



Trautrim, Alexander and Defee, Cliff and Farris, Ted (2016) Preparing business students for workplace reality: using global virtual teams in logistics and SCM education. *International Journal of Logistics Management*, 27 (3). pp. 886-907. ISSN 0957-4093

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A later version of this paper is published in the International Journal of Logistics Management (2016), Vol. 27, No. 3 by Trautrim, A., Defee, C. and Farris, T.M.

INTRODUCTION

Modern supply chains are complex, requiring the efforts of multiple organizations managing a variety of operations across many regions of the globe to efficiently and effectively deliver goods and services to consumer markets worldwide (Mentzer, 2004). The rise of supply chain management as a discipline has come about as a means of bringing order to this complexity. While the discipline has grown and defined itself over the past two decades supply chain management course content has generally aligned with the procurement, logistics, and operating needs of business.

Higher education has lagged behind, however, in preparing students for their chosen careers in a method of work necessary in today's supply chain environment. Business school pedagogy hasn't changed much in decades. One-way, lecture driven content delivery remains a staple of the typical college of business course (Mangan and Christopher, 2005). This is perplexing given the dynamic and rapidly evolving nature of supply chain management and the explosion of communications technology options available today.

As supply chain networks have become increasingly global (LaLonde and Ginter, 2008) an important change in work force dynamics has occurred – the emergence of the virtual team. Simply stated virtual teams bring together people from multiple locations across multiple echelons to solve supply chain issues. These teams may be short lived and focus on point problems or ongoing to support continuous improvement objectives. Whatever their duration virtual teams are a critical resource used routinely by world class supply chain organizations. Traditional team-based activities which are frequently leveraged in business school education are inadequate in creating experiences interacting with distant colleagues. Thus, we believe it is critical that supply chain education incorporates virtual team training to ensure students are adequately prepared to enter a global, highly interactive supply chain working environment.

This paper is organized as follows. It starts with a background chapter identifying the need for qualified supply chain personnel and portraying the skills requirement for future logistics and supply chain managers. It then explains the requirements for delivery of higher education content through online formats, what global virtual teams are and the particular skills students can acquire from their application in the classroom.

Afterwards we show the use of global virtual teams in an international multi-university exercise involving participants from several logistics/SCM courses and the underlying objectives in the exercise's design and execution. The student learning experience is analyzed from quantitative and qualitative student feedback; leading into faculty reflections on the exercise. The paper eventually concludes with the learning objectives achieved by students through participation in the exercise.

BACKGROUND

This chapter outlines the skills set required by future logistics and supply chain managers and the work environment they are facing in an increasingly globalized field first before

explaining the nature of global virtual teams and how their use relates to these required skills and their transfer to students in a higher education setting.

The future logistics and supply chain manager

Fawcett et al. (2008) identified the barriers to effective supply chain management as coming from organizations and the people within them. These barriers include poor collaboration between organizations within the same supply chain, an absence of trust, and a lack of training for new mind sets and skills. Through interviews with supply chain professionals, they identified human behavior as a root cause for most barriers of effective supply chain management. As a consequence, people are the key to successful collaborative innovations, and teamwork skills need to be an essential part of supply chain education and training. Incorporating the development of teamwork skills and inter-organizational collaboration into the curriculum of future supply chain managers is therefore a necessary undertaking (Handfield, 2004).

Similarly, in their development of the supply chain manager of the future, Mangan and Christopher (2005) argue that supply chain managers do not only need to understand their own discipline but also need to show understanding of neighboring areas and possess cross-functional skills. Curricula therefore should not only focus on delivering in-depth expertise in logistics and other fields of the supply chain, but also the skills to engage and succeed in this cross-functional and interactive setting. Cross-functional and cross-organizational interaction skills are also highlighted by Ozment and Keller (2011) who relate the need for such skills to the development from the functional silos in logistics operations to end-to-end supply chain thinking.

The ability to interact and collaborate with other supply chain partners is also highlighted by Gowen and Tallon (2003) who point out that the skill levels of employees in problem-solving, leadership, and team-building are a significant factor in the success of supply chain management practices. This position is supported by many others such as Razzaque and Bin Sirat (2001), Giunipero et al. (2006) and Larson (2008) who agree that logistics executives do not only need logistics and business content skills, but must also possess interfacing skills to succeed thereby agreeing with Mangan and Christopher's (2005) concept that the future supply chain manager needs the ability to interact and collaborate beyond their own function and own organization.

Myers et al. (2004) classify the human capital skills in logistics into social, decision-making, problem-solving and time management skills. In a survey of logistics and supply chain managers the authors investigated the influence of these skills on employee performance. They found that all these four skill sets positively influence the performance of logistics employees and show a much stronger relationship to employee performance than work experience. As their research targeted mid-level logistics managers as the unit of analysis, work experience and education can be considered as increasing in importance with career progress. University graduates will need to work their way through these mid-level positions during their career and universities therefore need to include social, decision-making, problem-solving and time management skills together with logistics and business content-based skills in the curricula.

Despite LaLonde and Ginter (2008) identifying global interactions in supply chains as the strongest factor for future growth of the supply chain discipline, Burcher et al. (2005) discuss that in Britain and Australia much of the higher education provision in supply chain management

lacks an international and interdisciplinary approach. Many of the surveyed managers identified a need for more language training, which can also be understood as related to skills of working in intercultural and global teams. Although additional language skills are almost essential for some niche career paths in logistics (Razzaque and Bin Sirat, 2001; Muhammad and Ha-Brookshire, 2011) these skills are somewhat more difficult to integrate into the curriculum of supply chain departments. Burcher et al. (2005) recommend including an international perspective in the curricula allowing educators to focus on the cultural and communication part of multi-country supply chains while using English as a *lingua franca*.

