

# EXPERIENCE OF GLOBALLY DISTRIBUTED DESIGN TEAMS IN A CHANGING WORLD

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## ABSTRACT

This study considers and reflects upon the experiences of globally distributed teams of design students, set a particular design challenge and given free choice over the tools that they use to complete that challenge. The study presents a reflective case study undertaken by staff facilitating a class consisting of asynchronous, globally distributed teams. The students were organised into teams across universities from New Zealand, the United Kingdom, Sweden, Finland, India, and Japan. The teams conducted the design challenges over eight weeks, culminating in completed design solutions. The academic staff involved in the delivery of this annual global design challenge reflect upon the changing and evolutionary nature of the class and students working practices since its inception in 2004. Interestingly many “traditional” tools were still employed alongside more contemporary options. The study reflects upon their experiences and how their choices shaped their solutions and learning throughout the design process.

*Keywords: Design collaboration, global design, distributed teams, teamworking in design*

## 1 INTRODUCTION

The development of modern communication and online collaborative tools has helped to increase the diversity and distribution of product design teams. Remote working and asynchronous design practices are rapidly becoming prevalent and are replacing shared physical spaces of designers. As the world continues to adapt to significant events post COVID-19, there is much debate about whether such working practices may become the norm and the value they render. At the same time, the emergence of digitally driven design and assistive tools offer teams a diverse range of approaches for rapid realisation during design development, with substantial debate regarding the efficacy of using such tools. Modern techniques in computer-aided design, generative design, rapid prototyping, and immersive tools offer new opportunities to accelerate and enhance the design process and, at least in theory, lead to superior design solutions, in comparison to physical model making, which was once the cornerstone of product design. Drawing on the notion that prototyping has been portrayed as an excellent activity to share inner thoughts [1], previous research has lacked a deeper connection between knowledge-building, project progression, and the escalation of design processes across distributed teams operating at an asynchronous level. This is further supported using generative AI tools which can support the many other facets of working in a globally distributed design team; tools for language translation, generation of code for mechatronic designs, automated scripting [2]. To facilitate team progression, past studies have looked at how collaborative cloud-based tools can enable efficient sharing, interaction [3].

This paper furthers understanding of how students employ various tools in response to challenges, through students' own experiences. It is important, either from an educational or industrial perspective, to understand the working practices of the next generation of product designers. This awareness not only adds important perspectives to further enhance feedback processes that may enable action points for project management and improve the use of internal team resource competencies [4]. The steps required

to achieve consensus in collaborative practices within design teams vary based on the phase of the design process, emphasizing the importance of cognitive processes and conversation activities [5]. The challenges for distributed team challenges are complex; in a recent study on global innovation teams in an industrial context [6], numerous factors enabling the work were identified. For example, ways to learn from each other, establish collaboration, and choice of technology for communication throughout the project, were seen as essential. Yet by examining critical team dynamics this paper will guide design educators in the support of students during team interactions and for feedback interventions in the act of solving design problems in a distributed setting.

## 2 PROJECT FORMAT & EVOLUTION

In order to explore these areas a class “Global Design” was created to provide a mechanism for design students to experience a truly international design challenge. The aim was to use digital tools and design methods to facilitate effective global team communication. Students undertaking the class gain a unique educational and design experience operating as part of a distributed global team. The setting aligns well with the ongoing trend of reduced travel for global development teams to lessen environmental impact [7] while also contributing to increased efficiency for the involved team members [8] and work quality [9].

### 2.1 Participating institutions

The class was initiated at the University of Strathclyde. Initially informed by the research of academic staff and their colleagues at other institutions, where similar programmes in design and engineering were offered and have continued to this day. Over the last 2 decades there have been a number of participating institutions, those involved most recently are shown in Figure 1.

