Global Design: innovative curricula towards global collaboration

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ABSTRACT

Increasingly design teams are engaged in distributed global working in either synchronous or asynchronous time modes. Such scenarios present diverse workplace challenges with regard to communication, coordination and collaboration.

Distributed design teams occupy both physical and virtual environments, and project managers must address issues relating to trust, unrealistic or inequitable expectations, cultural diversity, challenging logistics and unusual group dynamics. Differing work methods and behaviour may result in inter-team rivalry, misconceptions and unintended consequences with regard to project intent, processes and outcome. Tools, teams and environments must be carefully structured and managed to realise the potential strengths of global distributed design.

Contributing to the Erasmus Mundus Global Innovation Management course, the ‘Global Design’ unit addresses global product design and team management, where concurrent or sequential activities occur with responsibilities shared amongst distributed teams with limited informal interaction or social connectivity. In the design projects international Masters students at University of Strathclyde, Glasgow collaborate with design and engineering students from Swinburne University of Technology, Melbourne (in asynchronous mode) and the University of Malta (in synchronous mode).

Students utilise strategic methods, work cooperatively and manage workloads, responsibilities and product design development across cultural, language and time constraints. The experience gained in global distributed working is invaluable, and students develop understanding of societal, economic and environmental impacts of globalised design, manufacturing and distribution.

This paper describes curricula that focuses on processes and tools for global product design and development, and prepares students for non-traditional work environments and practices. Opportunities exist for development of new global synergies of understanding and cooperation, leading towards sustainable, responsible and equitable global product development. The authors (visiting Erasmus Mundus academic fellows) joined the course in its second year, contributing with lectures, studio teaching and curriculum development.

INTRODUCTION

The pervasiveness of globalisation in design, manufacturing and supply chain management has introduced organisational changes in the product design and development process, particularly through distributed design in both synchronous and asynchronous working models. These relatively new ways of working for designers and engineering designers are rarely included in curricula. Yet it is essential that graduates have the necessary skills to contribute to global teams though experience and understanding of the processes and tools of distributed design management. Effective collaboration, communication and coordination is necessary to realise the benefits of distributed global design such as faster, cheaper product development, utilisation of skill diversity, flexible response mechanisms, improved efficiency, innovation, and risk reduction.

As work in global distributed design occurs in both physical and virtual environments, collaboration occurs across time, geographical, cultural and functional borders. (Larsson, 2003) Consequently, project management must ensure that workloads are distributed fairly and equitably, project processes and intent clearly defined and understood, and communication (particularly information and knowledge transfer) and collaboration resources well organised.

In the ‘Global Design’ unit at University of Strathclyde students experience synchronous and asynchronous methods of distributed working, through projects that utilise simple design tasks to highlight the benefits of and barriers to, successful distributed design.

I. DISTRIBUTED DESIGN TEAMS

Virtual teams enable organisations to lever competencies and solve complex problems through skill diversity and competitive synergies which lead to greater innovation. (Prasad and Akhilesh 2002) These more flexible organisational forms offer faster response times, reduced development costs, access to specialised skills and greater information sources, new development opportunities, shared knowledge and expertise, improved localisation and enhanced cultural sensitivity. Divisions of labour, improved efficiency and differing perspectives also enhance the product design and development process. Transnational teams contribute to organisational cohesiveness (among autonomous national
subsidiaries) through the creation of lateral networks that enhance communication and provide opportunities for greater understanding of international and cultural issues. However, whilst transnational teams can provide new ways of looking at old problems, multicultural teams tend to perform either much better, or much worse, than mono-cultural teams.

Diversity of global teams, whilst advantageous, suffers from problems typical of geographically displaced workplaces where ‘different participants within different object worlds with different competencies, responsibilities and interests speak different languages’ (Bucciarelli 2002). Differing cultural expectations, attitudinal patterns and educational backgrounds must be negotiated by collaborators to achieve a collective understanding of the project goals, intent and processes. Distributed design teams lack informal communication and the synergies resulting from co-location, and require alternate socialising opportunities to develop cohesiveness, empathy and trust. This is particularly important in product design environments where design often occurs as a social activity requiring establishment of a shared understanding or common ground between team members (Larsson 2003).