Interacting with colleagues in foreign countries is also the focus of Poist et al. (2001) who argue that logistics managers operating in the European Union need to be broadly skilled due to the culturally and linguistically diverse environment. Their study shows that logistics managers need more skills deriving from the interaction with foreign logistics business practice and employees. Considering these results apply to an amalgamating European Union, the results can be considered as being transferable to an increasingly 'globalized' economy. Educating future supply chain executives with this global mindset is also called for by Dittmann (2013) who sees it as a key talent component together with cross-functional and cross-organizational understanding, leadership skills and technical skills.

The impact of globalization and the importance of multiculturalism to international logistics needs teaching methods that transfer the required skill sets to logistics and supply chain management students (Gravier and Farris, 2008; Canen and Canen, 2001). Additionally, university education needs to enable graduates to think outside the functional areas of logistics and connect their thinking to both the customer and the supply end of an organization (Ellinger, 2007). Gammelgaard and Larson (2001) conclude supply chain executives value interpersonal and interaction skills as highly as quantitative/technical skills for their career advancement.

Mangan and Christopher's (2005) comparison of industry-preferred teaching approaches suggest the transfer of these interaction skills is best achieved through the use of simulations, case studies, and group projects instead of traditional lectures.

The teaching method we present in this paper combines these approaches by creating workgroups composed of students from multiple universities around the world to solve a supply chain case problem. The student groups never physically met, but worked together in a virtual environment using various communication technologies. Before outlining the method further, we will describe how global virtual teams function and how they can address the skill sets required for future logistics and supply chain managers.

Global Virtual Teams

To transfer the necessary skills to future logistics and supply chain managers we propose the application of a case exercise executed by global virtual student teams as a teaching delivery method. Whereas teamwork, leadership and even cross-functional collaboration can be developed through the arrangement of on-campus group work, these collaborations tend to happen in relatively homogenic and mainly unicultural groups and leave future managers with a limited ability to collaborate within a global supply chain (Stahl and Brannen, 2013). Thus, to

equip students with a truly global mindset and to prepare them for global and cross-organizational collaboration, the classroom interaction needs to involve group members from a variety of backgrounds (Javidan, 2013).

Group work helps prepare students to interact with others effectively (e.g. Ettington and Camp, 2002; Fearon et al., 2012; Rudman and Kruger, 2014). The development of interpersonal competencies requires the use of active teaching methods in smaller groups (Velasco 2014). In group work students acquire interpersonal competences from each other through social learning (Fearon et al., 2012) and this aspect can be enhanced by the provision of content learning resources from faculty as students will learn in greater depth when learning from each other (Knabb, 2000).

Fearon et al. (2012) highlight key issues for successful educational group work. These include: a clear purpose; real world tasks; reflection; the ability to research content and communicate it; a system to deal with free-riders; leadership; and the existence of a facilitator. Rudman and Kruger (2014) place particular focus on the selection, size, management and assessment of group work. They found a large majority of students prefer self-selection of groups and a clear tendency to collaborate with familiar peers. Cultural barriers were not noticed by the participating students in their study, however, this may be explained by the self-selection of groups in the study and the setting in a single country.

Students in different cultural settings can have very different experiences from the same group work activity (Zhu et al., 2009). In heterogeneous and in larger groups the role of leaders increases in impact towards group members performance (Lim and Zhong, 2006). While Hunter et al. (2010) recommend the use of team-building activities prior to the group task, it is questionable how such activities relate to later real-life experience in short notice logistics projects. Also Kukulska-Hulme (2004) raises the point that allowing groups to build up relationships helps online student groups in becoming functional, in particular when no leader is appointed by the facilitator in the exercise.

As international collaboration is a key feature of a logistics career, the learning of intercultural skills is a necessary feature of career preparation. Burdett (2013) raises skepticism towards the transfer of intercultural skills simply by mixing students from different nationalities together. The group work must be managed by the educators to facilitate intercultural learning and ensure that students have the skills to communicate and debate in order to exchange learning. The setting and context of the group work impact the learning experience strongly as do the personalities involved in the group, who show clear variations towards preference or dislike of group work (Forrester and Tashchian, 2010).

In an online setting student group work cannot be assumed to be a replication of on-campus group work. Student groups online are challenged with the selection of communication technology in addition to the challenges common in campus group work. Online groups also use multiple technology applications for their communication and switch between them depending on an application's suitability. Prior familiarity with the technology reduces the time a group needs to ramp up. Online group members tend to be more cautious in the early stages of the group formation and tend to have less open disagreement compared to groups that meet in-

person, hence extending the time needed to become fully functional (Goggins et al., 2011). Being situated in an online environment changes the socio-emotional and socio-technical processes in a group significantly and on-campus work groups cannot prepare students for this aspect of a logistics workplace (Powell et al., 2004).

The use of internet applications creates new challenges in the delivery of higher education courses. In pure online courses interaction often does not go beyond the delivery of course content and cognitively complex engagement is not common. To deliver deeper learning students must participate actively in the course and establish social presence through interaction with their learning community and instructors. Henceforth teaching presence and teacher immediacy are needed to make students interact and create communities of learners (Wallace, 2003). This point is strengthened by Diaz and Cartnal (1999) who identify differences in learning style preferences between on-campus and online course students. Online students in their comparison accept collaborative activities if sufficient structure is provided and hence the teaching delivery for such activities must be adapted. Swan et al. (2003) further argue the assessment of collaborative learning must be adapted to online learning situations.

The availability of new information and communications technology (ICT) opportunities resulted in a variety of new education delivery approaches. Besides the pure on-campus and the pure online delivery, variations of blended formats emerged. Although students in blended learning achieve learning more easily than pure online students who perceive their workload to be higher, Lim et al. (2007) show that both online and blended approaches must include opportunities for collaboration that feature feedback and technical support, questions to check understanding, and learner progress feedback.

