member had access to the latest content. LC1

3.3 6.8 The students used different software applications for creating the documents; this was seen as an opportunity by some students to learn from each other.

I also thought that from a software viewpoint the multi-disciplinary team allocation allowed all members to show an interest in different software packages. Personally I was very interested in the

CAD packages that the architectural students were using from Ryerson. The capabilities and end products that the applications produced were excellent; this experience was new to me as I haven't used similar CAD packages during my development. L1D

7.7 to 7.14 Use of GoToMeeting

GoToMeeting required the acquisition by the students of a range of skills, and the learning of a set of preferred behaviours. Many of these would, however, appear to be self-evident, and indicate that there are pieces of advice and basic "how to" guidance that should be given to students to avoid these elementary mistakes being made.

1) Not breaking off for private conversations. In some cases, students report the participants at other sites muting their microphones in order to have private conversations. This would not be acceptable in a face-to-face meeting and so seems very odd that students would do it in a videoconferencing situation.

   In some of the early meetings we had, there was some conflict between Loughborough and Ryerson over how to proceed with certain points particularly with the information we were given. This did cause some tension particularly when microphones were muted and private discussions could be seen on the screen. I thought that this was quite disrespectful when Ryerson could be seen having private discussions when there was a problem that needed to be resolved and their actions could have escalated the conflict. L1A

   Some students however felt that this was acceptable behaviour and saw it as a benefit of using videoconferencing.

   Having options of muting audio and closing video camera helped us to secure privacy at some delicate situation when it was essential. L2E

2) Effectively supplementing face-to-face behaviours to compensate for less physical presence. As noted above videoconferencing is a more limited form of interaction than face-to-face situations, exacerbated by the connections in some cases not being effective. Students struggled with adapting to this in some cases, particularly when questioning each other. Techniques such as alerting a person to a one-to-one communication using their name, rather than directing one's gaze, had to be learnt.

   Weekly meetings were held via Go-to-meeting software. It was a new experience, communicating through a webcam is very different to face to face interaction and I found it harder to translate ideas and more of a struggle to build a rapport with team mates. I think the reason for this, is the fact we are communicating through a webcam and not face to face, so body language was harder to interpret and grasping each individuals understanding was more of a struggle. This improved as the project developed. Poor sound quality and lack of visual stimuli created some problems during meetings. To prevent having to repeat oneself, speaking slowly and clearly was vital. Additionally, because we were talking to a screen, directing conversation was problematic. I found the best way to deal with this was to state each individuals name when addressing them. CC1

3) Chairing meetings formally so that only one person speaks at the same time. As noted above, a difficulty with videoconferencing is that body language, gestures and faces are not so easily seen, and so seeing cues and knowing who is to speak next becomes more difficult.

Participation needs to be more formally structured so that only one person speaks at once, and all people get a chance to speak. This does not appear to have been learnt in all cases.

I don't think we were able to achieve effective collaboration through meetings in the final stages, because there were less structure and people were talking over one another. I found a good way to deal with this is to request the chance to speak, before offering an opinion, this was you have full attention of the group. CC2

4) Planning and structuring meetings. Students struggled through some meetings because they were used as a means to transfer information rather than discuss concepts. An example that one student referred to was of asking for information at the meeting rather than in advance so that it could be properly prepared for. Circulating agendas before a meeting was still not common practice with all the groups by the end of the first semester.

The questions they did ask were on topics which we were not discussing at the time. We were often caught off guard so it was difficult to find information and explain. I think if we had of used an agenda as frequently as in stage 1, it would have helped structure the meetings and given LU time to ask questions. Instead, they prepared a list of questions, left unanswered because we couldn't find the time. If they had of given us a few questions each week, during their time in the agenda, this would have worked better. CC1

5) Ensuring everyone is included. Some groups reported lapses in inclusivity, caused by their tendency for some people to dominate the videoconference and not employ techniques to include those who were finding it difficult to engage, even ones as simple as pausing occasionally and checking if anyone wanted to ask questions.

CC2 we could have asked if they were ok on a regular basis, just to acknowledge their presence, and to allow them to ask questions if needed. I think they may have got the impression they were more of a nuisance, than any help. They were quiet people and so checking if they are ok, is a good way to feel welcome.

6) Students speculated on whether there were specific cultural reasons that meant that some students were less likely to participate in videoconferencing sessions.

It was also observed that consultant team comprised of all members of Asian background, made more use of emails instead of video articulation. L2E

7) In the observations of the recorded videoconferences it has been observed that there is an echo in many of the meetings. The echo in videoconferences is caused by sound from a speaker being picked up by the microphone and relayed back. Usually this makes communication very difficult, and the usual procedure when this arises in professional videoconferences is to halt the meeting until whoever is responsible for the echo stops it. This is easily fixed by either a) using a headset or b) turning off the microphone when not in use. The students seemed prepared to put up with the echo rather than insisting on it being stopped. Some students seemed unaware that these simple remedies would prevent the echo from occurring.