Consequently, enhanced collaboration, communication and coordination are crucial to realise the potential of distributed design teams, as is control of project direction and ownership of strategy, objectives, tasks, and decision making processes.

II. THE ‘GLOBAL DESIGN’ UNIT

Contributing to the Erasmus Mundus ‘Global Innovation Management’ (GIM) course offered jointly by the University of Strathclyde, Aalborg University and the University of Hamburg, the ‘Global Design’ unit affords learning opportunities in the processes and impacts of global distributed working through synchronous and asynchronous collaborative projects.

In these global design projects, international Masters students at University of Strathclyde collaborated with students from partner universities in distributed teams to achieve a design solution; asynchronously with final year product design engineering students from Swinburne University of Technology, in Australia and synchronously with engineering students from the University of Malta.

The GIM students were culturally diverse, originating from Albania, Bangladesh, Brazil, Colombia, Ethiopia, India, Indonesia, Italy, Macedonia, Mexico, Netherlands, Poland, Serbia, Thailand, Turkey, Vietnam, and the United Kingdom with undergraduate qualifications in engineering, design, business and management. By contrast the Australian and Maltese student cohorts were mainly mono-cultural and single discipline.

The projects were relatively simple design tasks that provided understanding and experience of the diverse workplace challenges that occur when team members are distributed geographically and across time zones.

The projects emphasised effective communication, organised coordination, knowledge sharing and equitable collaboration and were supported with lectures on global working and distributed design management and tutorial workshops to enable effective use of the digital support tools. Post project reflection sessions were conducted firstly with co-located team mates, then between distributed team members and finally across the entire class, generating valuable inter-team comparative evaluations of the benefits and limitations of the distributed design process and communication tools.

III. DISTRIBUTED DESIGN PROJECTS

A. Project one - Asynchronous Project with Swinburne

In this project students designed a foldable and reusable tray to carry six coffee cups from cafe to workplace. The three-week exercise was conducted with distributed student teams located in Glasgow and Melbourne; a nine hour time difference ensured that direct communication within working hours was unfeasible.

The eleven distributed teams (each with three students from each university) were allocated specific communication tools (distributed randomly) through which all interaction and data transfer occurred. These tools consisted of freely available data/file sharing and communication media, as follows:

- Google Docs (online file sharing) - docs.google.com
- Wetpaint (online collaboration wiki) - www.wetpaint.com
- Blogger (blog publishing system) - www.blogger.com

Tools were chosen for accessibility and ease of use, and allowed students to benchmark differing communication tools to identify strengths and limitations. Whilst corporations use internal intranets and data management systems to facilitate and manage information flow, it was felt that these readily available communication tools enabled similar experiences but with sufficient interface variation to facilitate good comparative processes and learning opportunities.

![Asynchronous project flow chart](image)

Fig. 1: Asynchronous project flow chart
Project responsibilities were shared between team members from each university with tasks occurring either jointly (research and evaluation), simultaneously (concept ideation) and sequentially (design development and prototyping).

A particular challenge of the asynchronous project was the requirement for students who had never met, to collaborate to jointly evaluate conceptual designs and then choose a design direction in a non-competitive manner. Once the design direction was selected, teams worked sequentially to develop CAD models, then refine and prototype the final design. Shared and sequential tasks underlined the need for good communication and project planning as the significant time difference impacted on inter-team discussion, introduced delays and consumed valuable project time.

**B. Project two - Synchronous Project with Malta**

In the second project students addressed the rehydration of marathon runners (to improve existing water stations). The project was conducted in distributed synchronous mode with students that whilst not co-located, were in time zones only one hour apart, which facilitated greater interaction and direct communication.

These conferencing tools were chosen to provide a range of advantages and limitatio

![Synchronous project flow chart](image)

Fig. 2: Synchronous project flow chart

Teams were allocated either Google Docs or Wetpaint for data storage and information transfer, and one video conferencing tools for direct communication; either Polycom, Flashmeeting or Skype.