Global virtual teams are globally scattered teams using ICT to work on a group project. Such projects in an education environment bring together students from different cultural backgrounds (Taras et al., 2013). They expose students not only to cultural diversity but also to the challenge of running an international project without physically meeting each other. In their study, students working in global virtual teams were asked about their attitudes and perceptions towards language differences, time-zone differences, communication challenges, skill level differences, opinion and value differences, stereotypes and prejudices and coordination prior and after a global virtual team project. In all areas besides coordination the students' expectations towards the difficulty of the challenge was higher than it was perceived during the project and reported afterwards. It was mainly coordination that turned out as being a much harder challenge than anticipated by the students. However, by conducting a survey before and after the exercise, students were already forced to think about these potential challenges ahead of time and could mentally prepare for them. Nevertheless, it shows that coordination was the only underestimated challenge in international collaborations.

Van Ryssen and Godar (2000) report on a global virtual project in which student teams from different universities conduct an assessed project for their marketing class. They categorize the challenges into technical communications problems, timing problems, cultural problems, output problems (that results were acceptable for one side of the group but not to another) and instructor problems. The authors conclude that the students learned how to communicate not only in a technical sense but also demonstrated patience and attentiveness needed to bridge

languages and their use, developed a working relationship over a geographical distance, handled timetables and priorities, and negotiated compromises. All of these aspects can be seen as essential skills for global supply chain projects.

In their review of virtual team management Hertel et al. (2005) structure the lifecycle into five phases: preparation, launch, performance management, team development and disbanding. Although all of the phases have particular challenges, these challenges will also depend very much on the frame of the project that is given externally. Whereas such a frame will be predetermined by the project or the organization, this frame can be adjusted in a classroom setting depending on the learning outcomes targeted by faculty.

TRANSFER TO THE CLASSROOM

With global virtual teams becoming a feature of the logistics/scm workplace, higher education providers need to prepare their students for succeeding in such teams. The way the authors have developed this ambition into a classroom tool for their students and its implementation is explained in the following sections.

The classroom tool

The tool described in this paper is a combination of virtual teams, a supply chain case scenario, web-based support for student questions, and the use of one faculty member to serve as a central point of contact for all student and faculty issues (i.e., the case administrator). All participating faculty provided the case administrator with a list of students and email addresses several weeks prior to the case being introduced to students in the classroom. The administrator used this information to assign students to teams. Each student received an email including the case and team member contact information on a Sunday evening. The case was introduced in the classroom on the following Monday or Tuesday. From that point students had nine days to develop their solution to the case and present their results to one of the participating faculty. More detail on their case execution process is providing below.

Each global virtual team was comprised of students from multiple universities. The teams were assigned a case requiring the determination of the best among three possible suppliers based on a total logistics cost perspective. The case scenario presented to each team was identical, but a unique version of the case with different cost basis was prepared for each team. This provided students the option to collaborate on concepts and solution approaches with others at their local university, but ensured they had to work with their assigned virtual team to calculate the solution for their version of the case.

The case contained ten quantitative questions guiding the participants – who had to deal with differing transit times, unit costs, currencies, and tariffs (all which result in different order quantities and safety stock requirements) – to identify and quantify the costs associated with each supply chain and recommend the lowest total landed cost. Students also needed to address three qualitative questions to discuss risk mitigation strategies and opportunities for improvement in the selected global supply chain. The results then had to be presented online by the group to a participating faculty member via a videoconference.

Case selection was a critical factor. As it was important that students focus on the teamwork aspects of the activity, we wanted to utilize a case that leveraged foundational concepts presented in earlier logistics and supply chain management courses and did not require new concepts to be introduced in conjunction with the case. Key to the effort was finding a case study which was relevant to all of the different logistics and supply chain courses, had multinational content, and used quantifiable variables which could be modified to develop numerous versions of the case without changing the underlying lesson.

Another consideration in the design of the group case work was to ensure that students collaborated with each other rather than completing the work on their own. Challenging students to overcome the inconveniences of differing time zones, cultures, languages, and ICT applications was a key learning outcome of the assignment. Faculty also considered that logistics and supply chain work environments are often characterized by high time pressure and it was therefore decided to give the students approximately nine days from receipt of the case to the online presentation of their results.

The classroom execution

The international group case study was initially piloted with 168 university students from the University of North Texas, Auburn University, University of Hull (United Kingdom) and the University of Applied Sciences Upper Austria. The project was extended the following semester to involve an additional 155 university students from the University of North Texas, Auburn University, Bryant University (Rhode Island), Universidad de los Andes School of Management, (Bogotá, Colombia), and the University of Applied Sciences Upper Austria.

In the planning phase for the pilot appropriate courses at each university had to be identified both in terms of content and student numbers. In total eleven class sections at senior level from the participating universities were involved with student numbers ranging from twelve to thirty-seven in a section. In the first round students were allocated into teams of five and it was ensured that all groups consisted of both US-based and non-US based students. The execution included releasing the case to students, managing a case support website, scheduling and conducting final presentations, and collecting student feedback of the experience. Each of these steps is explained in more detail next.

The first two rounds of the assignment, occurring during fall 2011 and spring 2012 respectively, consisted of 323 students from six universities (note, the University of North Texas, Auburn University, and the University of Applied Sciences Upper Austria participated in both rounds). During the first execution participation was voluntary for students from the University of Hull but was a required element of courses from the other three universities. We discovered this to be a limiting factor for teams that included a voluntary member as many of these members failed to communicate consistently with other team members or simply opted out of the case activity. As a result we decided in future executions that the assignment must be a required, graded assignment for all participating universities.

In this regard, a grade equal to 10% of the total course grade was recommended to faculty from universities joining in, however the final decision on proportion of the grade to use was left up to each instructor. It was also recommended that instructors use a multi-dimensional grading approach including the elements of percentage of quantitative questions answered correctly, strength of responses to the qualitative questions, peer evaluation scores, and quality of reflections paper. To this end a spreadsheet produced by the administrator was provided to each instructor that calculated a multi-dimensional score that allowed each instructor to easily change the weights assigned to each element. As with the grade proportion each instructor was free to calculate grades for their students using their own preferred method.