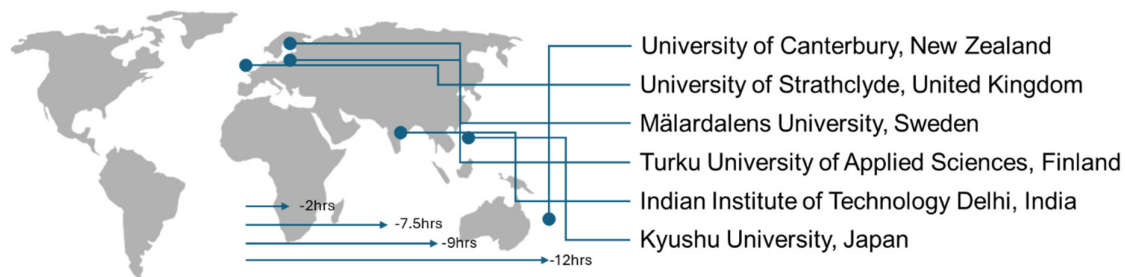


Figure 1. Participating Universities of Global Design 2023

### 2.2 Project structure and brief

In each iteration of the class, students are organised into global teams of 7 or 8 across at least 3 institutions and set an 8-week design challenge to complete; project timeline is shown in Figure 2. Students are typically from design-related courses but can vary from more technical engineering to business and strategy disciplinary backgrounds. The challenges have varied widely, ranging from designing travel accessories to automated pet feeders. In the most recent iteration, teams were challenged to design a solution to help prevent deep vein thrombosis (DVT) on long haul flights. A series of lectures provided students with the background information on the types of activity expected at each stage. It was up to teams how they organised work, conducted meetings, and allocated tasks for the global team, but there were two main types of design activity (divergent/convergent) and two main modes of working (synchronous/asynchronous). Teams were invited to choose from the tools and methods presented and reflect on their effectiveness with regards to these activities and modes. All teams were required to produce a folio documenting their design process and outcome, culminating in teams presenting their design output in a joint online presentation. The samples of some outputs are shown in Figure 3.

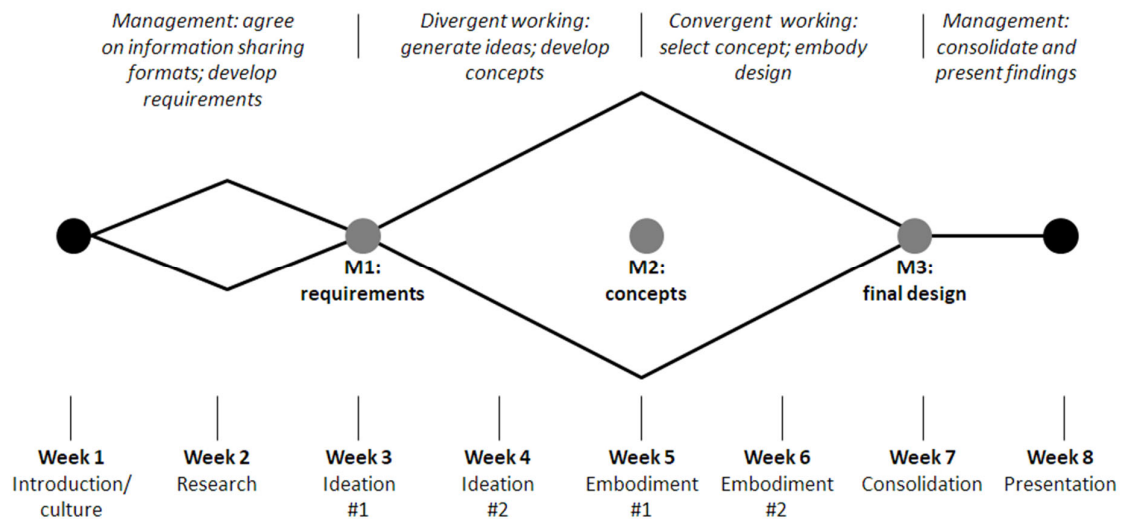


Figure 2. Timeline of the design project undertaken in the global design class

During the project, recurrent reflections by the students were conducted focusing not only on the progress of the project and the collaboration with the international team, but also on the course design. These were collected through field notes and written project reports. However, due to the variant nature of academic calendars around the world, and whether or not the class was included as part of an assessed educational activity or voluntary, each institution could set their own mechanisms of assessment. The academics involved at each of these institutions now reflect on these outcomes over the years and on discussions and observations of student work within the class. This represents a mix of both formally and informally gathered observations drawing from course evaluations, team journals and reflective essays produced as part of the class, each varying by institution.