There were major sound issues; sometimes I could hear my own voice after I spoke, which caused me the biggest problem. I don't see this as a problem we need to worry about, since in the industry, companies have the very best in internet and software packages, to prevent this occurring. CC2

8) Taking into account students with disabilities. One student amongst the participants was deaf and despite this, the team still used sound for their meetings. This meant that he could not participate in the meetings, as the webcam quality was also too limited for him to lipread, unless he was addressed directly, in which case his colleagues at his end could

interpret for him; a task they could not do the rest of the time as their attention was taken up with participating in the meeting. The student concludes:

This is something that can be learnt from by society in terms of working in teams with different people, where there may language barriers or in my case, hearing difficulties. In order to overcome this situation, the team needs to discuss these problems and devise ways of alternative communication. LA1

The students should be made aware that it is perfectly reasonable to switch to text chat and use this if any of the participants have issues with audio, either because of technological or disability barriers.

9) Working in unsuitable areas. Students reported problems with connectivity, due to working in places with poor wifi, and background noise making communication difficult. One student concludes that

Locating self in more silent zone while being on meeting will help to eliminate the noise disturbance issues and communication might be more efficient. L2E

These very basic, and possibly self-evident, techniques and behaviours illustrate the need for students to be given some guidance of how to conduct themselves online and how to prepare properly for meetings. It is not a safe assumption that students will create an environment, both online and offline, which is conducive to working, and will ensure that all people can participate in the meeting by making some simple choices that make best use of the platform.

Alterations due to addition of new LU students

In the move from semester 1 to semester 2, the membership of the teams stayed the same with regard to the Coventry and Ryerson members, but new students came in from Loughborough.

The observations of the videos were confirmed by the personal reflections of the students. Firstly, that the second phase was conducted more effectively due to the established working relationships between Coventry and Loughborough.

The second phase of the project was a lot more successful than the previous phase, due in part to having already had a working relationship with the Ryerson students. The task was more challenging as we were less familiar with the areas covered by some of the tasks, but the communication was a lot more effective due to the previous phase. CE2

Meetings were also conducted more smoothly because of the familiarity with the tasks and because the building design was more developed.

We were able to communicate effectively with the Ryerson students, as we were all familiar with the design of the building and the construction process. CE2

The students were also more experienced at working across timezones, and with collaborating online.

Having worked together in the past we were able to quite easily overcome the challenges associated with not being able to meet in person, as well as those met by living in different time zones. A routine

for meetings existed from the previous phase and we were able to easily carry it over and incorporate the new members of the group into the process. From the previous phase we had learned what information was necessary to share and what was not, and consequently we were able to quickly share relevant information required for the furtherance of the project. This helped greatly speed up the meeting process, while still allowing us to communicate the same amount of information. CE2

The students were also more effective at sharing information asynchronously, requiring synchronous communication just to iron out problems, and to discuss next steps.

Overall, the communication throughout this phase of the project was of a good standard. Problems arising from the work were overcome via meetings on GoToMeeting, or, if they were smaller issues, were discussed via email or Facebook. The team were able to share ideas and solutions, and the existing working relationship and knowledge of the design was extremely useful for aiding the project. CE2

Communication with the existing Ryerson team continued pretty much as before in the previous phase, using GoToMeeting and Facebook messaging for any contact outside agreed meeting times. CD2

Also, for this phase we didn't use formal Meeting Minutes, we just posted all the information that needed to be finished in advance on our Facebook group since we already were familiar with this option. CB2

The process was also simplified because of established schedules.

Learning from the first phase, the team agreed early on to have a regular set time to meet each week as we now had a good idea of when people were free. Continuity in team make up helped in this regard enormously. CD2

And also familiarity with each other's abilities, which enabled easier division of responsibility.

Since we knew our roles from the beginning we didn't need to go through this all over again, we just divided the tasks according to each person's role. CB2

Also the technical skills that had been acquired enabled more effective communication.

Familiarity with the software available was a boon - technical hiccups were removed in entirety in the meetings with just the RU and CU students. We were only really aware of how smooth our use of the meeting software had become during the first meeting we had with the LU students – they had neither the appropriate hardware nor location to be a productive and helpful partner during the two meetings we had with them.CD2

As had resolving the technical difficulties in collaboration.

RU and CU students struggled in the first stage with AutoDesk program compatibility as different editions do not work with each other. This sort of thing had been cured by the second stage. CD2

Greater familiarity with online behaviour also helped with effective communication, for example, learning communication techniques that compensated for the lack of body language in videoconferencing.

