# International student integrated project work using virtual teams comprised of students from the United Kingdom and Canada

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*Abstract: The paper uses a case study approach to review a working project aimed at establishing a final year international integrated student construction project at Coventry University. Due to the ever-increasing internationalisation of the construction industry the integrated student project at Coventry University aims to provide the participants with virtual international working teams, an increasingly common process within the construction industry. The teams undertaking the project are to be formed equally from two Universities, one in the United Kingdom (Coventry University) and the other in Canada (Toronto – Ryerson University). The paper reviews the process of establishing the international student construction project and reviews how the student teams needed to work together to produce technical outputs from a given brief, therefore promoting international communication and teamwork. The paper reviews the evaluation of the project through quantitative and qualitative data taken from questionnaires with a view to measuring the success of international integrated student collaboration with links to the construction sector.*

## Introduction

Coventry University mission statement is to

"…aspire to be a dynamic, global, enterprising university. We will work in partnership with external organisations through our research and engage our students as partners in a community of learning".

By aspiring to be a global university the university aims to

"ensure that every course contains a substantive international element that requires students: to conduct joint projects with peers in another university overseas mediated via digital technology".

In addition, within the University the Faculty of Engineering and Computing is adopting a new pedagogical approach of "Activity Led Learning (ALL)" (Wilson-Medhurst, and Glendinning 2009). The aim of ALL is to promote student engagement, retention and employability. A significant component of the teaching and learning to achieve this aim is team-based project work. This team based project work has been adopted by the Department of Civil Engineering, Architecture and Building due to the international scale and diversity of the Construction Industry. International mobility in the Engineering & Construction Industry is extremely important with over 60% of Engineering and Construction firms seeing the importance of international mobility to the success of the their organisation. International mobility is seen as critical to the success of their construction business, both today and in the future. An increasingly interconnected and globalised construction sector means that individuals often have to work collaboratively with people in different parts of the world, who they have not even met before, let alone worked together. Construction work, by the very process it undertakes to produce the final product, tends to be formed from multi-disciplinary teams. These multi-disciplinary teams can bring innovative products and process aimed at benefitting the construction process. However, effective teamwork skills in terms of management, leadership and communication are needed if the construction project is going to meet its prescribed output. (Horwitz and Horwitz 2007) This form of integration is difficult due to the different professions and process involved. Further and Higher education institutions can help prepare prospective students on the problems facing multi-disciplinary teams by introducing forms of integrated project work within their curriculum. Exposure to this type of process within their education can help prepare students for similar exposure within the real

workplace. In addition, as construction projects continue to become more complex, due to the use of new working practices and regulations, the use of new communication technologies, information and communication technologies (ICT), has allowed construction companies to form virtual global project teams to undertake construction projects (Rezgui 2007). On the back of these factors, the Department of Civil Engineering, Architecture and Building has developed a joint integrated project with students from Ryerson University, Toronto, Canada.  The project aims to meet the needs of the department's activity led pedagogy, whilst addressing the increasing need for student internationalisation within the construction industry. The innovative project aimed to develop a single integrated project that is undertaken by teams comprising of students from both Universities. The approach of having virtual teams comprised of equal student numbers from both institutions represents the ever changing ways of working within the construction industry. As the teams worked through the project they needed to undertake group meetings, using a variety of technologies. The geographical positioning of the team members prevented face-to-face communication and physical interactions often used by collocated teams for decision making. This brought challenges to how the students managed the virtual teams. However, it would be inappropriate to assume that the factors influencing collocated team effectiveness were the same for the virtual teams (Potter and Balthazard 2002 c.f. Kirkman et al. 2004). There has been extensive research undertaken to understand how and why teams achieve their desired outcomes. However, relatively little is known about the factors that affect virtual team performance (Lee-Kelley and Sankey 2008, Algesheimer et al. 2011). The list produced by Gaudes et al. (2007) covers the factors that contribute towards the effectiveness of virtual teams, but there is no pointer to which factors are the most appropriate for a certain context, and the same list could also be applicable for collocated teams. Given the limitation of resources, it would be impractical to consider all factors. This paper reports the initial findings of the virtual team integrated project between the two university institutions.