All students in the first two executions were third or fourth year. The courses where the case was used emphasized logistics or supply chain management (L/SCM) content, and the majority of students were majors in a L/SCM program. Introductory L/SCM courses with primarily third year students, intermediate L/SCM courses containing both third and fourth year, and capstone L/SCM courses with primarily fourth year students were represented. Student experience with group work was varied, with many of the students in introductory courses commenting that they had little or no previous group work experience in earlier university courses. Essentially all students at the senior level reflected prior group work experience. None of the students had previous exposure to long distance team settings in their formal education.

Start

Teams were formed using a blend of students from at least three of the universities. The first round in autumn 2011 consisted of 32 five-person teams and 2 four-person teams; 28 teams contained one member from each university with five teams receiving a mix from three universities.

Students received their version of the case along with a list of team members and email addresses. Each of the 33 student teams had nine calendar days to develop a solution culminating in a 15-minute executive-summary presentation to a displaced faculty member using Skype videoconferencing. 68 presentation time slots over two days were offered by faculty members. A webpage was used as a platform for communication between the student groups and the faculty. The webpage was updated every six to eight hours and offered a centralized location for the students to obtain additional information about the case, faculty contact information, readings, a question and answer section, and a list of available presentation time slots.

Each faculty member received a standard grading form containing the answers for each numerical question of the case. Faculty marked whether the team's answer was correct. The remaining qualitative questions required the group to identify two additional risks not found in the case, offer two quantitative measures for analyzing each of these risks, and suggest areas in the supply chain where the group felt they could find improvement opportunities. The answers provided for these three questions were subjectively graded as "Weak", "Acceptable", or "Strong". Additionally, students were required to complete a zero-sum peer evaluation ranking the performance of everyone in the group including themselves. In the first round only two of the faculty used this peer evaluation feedback in determining a portion of their students' grades for the assignment.

Following completion of the first round the faculty met via videoconference to assess the results of the assignment and identify changes needed to improve the experience in the future. Feedback from students was gathered quantitatively in the form of an anonymous online survey as a compulsory step in the overall classroom activity (n=161; 95.8% response rate) and qualitative feedback in the form of a reflections paper was required in four of the five classes (n=139 papers). The qualitative feedback was also useful to triangulate the validity of survey responses.

Changes between first and second round

The second round was conducted in spring 2012 with a new set of students. It followed a similar schedule as the first round. Students received their version of the case along with a list of team members and email addresses and each team had nine calendar days to develop a solution culminating in a 15-minute executive-summary presentation to a displaced faculty member.

During the second round Adobe Connect was used as the videoconferencing software for the presentations. Otherwise communication between the faculty and the students worked in the same way.

The marking process was more streamlined in round 2. Whereas in round 1 some students were not marked based on the presentation but on the submission of a written report of the results, in this round the presentations formed the key grading component for all students. During this round, grading was identical for all students, requiring them all to participate in the final presentation, complete the zero-sum peer evaluation, complete the anonymous online survey, and provide qualitative personal learning experience feedback in the form of a reflections paper.

Three more rounds were conducted in the following three semesters with a further 252, 182 and 285 students respectively.

In the following paragraphs we will present the demographics of the participating students together with the results from their quantitative and qualitative feedback. As the participating institutions changed further after the second round we vary in the inclusion of data from the five rounds depending on the most relevant and available data. After the student feedback we also present the results of a faculty reflection meeting.

RESULTS

After completion of the exercise students were asked for feedback through an online survey and through the submission of reflection papers on the exercise. The student feedback is presented and discussed separately in the next sections. Afterwards the faculty reflections on the exercise experience in combination with the student feedback are discussed.

Quantitative survey feedback

Over the first two rounds 323 students participated in the case assignment and in total 1,025 students across the five rounds. The response rate to the survey was more than 95% for all

rounds. As the case study exercise progressively developed over the rounds (i.e. student cohorts), some of the data that follow are analyzed over different time horizons. Demographics were collected to understand the participant country of origin, gender mix, age mix, and experience in logistics. Table 1 reflects the broad cultural spread of students participating in the pilot. With 18 universities (University of North Texas (Texas), Auburn University (Alabama), US Air Force Academy (Colorado), Bryant University (Rhode Island), University of Miami (Ohio), University of Wisconsin La Crosse (Wisconsin), University of Wyoming (Wyoming), Texas Christian University (Texas), The Citadel (South Carolina), Weber State University (Utah), UAS Technikum Wien (Austria), Aix-Marseille-Université (France), HEM - Business School Grand Ecole (Institut des Hautes Etudes de Management (Morocco), Hanken School of Economics (Finland), University of Nottingham (UK), FH-Steyr (Austria), Universidad Peruana de Ciencias Aplicadas (Peru), University of Hull (UK), and Universidad de los Andes (Colombia) located in 8 countries students from 50 countries participated in the exercise as shown in Table 1.

<insert Table 1 about here>

Overall the gender mix was weighted toward males with twice as many male as female students participating consistently across the five rounds. Student ages ranged from a low of 19 years to a high of 47 years. The average age was 23.7 and the median age was 22. Students were queried regarding the level of their experience in the field of logistics. As shown in Table 2, 16% of the students had work experience, 24% had completed or were currently working on internships, and 55% had only classroom experience. The table highlights significant variation between the participating institutions for the set of students in the first two rounds in autumn 2011 and spring 2012. Hence, the assignment produced a mixing of students from diverse learning backgrounds and education paths.

<insert Table 2 about here>

We also sought to understand how students used the technology to aid in completing the assignment. Students were queried regarding their comfort using a computer, frequency of internet use, how many email accounts are maintained, and which one was used during the case exercise. Faculty expectations were that the millennial student has grown up surrounded by technology and would be comfortable with computers. Surprisingly only 80.5% of the respondents indicated they were “very comfortable” with computers as shown in Table 3.