These conferencing tools were chosen to provide a range of experiences, each with unique advantages and limitations; such as advance booking, poor quality visuals or sound or bandwidth limitations. To enhance the direct synchronous interaction enabled by the video conferencing, students were encouraged to use digital whiteboard tools that enable real time collaborative conceptual sketching between distributed team members. Of these Skrble (www.skrble.com) and Imagination Cubed (www.imaginationcubed.com) proved invaluable as this virtual environment allowed students to simulate interaction that is normally only be possible between members of co-located teams. As designs advanced, teams used Google SketchUp (http://sketchup.google.com) to transfer 3D designs across distributed locations.

**C. Project comparisons and outcomes**

These projects provided opportunities for students to plan, organise, manage and execute projects with short lead-times and work with distributed team members with whom there was no previously established relationship, trust or understanding of skills and competencies. A preliminary (week 0) stage was necessary in both projects to facilitate initial contact, establish rapport and develop proficiency with the allocated communication and data exchange media. In the early stages, students sought to develop personal relationships using short biographical introductions and personal images. It was essential that students liaised effectively, understood each other’s key competencies and workloads and established project parameters and responsibilities.

Students found dependence on distributed team members (for task completion) troublesome, and it was soon apparent which teams had established an effective project plan, allocated responsibilities and were actively managing the workflow.

During the asynchronous project, which was run first, students inexperienced with distributed design often failed to ascertain whether crucial tasks had been actioned. Whilst the students were at similar aptitude levels (final year undergraduate and first year masters) there were discrepancies in skill sets and differing levels of commitment to the project (as the Swinburne students were completing the final weeks of their course). The time difference between Melbourne and Glasgow exacerbated poor communication leading to significant project delays; highlighting the need for clear allocation of responsibilities and strong project governance.

One example of poor communication and project specification was found in the construction material of the coffee cup holder. Whilst the written project brief did not specify a material, the Glasgow students were verbally briefed that it was to be folded cardboard construction. The Swinburne students interpreted the brief differently and through a strong sustainability covenant utilised different materials and processes to ensure product longevity. This resulted in the distributed team members developing concept designs to completely different parameters and only one team out of eleven had sufficient depth of project definition and rapid communication to identify the issue early and avoid time wastage. This proved a valuable learning experience as students revisited the communication-collaboration-coordination matrix and found their methods underdeveloped.

On the communication side, projects were often badly planned and managed, parameters poorly specified and clarified, and insufficient engagement and liaison was exacerbated by asynchronous communication.
suffered from a lack of cohesive decision making and there was evidence of co-located teams working in isolation from their distributed team members. Likewise, project coordination was let down by inadequate ownership of responsibilities and tasks, and poor time and role governance.

Post project reflection sessions analysed not only the team performance, but the positives, negatives and barriers presented by the allocated communication tools. All of the digital media tools were found suitable but limited in their capacity as project management tools. Google Docs had the advantage of real-time collaboration but was impersonal, lacked change tracking and a discussion area and had file-size limitations. Wetpaint, whilst containing a discussion section and an activity bar, suffered from upload difficulties and incompatible file types. The blog tool (Blogger) was easier to use and encouraged greater interpersonal and informal activities, but lacked formal structure. Communication in all tools was hampered by a lack of notification following uploads, necessitating additional email communication to ensure information exchange.

Despite technical difficulties and students inexperienced in distributed design, project outcomes were of high standard and reflected a diversity of approach that supports the objectives of global design. Students enjoyed the experience and gained valuable insight into the importance of clear project definition and careful project planning and management to ensure successful collaborations.

The synchronous project differed greatly as the students’ commenced work with a greater understanding of the process of distributed design and the importance of effective communication, coordination and collaboration. It was apparent from the outset that parameters would be clearly defined and projects more firmly managed. As the collaborating students from Malta were 2nd year undergraduates, the GIM Masters students quickly established themselves as project leaders and were pro-active in all aspects of the project.