## Project methodology

Coventry University and Ryerson University signed a joint memorandum of understanding to help facilitate the integrated multi-disciplinary group project. Both parties were interested in evaluating the possible benefits, and reviewing possible problems, that arose from trying to establish an international virtual team project work. To explore possible answers a case study approach has been adopted to show the data collection methods used to obtain the results. The methodology for establishing the project was as follows.

### Assignment development

The international integrated project required a construction project to be devised that met the needs of the virtual multi-disciplinary integrated teams. The virtual teams were composed of students undertaking degrees in Design and Project Management at Ryerson University and a range of Civil Engineering degrees, including Civil and Structural Engineering, at Coventry University. A common project was devised that allowed the teams the opportunity to successfully work together within the function of a design and build context. The project brief was developed on a scenario of a new Civil Engineering, Architecture and Building Departmental building based in Coventry University. The reason for choosing a UK based project brief was taken on the prior experience Coventry University had in running integrated projects. The brief included:-

- Clients brief – which outlined the scenario building, project brief aims, site details and schedule of accommodation

- Group formation and work processes – team leadership, management, and documentation

- Assessment – detailed outline of tasks to be undertaken by the virtual team within the two phases of the project.

In addition, specific context documentation were obtained.

The brief was fully reviewed by academic teams from both Universities to ensure that the tasks that the students were being asked to would be at the appropriate academic level and also offer a range of multi-disciplinary tasks to the virtual teams to undertake. The project was split into 2 phases, to coincide with academic year structures; (phase 1 – September to December, phase 2 – January to April). The multi-disciplinary tasks for phase 1 (design) were to architecturally and structurally design the proposed building including parking, drainage and accessibility, an initial cost estimate and outline specification. The tasks for phase 2 (tender) were to finalise the architectural and structural design

including parking, drainage and accessibility, reports on quality and health and safety, and programme the construction of the project.

## Student briefing on the project

The project brief was launched to the students from both institutions at the end of September. They were provided with a full description of the formation and management of the project, along with a clear description of the technical task requirements. As part of the initial launch the students were asked to form teams of 4 students from the same institution. The teams then linked with another team from the different institution to form 1 virtual reality team of 8 students (4 Coventry & 4 Ryerson). As the teams had not worked together before, they needed a way of getting to know each other professionally. This was undertaken through a poster process. Each group was asked to produce one A2-sized poster which advertised the skills in the team, with a view of attracting offers from opposite teams. The aim was to form the strongest team. The poster needed to identify technical and management skills that individuals could offer to the team. To enable these posters to be produced, the teams reviewed the tasks in the project brief and identified previous technical skills that they had undertaken which showed that they could meet the tasks. As the students would be working as a team, they were asked to identify people management skills (e.g. leadership, team working, communication) that they could also demonstrate. Upon receipt of the posters the teams reviewed them and selected and contacted an opposite institution team to work with. Academics from both universities were available to oversee this process and mediate where there were any problems with team choices. The whole exercise was aimed at developing a comprehensive understanding of the project brief, and reviewing potential strengths and weaknesses of the team members. This then developed their skills for identifying expertise to complement the existing team members. Having formed the virtual reality teams, the students started working on the project. To help the initial process of communication the first task focused on the team formation and planning of the main technical outputs. The companies were asked to plan the forthcoming technical tasks and write reports showing the interdependency within the tasks and how they intended to manage the team.  This then led into the specific technical tasks that the students undertook.