<insert Table 3 about here>

Over the years faculty members have seen an increase in the number of technology gadgets used by students in the classroom. In prior decades, the technologically savvy student was equipped with a cassette recorder to record lectures. Now students are equipped with laptops, smart phones, and digital cameras. The expectations were that the millennial student actively utilizes the internet as a part of their daily life. Across all rounds a minimum of 95% of respondents accessed the internet more than once a day. Even in rounds with a higher participation from countries with slower internet infrastructure this number did not drop compared to other rounds.

The release of the case provided recipients with the university email addresses for each group member. The faculty quickly discovered many students prefer to use other email addresses as their primary email. The survey results shown in Table 4 reflect the students indicated the average number of email accounts held was more than three. This also related to qualitative feedback that some groups struggled to initiate contact and communicate effectively via email. The outlier in spring 2012 is explained by two universities with a large number of students participating in the exercise changing their email system at that time and hence many students had two university email accounts.

<insert Table 4 about here>

The students were asked to identify which email account they primarily use. Table 5 shows that approximately 81% of the students used their university email account as their primary email. However this was strongly influenced by university policies towards their institutional communication with students and not necessarily the students' choice as can be seen in a comparison of the institutions involved in the first two rounds.

<insert Table 5 about here>

During the first round faculty were surprised to discover many students struggled to use ICT effectively for their group collaboration. Additionally it was noticed that students diverted into many different channels for their communication, even including the use of telephone calls.

Hence in the second round a question was added to the survey seeking to identify what ICT applications were used by the students for collaboration. Table 6 reflects heavy reliance on email and videoconferencing (Adobe Connect), which was self-fulfilling since initial contact information offered email addresses and the final presentations had to be conducted using Adobe Connect. In addition Skype, Dropbox, and Google Docs were frequently mentioned by the students. While only one group in the first round indicated they set up a Facebook group, the following rounds saw widespread use of Facebook, although with strong variations between rounds.

<insert Table 6 about here>

The survey sought to identify how much time students spent completing the case, the perceived level of difficulty, and how well the case was administered. Previous experience in using the case in a classroom setting at one institution usually required about 80 minutes. The additional complexities of multiple group members, time zones, varying skill levels, comprehension, and the inherent obligation to explain, discuss, and seek concurrence from the group all extended the expected time to complete the task as shown in Table 7.

<insert Table 7 about here>

A key learning aspect of the exercise was the challenge of overcoming time and distance between the student participants. Table 8 shows student responses when they were asked to rate

the difficulty of the case experience using a Likert scale (1 = Not difficult at all, 4 = Normal compared to other assignments, 7 = Extremely difficult). The students indicated the most difficult portion of the experience concerned maintaining team communication followed with completing the task to a point of forming a cohesive final presentation.

<insert Table 8 about here>

From the second round survey onward three additional survey questions were posed to the students. Table 9 reflects student responses concerning their biggest learning from the experience. Students zeroed in on the key focus of the project – working in displaced workgroups – which emphasized the importance of communication skills, cooperation, and collaboration.

<insert Table 9 about here>

The second new survey question asked students to identify the biggest challenge in completing the case. The top three answers shown in Table 10, communication, time zones, and coordinating team meetings were anticipated by the faculty despite Taras et al. (2013) noting that these challenges in their use of global virtual teams was perceived lower than students anticipated.

<insert Table 10 about here>

Finally, an open question was posed to the students how we could increase the value of the experience. Many of the answers reflect the shortcomings of our educational process. Students have been conditioned to receive a lecture on how and what to specifically do and then regurgitate the answer. This approach is comforting to students and non-threatening. Students wanted specific questions, specific processes, and technology designated for them to use. All team members should be at an identical knowledge level and all participants should be star performers. Forcing students to develop their critical thinking skills to resolve and support their solutions to unknowns within a short deadline, while a realistic and critical skill for their careers, proved to be uncomfortable for many students.

<insert Table 11 about here>

Qualitative Feedback

Fall 2011 Reflection Papers

In addition to the quantitative survey feedback, qualitative feedback in the form of a reflections paper was required in four of the five classes (n=139 papers) for the first round. The format was open for the students to discuss the issues that they perceived as the most prominent. 96 documents were randomly chosen and analyzed using the coding software NVivo. The 96 documents appeared to be a sufficient number to achieve theoretical saturation within each university group (Glaser, 1978; Manuj and Pohlen, 2012). The documents were coded in two

rounds of reiteration. The identified topics and the established codes for layer one and two are shown in Table 12.

<insert Table 12 about here>

Not unsurprising most students mentioned communication as a major challenge in conducting their group work. The faculty initially assumed that today's student population is familiar in the use of technology. Nevertheless, most students mentioned that they had never used the VoIP (Voice over Internet Protocol) software Skype and many struggled initially to set up their computer equipment. Only 22 out of 96 papers mentioned the positive impact that technology had helping them to deal with some of the case study's challenges. Some reflection reports mentioned that students used ways of communicating other than email and Skype such as setting up a Facebook group so every group member could see all conversations that were going on. Other groups indicated they managed document sharing via Google Docs to exchange their calculation results with each other and track changes made to the group's solution. Doing so ensured all group members had access to the same level of information at all times without the need to be available at the same time. This helped the group deal with the time constraints. The use of new communication applications and the considerations of their advantages and disadvantages for a particular project can be seen as a primary learning outcome for the students.

Almost all of the reflections mentioned the struggle to set up meetings with their fellow group members due to different time zones and personal schedules. The physical division between group members became a challenge to many groups and some mentioned that discussing solutions amongst group members was difficult enough in on-campus group work but was much harder due to the limited methods of communication. Some groups with more than one member from the same university developed camps within the group that worked separately from other team members at times.