I felt like in the first stage there were extended periods of silence in the meetings as team members weren't sure who would or could speak next – I think that might have been as a result of the reduced ability to read body language as one might do in person. This we had largely eradicated in the second stage by getting into the good practice of using agreed meeting agenda, sent around the team members (usually) the day before the planned meeting. This produced more purposeful meetings and a more professional feel to them. There was also more of the life-like banter one might find in a meeting, due to better interpersonal relationships established over time. CD2

This ease of working with the others was not only manifested in the synchronous communication, but in the asynchronous too.

I felt that personally I had improved in communicating with other team members. This was on account of better familiarity with software but more importantly better relationships with team members. This was lacking in the first stage I felt, as it was somewhat awkward when requesting progress or information from other team members. The second phase saw that sentiment removed as I could flick a message to RU and not feel that it might be perceived rude and vice versa, RU students could send me a message out of meetings that was brief but to the point and it wouldn't feel brusque as we would catch up in the next meeting. CD2

The reduced size of the group also helped in this respect.

As a result of this effective reduced group size, we were able to proceed in meetings at good pace, not wasting as much time in meetings. CD2

only students from Coventry University and Ryerson University had to finish the rest of the project. Due this fact, to communicate with each other was easier. CB2

Although others found this added to the difficulties.

now with less people to complete work and fewer minds to solve problems we were less of a team. CC2

Problems introduced by changing Loughborough students

The change in structure of the teams introduced some issues for the teams already set up. The first of these was that the students were unfamiliar with the project up to that point.

Unfortunately the new members of the group were unfamiliar with the construction, and time that could have been used gathering information for the continuation of the tasks was instead used on explaining the design and background to the task. While the idea of a consultant was useful, it would have been more effective had we continued with the old team members who were familiar with the background to the project. CE2

The team took time to readjust, people's motivation seemed to be depleted and as a result communication was less effective. We even missed a number of meetings due to time differences, which only happened once in semester 1. CC2

This was particularly difficult for some due to the role of the new people being that of consultants. As stated earlier, in the videos of the meetings it is evident that some Loughborough students addressed by demonstrating the sort of service they could undertake for the others.

Though the addition of new parties to the group posed a challenge to us all, I feel as though we were able to take it in stride and adapt to the change so that time was not wasted and we could proceed with the task at hand. Instead of focusing on the negative aspect of new group members being added (and the additional learning curve), we took the opportunity to ask the new group members about some sustainable initiatives that they had in mind for the project, and everyone cooperated so that both the graduate and undergraduate students could gather enough information to complete their respective tasks. R2

Some groups however, found this an adjustment that was difficult to make.

Initially, being a later entrant as sustainable consultants into the project design phase, it was difficult to get adapted to the service model. Members in consultant team hesitated to meet online and showed no interest to participate in discussion, as their involvement was neither monitored nor compulsory L2E.

The teams also missed the experience of the previous cohort of Loughborough students.

LU students experience in management and leadership was valuable asset and because we had lost this, the team was less able to evolve - it was as if we were in a meeting for the first time. CC2

The difference in experience also showed itself in the unfamiliarity with the technology.

during the first meeting between the Consultants and the designers, LU team had some technical problems which needed some time to be solved due to the absence of an expert, hence leading to a short delay. L2A

Connection through Wi-Fi or plug-in-cables was essential in order to go online. This played a difficult task, because it required being in special zone and place where Internet facility was available. L2E.

And the ability to manage timezone differences.

At first, Loughborough team made a mistake about the time difference, hence they missed the meeting for an hour which is really a pity because it waste Canada students a hour.. L2D

Some teams however adapted quickly to the change.

We made use of GoToMeeting to communicate with the members located in different geographic locations and different time zone. We instantly developed a good rapport with the members from the two teams. Over our following GoToMeetings with the design team members; they explained to us the factors that they considered for choosing the proposed design and the vital changes in the design of the building they have implemented. L2C

3. Analysis of video recordings

The key element for effective communication in BIM Level 3 is the creation of a 'shared situational awareness' (Adamu, 2014; 16). This developed in concert with a growing competency with running meetings (using agenda, assigning a chair, taking minutes by an assigned person, clarifying action points at the end), a growing dexterity with using the software (moving between programs, interacting with programs) and a developing maturity of the project (ideas moved beyond the initial "messy talk" phase, remaining tasks became clearer, whom to assign tasks became more obvious). When asked if there was a causation between these factors, i.e. did one become easier because another had become easier, students responded that no, these were correlated, in that all developed separately over time, but did not directly help each other. However, from observing the recording of the interviews, all seemed to contribute to flow, which in itself contributes to the shared situational awareness.