## Students undertaking phase 1

Part of the emphasis of the project was the communication aspect that the students needed to undertake as virtual teams. Therefore, the teams conducted weekly meetings, and appointed a team leader and secretary. These had to be rotated every four or five weeks enabling each member of the team to carry out each role. The team leader chaired the weekly project meeting, monitored and co-ordinated the work of the group, ensured that hand-in dates were met and generally oversaw the day-to-day running of the project team. The team secretary took the meeting minutes, noting any important points discussed, and deputised for the group leader in the event of their absence. Copies of the meetings formed part of the assessment process. Companies were encouraged to also meet outside the scheduled meeting time. In addition, they were encouraged to use a range of ICT to successfully communicate, including Skype, Messenger and Drop Box for document storage. Academics from both institutions held tutorials with the virtual teams, through these forms of ICT, to help facilitate any questions regarding the technical tasks and monitor team performance. The marking scheme for the project combined individual and group marks. Individual marks were derived from the assessment of the task that the individual was responsible for. The group mark was derived from the team formation process and presentations. The group grade was peer-assessed using Web-PA system. The system provides a control mechanism to discourage students being 'passengers' in the team. Further pedagogical benefits from peer assessment to the skills formation in a group work is explained in Wilkinson and Lamb (2010).

## Completion of phase 1

The companies needed to submit one document, in response to the technical tasks, in Coventry and Ryerson at the same time. In addition, the companies needed to liaise with each other and produce one presentation. The presentation was delivered to the academics from the respective University they derived from. The presentation needed to outline the work undertaken in the first phase of the project by the team. When presenting, the teams concentrated on outlining in depth the specific parts they had undertaken, but also needed to demonstrate an acceptable level of understanding and comprehension of what the other half of the virtual team had produced. This was particularly relevant to the architectural and structural design of the proposed building.

Following the completion of the first phase the students completed a questionnaire seeking their opinion on distance collaboration. Due to the distances involved a questionnaire was used so that initial data could be collected from all students involved at the same time.   The students were asked to rate their extent of agreement to a range of statements regarding some aspects of distance collaboration listed in table 1 below.

**Table 1: Distance Collaboration Questionnaire 1**

| Statements | Level of Agreement | | | |
| --- | --- | --- | --- | --- |
| | *Strongly disagree* | *Disagree* | *Agree* | *Strongly Agree* |
| I need to check to see if the other team members have progressed their tasks as promised. | 1 | 2 | 3 | 4 |
| I need to check the quality of work of the other members. | 1 | 2 | 3 | 4 |
| In group work, I am exposed to higher risk of poor mark / performance. | 1 | 2 | 3 | 4 |
| I feel more rewarded by working in team. | 1 | 2 | 3 | 4 |
| The other team members make my job easier. | 1 | 2 | 3 | 4 |
| The other team members are competent. | 1 | 2 | 3 | 4 |
| The other team members are honest. | 1 | 2 | 3 | 4 |
| The other team members complete work on time. | 1 | 2 | 3 | 4 |
| Communication over internet is difficult. | 1 | 2 | 3 | 4 |
| Face-to-face meeting is essential for a high performing team. | 1 | 2 | 3 | 4 |
| Overall, I am satisfied with working in team. | 1 | 2 | 3 | 4 |

The results from the first questionnaire will be discussed in conjunction with the second later questionnaire.

## Student reflection of phase 1

At the start of the second phase of the multi disciplinary virtual team integrated project the companies needed to again allocate the technical tasks to respective team members. In addition, the team members were asked to reflect as a group, and then as an individual, on their performance within the first phase of the project. At the end of the first phase, and as part of the WebPA peer and self assessment process, the students were asked to rate themselves and team members against a range of criteria that had been devised by the cohort of students undertaking the integrated project. The criteria were:-

1. Attendance/reliability/punctuality at team meetings

2. Communication within meetings and externally

3. Teamwork

4. Quality and presentation of work

5. Knowledge and technical ability demonstrated

6. Effort and enthusiasm during the project relating to set tasks, presentations and meetings

7. Leadership skills when managing the team

Once the WebPA had been completed the students were able to access a report which indicated their criteria strength and area for development. Having obtained the report the first meeting of the second phase of the project required an initial group discussion using the results from peer and self-assessment. Members of the group were asked to discuss team members' performance in terms of strengths and areas that could be improved, with an overall aim of facilitating individual reflection that was to be implemented for the second phase of the project. The individuals then produced reflective commentaries on their performance for phase 1 of the project and highlighted any steps, both positive and negative, that they felt they needed to undertake within the second phase of the project.