When communicating online with overseas group members, language became an issue to only a few groups. Most groups did not experience a language barrier. Some students expressed relief that all their group members were able to speak English – a fact that other students took for granted - which are also the students that showed comments about the positive impact of different skills sets in the group and a general appreciation of diversity. Working in culturally diverse groups is an everyday reality in many logistics and supply chain careers and the exposure to such group work adds to the students' preparation for their future career. Students may need some guidance to identify this as a learning outcome and need to be encouraged to reflect on this issue, as most students did not reflect on it independently. Although the reflection paper was initially designed to gather feedback it can be considered a crucial component in such case exercises to ensure students realize their learning outcomes which would agree with van Ryssen and Godar's (2000) pedagogical conclusions.

Most comments relating to the work structure and team dynamics during the exercise can also be expected to occur in 'traditional' on-campus group work. The amplitude is larger in this case with double the amount of student reflections mentioning problems with their team or even conflicts than reflections that mention a common goal-oriented work attitude. The more difficult communication arrangements, compared to on-campus group work, and the diverse background

from different countries and education systems may be the main causes. Most groups mentioned a free-rider problem. However, most did not probe this perception during the exercise and many reflections contain narratives indicating some students were very suspicious towards their group members and interpreted a lack of contact as a non-contribution indicating that frequent communication for global virtual teams is rated of higher importance than for on-campus group projects. A few students tried to take their peers' perspective, considering different cultural backgrounds, or questioning their own leadership skills. Many reflections mentioned leadership or the lack of it in their group. Although many identified a need for a group leader, only few took up this role at their own initiative; which makes one wonder whether the transfer of leadership skills needs more consideration in our curricula.

With the lack of leadership also comes the inability of many groups to approach group work in a structured manner or to review their structure once they identify it is not suitable to the nature of the problem. About one-third of student reflections noted the lack of structure present in their team. Surprisingly many reflections noted shyness at the initial team contact and they related this to later inefficiencies in their work structure, supporting Goggins et al. (2011) and Powell et al. (2004) that students take much longer in online group projects to establish a functioning structure and that the learning experience in online group work is fundamentally different to on-campus group work. This may suggest a mismatch of certain students' expectations of their peers from other countries being "different" in some basic way. Alternatively, the slow start of some groups may be related to the lack of an emergent leader as described previously. Neither of these rationales was probed in the survey, and may be areas for further investigation in future global virtual team projects.

Although the vast majority of students expressed negative views on the uneven provision of information and different marking criteria of the participating institutions, a few students believed this to be a realistic aspect of international group work in their current and future careers and saw it as a key learning point. A few reflections mentioned that their peer evaluation did not reflect their real participation but was based on the fact that students at one institution were not assessed on the peer evaluation. Also, a couple of reflections mentioned the fear that students from the same institution might evaluate each other the highest scores. Analysis of peer scoring did not substantiate these claims.

Spring 2012 Reflection Papers

In the second round all universities provided student reflection reports for the qualitative analysis (n=155). In this round 95 reflection papers were coded initially starting with the coding framework from round one as a base. The reflections papers positively reflected the improvements from the first round.

Student reflections in round two did not mention misaligned grading criteria between the institutions, which was a major source for complaints in the first round. Although the complaints about problems with team members and their contribution to the group's success were lower in the second round, this remains the most mentioned negative aspect for students in their reflections on the international case study.

Similarly problems of scheduling communication across time zones were lower than in the first round but remain high and only a few groups did not mention issues relating to scheduling or time zones. There was evidence that students learned from the experience of their peers who had participated in the first round, with the consequence of more preparation and structure in their approach to solve the case with their group. Since students still mentioned these areas as main challenges, one can conclude that their learning experience is not reduced by the informal learning from their home institution's peers.

The number of reflections raising the issue of the positive impact of technology remained similar, as did the number of reflections reporting struggling with the technology and the learning of new technology.

Surprising was the increase in reflections mentioning the formation of subgroups – in some cases between US students and non-US students but more often when two students from one institution were in the same group. We view the formation of subgroups as avoiding the intended learning from a global virtual team exercise. As a consequence future groups should ideally contain only one student from each institution. Fawcett et al. (2008) mention non-aligned performance measures as a barrier for successful SCM collaboration and this was evident in the student reflections papers as well.

FACULTY REFLECTIONS

Autumn 2011

After completion of the first round faculty met for a videoconference to discuss what worked and what needed to be modified in the execution of the case to enhance the learning and to prepare students for working in global virtual teams in their future careers. It was agreed it was critical to solicit the students to collect their preferred email address instead of retrieving emails from university systems. Doing so will avoid delays in group communication facilitating faster, and perhaps better quality, first group interaction.

There were enough student concerns expressed, whether real or perceived, that workgroups should not contain more than one student from any given university that future efforts will attempt to avoid setting up groups in this manner. The faculty identified two methods to help achieve this; first, increasing the number of universities participating in the experience will allow for a more diverse mixture of student teams, second, reducing the size of the groups from five students to four students. Doing so will marginally increase the number of groups and requires developing additional unique versions of the case.

Although students were asking to receive clear guidance on what role every group member should take in the project, faculty considered that in a cross-organizational supply chain environment hierarchies are also often rather blurry and therefore decided to keep roles open. The same point was made towards unequal marking weights. It became clear that participation needed to carry some grading component to ensure students are participating all way through. However, in the reality of global teams graduates will face that some group members have more or less motivation and more or less interest in the success of a project than others and although we believe the global virtual team project should carry a significant grade weight in each course represented a total uniformity would actually reduce the learning towards leadership.

Finally, in round one faculty allowed local students to be in the same room as the faculty member during the presentations. It was the opinion of the faculty during the post-mortem that presentations should require all students to be in a remote location and present in front of the camera.

Spring 2012

Positive changes made to the exercise included creating smaller student groups (four instead of five students) to allow for an improved mix of universities represented in each group plus the addition of two more universities. All universities held to the same requirements for the students which eliminated the disparity between student motivations. These actions reduced student concerns. Faculty appreciated the shift to Adobe Connect which allowed students to more easily show their presentation slides and supported the ability for all students to be in locations different than that of the faculty member viewing the presentation.