Specific techniques that added to this awareness:

7.15 Getting the technology right. In early stages, students used laptops that were too low spec to run GoToMeeting and CAD software simultaneously, students did not seek out the areas with better broadband connections, students did not use headsets, or left microphones on when not speaking, leading to disruptive echoes as the output from mics were picked up by speakers.

7.16 Acquire fluency. The more experienced the students became, the more able they were to switch between applications, zoom in on the parts they needed to zoom in on to illustrate a point, and overall identify the best way to communicate visually autonomically, with the technology being transparent to their communication.

7.17 Online etiquette. Be on the whole time, or let other people know when you've got to be afk. Occasionally students needed to be preoccupied with some other task, such as searching on the Internet, looking for information on plans, opening files. In early stages students would simply withdraw from conversations, not answering questions until they had information, and leaving other participants confused as to whether they were hearing them or were still present. As they became more familiar with the interactions, the students would explain what they were about to do, before undertaking it, so others would be aware of what was going on.

7.18 Don't tell; show. Students would describe parts of the building under discussion, or discuss work they had undertaken, leaving the screen with a static image and always leading to confusion with the other delegates. The students would then open a plan and use this to clarify what they were talking about. In later meetings, students immediately showed the plans and zoomed in on the part they were talking about. The others' attention could be drawn to the part of the diagram they were talking about using the cursor, or even circling the specific part. More experienced students always backed up their communications with documents, for example demonstrating work they had undertaken, such as scans of written calculations, or Excel spreadsheets.

Keep the conversation on screen not offline. Occasionally plans were discussed and parties at all the ends would have access to the same information, but they would look at paper plans, separately offline while exchanging some conversation. The default was not to put the plans on screen and

jointly look through them, and all be aware of the same part of the plan at the same time. In later stages all the work discussed was put on screen so all would be looking at the same thing at the same time, and have a shared experience of the matter being discussed.

7.20 Make an appearance; students were very reluctant to create a presence on-screen, at best all that existed of the student was the cursor moving on the screen, with the occasional flash of the webcamera image. Students communicated with each other using Facebook, which also would enable them to engage socially, but there was little or no socialising in meetings. Recent studies (Shellenbarger, 2014) indicate the importance of making a social connection when collaborating, and this was underdeveloped. Participants tended to refer to the members of the team at a distance by the institution at which they worked rather than by name. Having webcameras on view constantly (perhaps on a separate monitor, e.g. running a social channel in parallel) would enhance this aspect of collaboration.

7.21 Doodle; scribbling on diagrams, providing a quick diagram in sketch-up to explain a shape, were all ways to express ideas and back up speech, but in a less formal manner. Having a whiteboard to hand to add an extra component is useful.

7.22 Modify each others' work. Where the students completely failed to engage with co-creation was by taking each others' documents and altering them. Although genuine and full co-creation did take place, by commenting and requesting advice, the others' input was always added offline and outside of the synchronous sessions, by the owners of the documents. This could be because of altering someone else's work as being seen as intrusive, or (because of the nature of the assessment) each wanting to keep their own contributions separate to some extent. Participants need to give each other permission to alter each others' work before they will feel comfortable with doing so.

In summary, in initial stages students gave little thought to the perception by their distanced peers about how their communication appeared on screen, there was little joint working, or idea of the on screen space being the shared space, activity too frequently broke off into the separate offline spaces. As the sense of the meetings being a shared situated experience developed, however, the majority of students' attention was on the shared collaborative space, indicating not only that a better collaborative experience had been formed, but also potentially itself establishing a stronger shared collaborative experience.

In the move from semester 1 to semester 2, the membership of the teams stayed the same with regard to the Coventry and Ryerson members, but new students came in from Loughborough.

An analysis of the videos from this period indicates several differences between the online meetings in semester 2 when compared with semester 1:

1) Meetings are shorter. The recordings made of semester 1 meetings are an hour long on average, semester 2 meetings are only 28 minutes long.
2) Meetings are more dynamic and focused. Switches between applications take place every 2 mins in one meeting, every 5 mins in another. This is a contrast with semester 1 where the same image sometimes stayed on the screen for up to 25 mins.

3) Information is shared effectively asynchronously which means that less needs to be shared during the meetings. In fact one meeting ends with the statement that "we don't need to have another meeting because we are sharing emails so fast".
4) Participants are invited to ask questions at the end of presentations by name, to ensure everyone gets to speak.
5) There is a variance between the degree to which Loughborough students have been involved in the new teams. In some recordings the Loughborough students are sharing materials and explaining the contribution they can make to the team, in others they are not present.
6) The videos show higher social commitment to each other, in general. In the majority of the videos, students thank each other for the promptness in replying to emails, and suggest keeping in touch beyond the end of the project (possibly working on further projects) but one group selected to submit the recording in which their team-mates did not show up.

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