## Completion of phase 2

At the end of the second phase of the project students had to submit the necessary tender documents and undertake presentations to their respective institutions academics. Having completed the multi disciplinary virtual team integrated project all companies were again asked to undertake a more detailed questionnaire to quantify the interaction between the different teams within the overall virtual

team in terms of vision, cooperation and learning. The students were asked to provide written responses to a set of questions which are listed in table 2 below:-

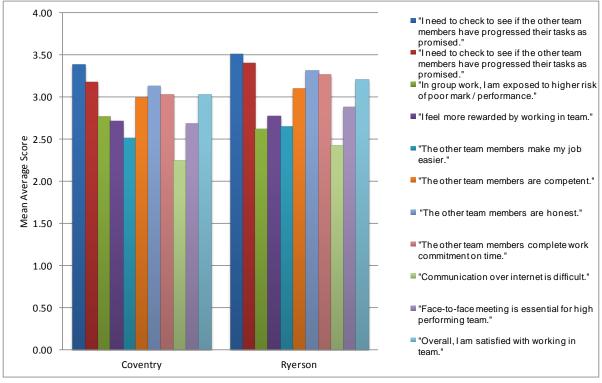**Table 2: Distance Collaboration Questionnaire 2**

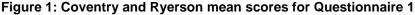| Statements |
| --- |
| |
| **Vision** |
| My team has a shared vision of the project with our overseas team |
| How do you rate the verbal commitment of *'overseas team'* to the shared vision of the project? |
| How do you rate the demonstrated commitment of *'overseas team'* to the shared vision of the project? |
| **Cooperation** |
| How do you rate the demonstrated commitment of *'overseas team'* to completing his/her own project tasks? |
| How do you rate the ability of *'overseas team'* to produce and complete his/her assigned tasks as required or expected? |
| How do you rate the willingness of *'overseas team'* to share knowledge to improve work output? |
| How do you rate the willingness of *'overseas team'* to accept suggestions or ideas to improve work output? |
| **Learning** |
| How do you rate the contribution of *'overseas team'* to your learning in general? |
| How do you rate the contribution of *'overseas team'* to your professional practice habits and behaviour? |

The qualitative responses to these questions can be combined with the quantitative data from the first questionnaire to provide a good understanding of the issues that the students faced when undertaking this international virtual multi-disciplinary integrated team project.

# Results and analysis

The results from the first questionnaire have been compiled to show the difference between the Coventry and Ryerson students to the eleven set criteria. When considering the results cultural issues were considered in terms of age, gender and race/ethnicity. The age of the students was fairly uniform and race. Many of the participants were from overseas origin from both Universities. Therefore the only issue to be considered was gender. The impact of gender was investigated in further separate research linked to virtual team performance. The first set of data produced (Figure 1) shows the mean average score to the criteria. For both sets of students, out of the eleven categories, six of them scored a mean average of 3 or higher (agree or strongly agree). These were in the categories of

- "I need to check to see if the other team members have progressed their tasks as promised."

- "I need to check the quality of work of the other members."

- "The other team members are competent."

- "The other team members are honest."

- "The other team members complete work commitment on time."

- "Overall, I am satisfied with working in team."

**Figure 1: Coventry and Ryerson mean scores for Questionnaire 1**

Out of the other five categories four of them scored a mean score of 2.5 or above. The only criterion to score below 2.5 was "Communication over internet is difficult."  When evaluating the performance of virtual teams Lee-Kelley and Sankley (2008) found that time zone and cultural differences affected communication and team relations more than collocated teams. This is supported by the data. . However, overall there was very little difference between the two sets of mean scores that the students gave to the individual criteria. The Ryerson students had a slightly higher mean score (3.27) for "The other team members complete work commitment on time." compared to the Coventry score of (3.03). In addition, for ten of the eleven criteria, the Ryerson students mean score was slightly higher than the Coventry students mean score. However the range in mean scores was only 0.17 across these ten criteria. The only criteria where the Coventry students mean score was higher was "In group work, I am exposed to higher risk of poor mark / performance." showing a greater concern for group work compared to the Ryerson students.