There were audio issues during the presentations which were attributed to the lack of familiarity and practice by students. If two or more locations had their microphone open, it resulted in distracting feedback throughout the system. Faculty agreed this can be resolved in the future by encouraging students to utilize Adobe Connect for their group interactions and practice prior to their presentations. It was again a surprise to faculty that many students were ill prepared for online videoconferencing. Whereas international students were often accustomed to the use of Skype-style communication applications, it was a new experience to many U.S. students. In general students appeared to underestimate the effort required to make the application run smoothly on their computers leading to a fair number of students missing the presentations of their groups and in many cases to a reduced quality of the presentation.

CONCLUSIONS

Graduates entering a logistics and/or supply chain management career can expect to be facing work projects in global virtual teams. Whereas the content preparation for that career is well established in academic institutions the interaction and collaboration skills are underrepresented in the curricula. Nevertheless these skills are essential for graduates' career progression. From the use of global virtual teams in our group project work we can conclude that most students do not possess these skills as yet despite the widespread thought that this generation of 'digital natives' would find it easier to engage internationally via ICT than previous generations.

Using global virtual teams in the classroom equips students with some of the key skills for a supply chain career as outlined by many scholars uniformly. Ellinger (2007), Gammelgaard and Larson (2001) and Mangan and Christopher (2005) all highlight the interaction and coordination skills that logistics and supply chain managers require and our classroom application shows that students find these aspects of our case study much more challenging than the content-base of the assignment. After multiple years of the international group work project we have also received informal feedback from graduates that their employers valued their experience of global project work in the selection process and future research could consider

monitoring the career progression of graduates exposed to global virtual teams in the classroom through a longitudinal study.

We must also conclude that the learning experience for students was less obvious than in a content-based assessment and that many students only realized during the reflection process how much they actually learned and what skills they developed. Our study can therefore be seen as a confirmation of van Ryssen and Godar (2000) and Ettington and Camp (2002) who see the reflection on the learning process as a key pedagogical point in the use of global virtual teams in education.

We can also conclude that through global virtual teams students are exposed to a level of diversity that is very often new to them and prepares students better for the reality of the global nature of logistics and supply chain management. Even if this level of diversity is available on campus, students may not necessarily engage with peers from other backgrounds. Making the participation in the global work project a part of the assessment therefore pushes students out of their comfort zones and forces them to deal with this managerial challenge.

The key challenge that was continuously mentioned by students is communication. However, communication struggles were experienced in different meanings. A surprisingly high proportion of students struggled to apply technology correctly to enable communication. Managing the communication and deciding on a communication channel was another challenge for most groups. Additionally communication was made more difficult through time zone differences and language barriers.

The study also showed that many student groups did not manage to set up a management structure for their project for some time or even the entire project. It was often commented that students missed a clear guidance on what role everyone should take up in the group supporting Rudman and Kruger (2014) who identified student preference for detailed structure in group projects. The feedback also shows that groups let too much time pass until they became functional, supporting Goggins et al.'s (2011) claim that students in online group work are more cautious initially and take longer until a structure emerges than in an on-campus setting. In reality the leadership will not always be clear, but encouraging students to determine a group management structure as a first step may help overcome this obstacle in future executions of the case project.

Our study substantially contrasts Taras et al.'s (2013) study which found language barrier and time zone differences less of a challenge than students anticipated. This contrast may arise from the different design of both studies as our students did not receive a pre-project survey that would confront them with these issues and make them consider such issues prior to the exercise. We did also avoid stark contrasts in language abilities by running the project in advanced university classes and hence extreme communication barriers were avoided. As a result the project groups were much less likely to be confronted with the worries surrounding intercultural learning that Burdett (2013) raises and the qualitative feedback provides evidence that intercultural learning occurred as a result of participating in the project.

The global realities faced by industry are increasing the demands on universities to turn out graduates that are ready to work effectively across country and cultural borders. Our study shows that the use of global virtual teams as a classroom tool addresses many of the skills needed by logistics and supply chain managers as outlined by Dittmann (2011): global orientation, technical savvy, cross-organizational interaction, and leadership skills. We would encourage instructors in all logistics and supply chain management programs to consider a similar approach to build these skill sets.

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Table 1: Country of origin of participating students (all rounds)

Country	Participants	Percentage
USA	560	54.6%
Austria	141	13.8%
Morocco	77	7.5%
Colombia	55	5.45%
Germany	33	3.2%
France	26	2.5%
China	22	2.1%
UK	19	1.9%
Peru	12	1.2%
Finland	10	1.0%
Vietnam	6	0.6%
India	4	0.4%
3 each: Brazil; Brunei Darussalam; El Salvador; Hungary; Lithuania; Mexico; Russia Federation	21	2.0%
2 each: Belgium; Bosnia Herzegovina; Bulgaria; Georgia; Ghana; Latvia; Nigeria; Singapore	16	1.6%

1 each: Afghanistan; Bahrain; Denmark; Djibouti; Estonia; Ethiopia; Guatemala; Hong Kong; Iran; Jamaica; Malaysia; Myanmar; Nepal; Netherlands; Norway; Qatar; Romania; Slovakia; Slovenia; South Korea; Spain; Turkey; Uruguay	23	2.2%
Total	1025	

Table 2: Logistics Experience (autumn 2011 and spring 2012)

	Work experience	Internship experience	Only logistics courses at university
North Texas	20%	49%	32%
Auburn	9%	29%	61%
Hull	24%	24%	51%
Bryant	0%	0%	100%
Los Andes	0%	0%	100%
Steyr	20%	34%	46%
Overall	15%	33%	52%

Table 3: Computer confidence (all rounds)

Very Comfortable	Somewhat	Not Very	Not At All
80.5%	17.1%	2.0%	0.7%

Table 4: Number of Email Accounts (all rounds)