Due to the synchronous nature of this project, students worked more closely with their distributed teammates, with scheduled video conferencing occurring at least once a week, aided by concurrent data uploads and on-line whiteboard sessions as required. The frequency of contact and real-time interaction enabled students to quickly establish a good team rapport and teamwork benefited from synergies not apparent in the asynchronous project. Working synchronously afforded more opportunities for collaboration and reduced the independent and isolated working patterns evident earlier. In this project the benefits of effective distributed design working were more evident. Students simultaneously used multiple collaboration tools including digital whiteboards, on-line discussion threads, data uploads and video links.

However dependence on technological aids impacted on project progression. Technical equipment failures, on-line access issues and occasional unavailability of on-line software contributed to stress and consumed valuable time. Users of Polycom and Flashmeeting were frustrated by the need to book sessions and equipment (negating spontaneous discussion), an issue not troubling the Skype users who had significantly more interactions, including off campus and informal discussions, although at a low quality due to reduced bandwidth. The Polycom users relished the quality of both visuals and sound together with the camera zoom function whilst the ‘press to talk’ functionality of Flashmeeting stilted some conversations.

However the design outcomes were highly developed and demonstrated the innovation that can result from cross-cultural collaboration, and reflected a higher degree of input from all team members.

IV. REFLECTION

The ‘Global Design’ module affords students opportunities to compare and contrast global working for different sites with different time differences, languages, cultures and team profiles, and provides a framework for evaluating tools and methods for distributed working and specifically for different distributed design activities. (Wodehouse et al. 2008)

Unfortunately the order of projects was dictated by partner university timetabling. By necessity the asynchronous project with Swinburne was run first to complete it before the end of the Australian academic year. It would be more advantageous to run the synchronous project first to allow the students familiarity with the methods of distributed working, prior to tackling the most challenging distributed design model. However the difficulties faced by students as they developed their distributed design methodology, afforded significant learning opportunities and the students gained a higher level of exposure to the barriers to successful global design.

Students indicated a preference for both parts of each team to be coordinated by the same academic for consistency; however we consider that diversity of opinion and the potential for unexpected issues outweighs their concerns and enhances the learning process. The students expressed concerns regarding technological dependency, complexity of cross-cultural communication (including language barriers), storage, retrieval and security of information, lack of consensus at critical stages, misunderstandings and lack of personal connection with distributed team members. This feedback combined with the successful design outcomes is indicative that the unit has been successful in not only providing experience of the difficulties of global distributed design, but also in providing the necessary organisational platforms for successful product realisation in that arena.

V. DISCUSSION

Globalisation is a pervasive force driving world economies with the potential to increase economic prosperity as well as opportunity, especially among developing nations. The opportunity exists for civil liberties to be enhanced and for free trade to lead to a more equitable and efficient allocation of resources (and rewards) for all countries. This should result in lower prices, more employment, higher output and a higher standard of living for all stakeholders. However globalisation hasn’t yet realised its potential to create a better, more equitable and harmonious world.

Critics argue that due to globalisation, poorer countries suffer disadvantages including the negative impact of western
government subsidies on the economies of poorer nations, exploitation of impoverished workers (including children), unfair trade agreements, environmental degradation and resource depletion. Even first world economies suffer though wage and benefit reduction, deterioration of the middle class and wide scale loss of skills and societal potential.

Consequently, curricula teaching the tools for enhanced distributed global design must also be sensitive to the potential negative impacts of global activities, particularly with less developed economies and disadvantaged populace. Efforts were made in the ‘Global Design’ module to ensure that the students were imbued with a strong sense of purpose and humanitarian, cultural and environmental consciousness.

It is essential that global designers understand their responsibilities as global citizens and face their biggest challenge; addressing the needs and aspirations of those who currently lack the basic elements that contribute to a healthy, safe and equitable lifestyle. As global designers our graduates must be ethical and responsible, and understand the consequences of their activities, the potential for a greater societal contribution and their responsibilities to all global stakeholders. (de Vere et al. 2009)

REFERENCES