In addition to calculating the mean scores from the data, the percentage of students who agreed or strongly agreed to the criteria was also calculated (Figure 2).
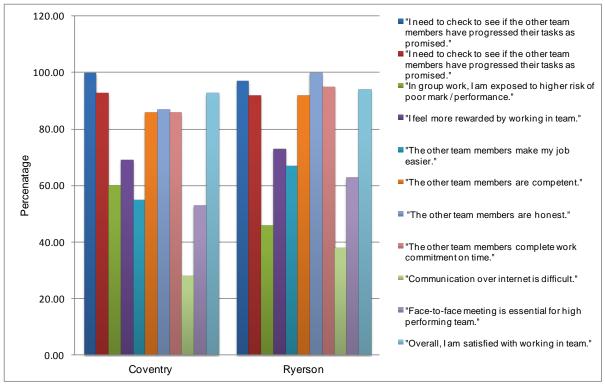
**Figure 2: Coventry and Ryerson percentage of students who agree or strong agree to the criteria in Questionnaire 1**

What can be seen from the data is, compared to the mean score, the percentage responses of students who agreed or strongly agreed to the criteria shows some variation between the Coventry and Ryerson students. There was only one criterion for the Coventry students below 50%, "Communication over internet is difficult" at 28%. In addition, the majority of criteria for the Ryerson Students were above 50% with, again, the lowest score, 38%, being for "Communication over internet is difficult"; this correlates with the mean score data. The data also reconfirms the mean score data regarding the Coventry students concerns relating to group work with a majority feeling that "In group work, I am exposed to higher risk of poor mark / performance' (60%), compared to the Ryerson percentage of 46%, a range of 14% and the highest range across the complete eleven criteria. The data also showed some variations compared to the mean score data. This related to the criterions "I need to check to see if the other team members have progressed their tasks as promised." and "I need to check the quality of work of the other members". Both had higher mean scores for the Ryerson students, but when calculating the percentage response that agreed, the Coventry Students were higher, though the range was small of 3% and 1 % respectively. In addition, the percentage data showed 3 other criteria, not previously discussed, where the range was 10% or above. These were; "The other team members make my job easier" (12% range) "The other team members are honest" (13% range) "Face-to-face meeting is essential for high performing team" (10% range). In all three criteria the Ryerson student's percentage score was the highest.

The data from the first questionnaire raised issues on a number of points: -

1.  The students didn't feel that they were excessively exposed to risk by the group work, though the Coventry students felt the risk was higher.

2.  The students felt rewarded by working in the teams and also felt that the counterpart teams members were competent, honest and committed.

3.  Communication over the internet was not deemed difficult, though the groups did want some form of face to face meeting.

4.  Students felt the need to check the other teams work was being progressed and the quality of the work being produced, with mean scores of above three for both sets of students, and the Coventry students showing a higher percentage of agreement.

5.  There was a high range between the teams in terms of the other teams members making their job easier, with the Coventry student's percentage being the lowest.

The final two points above highlight the key issues that the students felt they were experiencing at the end of the first phase of the project. These focus mainly on the output that team members were producing as part of the multi disciplinary virtual team integrated project.  Therefore, the qualitative responses the students gave in the second questionnaire to the questions regarding vision, cooperation, and learning have been analysed in response to the concerns raised from the first questionnaire.

## Vision

Both positive and negative responses were received in relation to this area. Some teams noted that "A particular team member at *'overseas team'* did not share in the vision and understanding of the project with the rest of the team" and "Working with our team members overseas was very difficult because of a lack of passion on their end", whilst other teams noted that the vision wasn't to do with the other team but more due to specific individuals or even themselves, "I feel that certain members let the project down overall, but through no fault of the members at *'overseas team'* (or in fact the other members of the *'home team'*), and "The main problem I had with the project wasn't with the project itself but my motivation with doing the work, so was more of a personal reason". However, students showed some really positive group work experience in relation to the projects vision, which balance out these responses, "Overall I think working with *'overseas team'* went well, and we had one of the best groups in my opinion". The issues that the students raise in terms of the vision of the project are not exclusively related to the fact that the project is run through virtual international teams and are generally experienced by students in any form of teamwork. "I had a great experience with the *'overseas team'* team. My home team experience could have been more positive, but ultimately that is a failure on my part and not the course. Working with *'overseas team'* was worthwhile". The same response can be said for the second area of focus co-operation.