Round	University	Work	Personal	Average number of email accounts per student
Autumn 2011	179	69	247	3.07
Spring 2012	326	125	444	6.09
Autumn 2012	283	198	368	3.37
Spring 2013	194	123	248	3.10
Autumn 2013	295	226	454	3.42

Table 5: Primary Email Account Used (autumn 2011 and spring 2012)

Institution	N=	University	Work	Private
North Texas	62	39%	2%	60%
Auburn	129	98%	1%	1%
Hull	33	79%	3%	18%
Bryant	8	100%	0%	0%
Los Andes	16	88%	0%	13%
FH-Steyr	31	85%	2%	15%
Overall	307	81%	1%	18%

Table 6: Collaboration ICT Applications Utilized by Groups

Round	Email	Adobe Connect	Instant Messaging	Dropbox	Google Docs	Facebook Groups	Google+	Other
Spring 2012	95.9%	76.2%	60.5%	29.9%	22.4%	19.0%	0.7%	N/A
Autumn 2012	90.5%	71.8%	38.1%	1.6%	22.2%	40.9%	2.4%	11.9%
Spring 2013	93.4%	73.6%	15.4%	0.5%	22.5%	9.3%	4.9%	18.1%
Autumn 2013	90.9%	73.7%	41.8%	22.8%	37.5%	59.3%	8.4%	14.0%

Table 7: Median Time (Hours) Spent Completing Case (autumn 2011)

Auburn	Steyr	Hull	Bryant	Los Andes	North Texas
8.0	8.5	20.0	6.0	20.0	11.0

Table 8: Case Difficulty

	Autumn 2011 n=161	Spring 2012 n=147	Autumn 2012 n=252	Spring 2013 n=182	Autumn 2013 n=285
Scheduling meeting/discussion times with team members	4.86	4.43	4.43	3.13	3.12
Communication between team members	4.56	4.05	4.05	3.38	3.48
Performing Quantitative analysis (Q1-Q11)	4.33	4.06	4.06	3.06	3.01
Planning content to deliver at final presentation	4.21	3.80	3.80	3.26	3.40
Coordinating schedule for final presentation	4.18	3.70	3.70	3.43	3.65
Developing qualitative analysis (Q12-Q13)	4.01	4.32	4.32	3.07	3.24
Making technology decision(s) to support final presentation	3.89	3.79	3.79	3.28	3.45
Making initial contact with team members	3.82	3.33	3.33	3.93	3.85
Understanding requirements for case deliverables	3.44	3.31	3.31	3.64	3.55
Understanding case content	3.34	3.25	3.25	3.57	3.68

Table 9: Student Reported Key Concept Learned (spring 2012 round)

Percentage	Key concept learnt
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34.0%	How to work in displaced workgroups
22.4%	Importance of communication skills; cooperation; collaboration
12.9%	Working in a group; teamwork
7.5%	Support your position by quantifying
7.5%	Using technology
5.4%	Cultural differences
4.8%	Dealing with time zones
3.4%	Logistics concepts
0.7%	Project management

Table 10: Student Reported Biggest Challenge (spring 2012 round)

Percentage	Key challenge
24.2%	Communication
19.5%	Time zones; distance
18.1%	Coordinating team meetings
15.4%	Working together; agreement on answers
10.1%	Technology
4.0%	Math
3.4%	Difficult case
3.4%	Uneven knowledge of group members
2.0%	Culture; Language

Table 11: Student Recommended Changes (spring 2012 round)

Percentage	Change
21.6%	<p>Increase Handholding</p> <ul style="list-style-type: none"> • Specifically tell us exactly what is needed; tell us how to present; I was unaware we had to quantitatively support my answers; precise information and no assumptions (23) • Set up networking website for students (4) • Lecture how to complete each question prior to assigning project; provide bibliography so we can find the answers; provide a user manual (4) • Have live Q&A capability (1)
20.3%	<p>Timing</p> <ul style="list-style-type: none"> • More time for project (19) • Different timing during academic term (6) • More time to present answers instead of executive summary (5)
14.2%	<p>No changes</p>
13.5%	<p>Technology</p> <ul style="list-style-type: none"> • Specific technology/kickoff training sessions; tell us how to communicate (12) • Change presentation technology (8)
10.1%	<p>Groups</p> <ul style="list-style-type: none"> • More diverse mix/more international within groups (3) • All students should be on same expertise level (3) • Faculty should assign tasks within each student group; assign individual questions; specify work times for groups (3) • More schools; different time zones (2) • Assign groups earlier (2) • All participants from same school; paired grouping 2 students from each school (2)
8.1%	<p>Grading</p> <ul style="list-style-type: none"> • Eliminate peer grading forcing us to rank participants (5) • Make case required; case “value” should be equal at every school (4) • Make case optional (2) • Implement panel grading (1)
6.8%	<p>Workload</p> <ul style="list-style-type: none"> • Make problems easier; less questions; no math (4) • Make case more difficult; more emphasis on quantitative (4) • Limit possible answers on open-ended questions (1) • Require each student put in equal effort (1)
5.4%	<p>Other</p> <ul style="list-style-type: none"> • More feedback from faculty (4) • Operate on 2 shifts to avoid time zone problems (1) • Use a different/unique case for every group instead of changing numbers (1) • Require all student speak English (1) • Add a surprise variable midway through the case(1)

Table 12: 1st and 2nd Layer Coding Nodes

Communication	Cultural Difference	Scheduling	Team Work	Work Structure
<ul style="list-style-type: none"> • Language barrier • Technology • Time zone 	<ul style="list-style-type: none"> • Appreciation of diversity • Cultural problems 	<ul style="list-style-type: none"> • Job-Study • Struggle to arrange meetings • Time pressure 	<ul style="list-style-type: none"> • Discussion • Free-rider • Leadership • Physical divide • Team structure • Uneven base • Uneven spread of work 	<ul style="list-style-type: none"> • Lack of structure • Set structure and followed it • Set unsuitable structure • Set structure but did not follow it