## Co-operation

This area of focus is not exclusively linked to the international virtual team aspect of the project, but could have been significantly enhanced by this factor.  Students again reported both positive and negative aspects, in terms of co-operation. "The *'overseas team'* team was very good. They communicated fantastically with us and I am very happy with their performance", and "Our *'overseas team'* counterparts performed with a high level of excellence. We are glad to have worked with them in the past 2 terms". However, as expected, there were also co-operation issues raised. "Though this project posed to be a great learning experience for collaborating with a team abroad, it also created numerous issues in terms of different goals and work ethics for our *'home team'* in comparison to your *'overseas team'*. The greatest issue seeming to affect the co-operation was to do with the work outputs that the students were collaborating on and specifically the communication of these outputs, "Information flow was very one sided. *'Overseas team'* were keen to receive, yet reluctant to deliver vital information required by *'home team'* to complete certain tasks. *'Home team'* did it's best to resolve any queries ASAP; however this approach was not mirrored by *'overseas team'*'" and "Our *'home team'* members often felt as if we were begging for information from our *'overseas team'* members. The work provided was often late and at a different capacity, one that we are not as knowledgeable in the matter to be able to critique. This then led to greater levels of frustration as no matter how much collaboration took place we were at a constant struggle".

There appears to have been more issues in terms of the response to communications sent out by the teams, than the actual process being undertaken, "Communication between our team and our overseas team was harder through internet meetings and emails as many times we did not get a response or confirmation of meeting time and date with our overseas team", and "Generally the project ran smoothly although collaborating the work at the end of term 2 gave problems. They were mainly to do with communication and were eventually sorted out". In addition, some teams noted the opposite, "Communication was much better than expected through Skype and regular meetings were held to help the project progress". One way forward in trying to solve this problem is for the institutions to agree a more cohesive date in which the students could communicate more effectively with each other, rather than letting them arrange this on an individual basis.

## Learning

The final area that the students commented upon was the learning of the project. This was consistently more positive. "Integrated tasks management, team building, refined communication skills development are some of the benefits of this type of collaborative study", "It allowed us not only to experience project management challenges but to also discover the difficulties behind dealing with

various individuals who of course, possess various work ethics and habits' and, "What I personally enjoyed the most in doing this particular project was the ongoing unpredictable challenges; this project presented practical obstacles in which I would never have foreseen theoretically". As such the project, overall, delivered a key-learning objective of demonstrating group integration, across various construction professions, of knowledge and skills, for a major scenario-based project, within a design and construction environment.

A final analysis of the responses showed issues in relation to the delivery of the module and the different terms dates that the two institutions had. "If the scheduling of the project is better, it might increase the outcome's quality".

# Conclusion

The multi disciplinary virtual team integrated project between Coventry and Ryerson University has now completed its first year of delivery. From the case study outlined it has shown how it is possible to develop such a project with the view of providing a truly international curriculum to students focussed on an industry that is becoming increasingly internationalised. The establishment of the project has been outlined and the data from the qualitative and quantitative questionnaires outlined. It has shown that the project, in its first year, has successfully delivered a group based major scenario project, using virtual international teams. The data has also shown that the students have encountered issues of vision, in terms of producing technical outputs and co-operation. However, these issues are not specifically down to the international virtual team aspect of the project, but could have been emphasised more due to lower communication levels. In addition, the issue of the delivery of the project, between the two Universities, needs to be addressed to allow for better scheduling of the technical outputs and to allow for easier communication. Overall, within its first year, the project has been successful, with students noting "Having the chance to work with the '*overseas'* students was a once in a lifetime experience and I thoroughly enjoyed it!", "Working with them was a fun filled experience." and "overall I feel the project was a success". During the next year of the project additional data will be collated through questionnaires and student interviews to again be able to review the process being undertaken.

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