## Global Design 2023

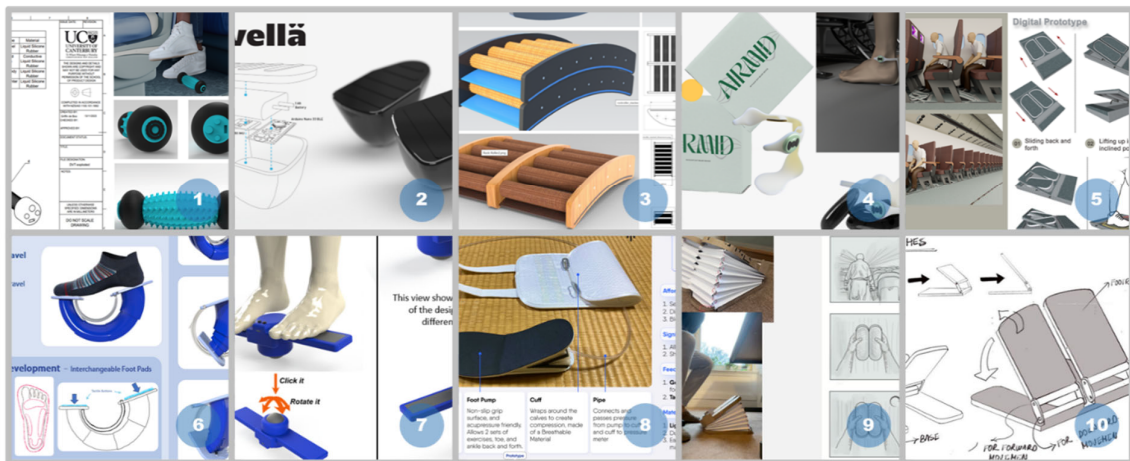


Figure 3. Samples of output generated by participating teams

### 3 EXAMINATIONS OF PRACTICE & CHANGES OVER TIME

Much has changed and evolved since the inception of the class. However, it is reflected that many of the principal benefits and challenges of participating have remained consistent. These are best summarised under three principal categories of technological support, organisational matters and cultural aspects. In Table 1 we present a summary of the key observations in each of these areas in the early stages of the class and the later stages of the class.

Table 1. Summary of evolving practices

	Observations from early iterations of the class (2004 – 2009)	Observations from later iterations of the class (2019 – 2024)
Technological support	<ul style="list-style-type: none"> <li>• <b>Social media</b> quickly becomes the defacto means of communication; students cite the more intuitive means of communication compared to features built into software or email.</li> <li>• Different institutions make use of <b>different standard software</b>, this is a perennial challenge still relevant in 2024.</li> <li>• Many of the best tools remain prohibitively expensive for student teams, still relevant in 2024.</li> <li>• Language and <b>communication software</b>, particularly live systems are limited and inaccurate.</li> <li>• While social media is the defacto means of communication <b>video conferencing</b> remains popular and is often cited as the preferred means of synchronous communication as a team.</li> </ul>	<ul style="list-style-type: none"> <li>• Social media remains the prevalent form of communication. However, as platforms limit cross-platform functionality and require more “buy-in” <b>personal preferences</b> create challenges in arriving at consensus (e.g. “Don’t like Facebook”, “don’t use social media”)</li> <li>• Language and communication software, particularly live systems, have become increasingly powerful and accurate. However, <b>increased trust</b> presents issues when errors occur and are then propagated by the human users.</li> <li>• “Zoom fatigue” has become an issue, a pre-emptive sense of exhaustion prior to large calls.</li> <li>• <b>Fewer barriers</b> to equipment post pandemic following the global adoption in both personal and social contexts.</li> <li>• AR/VR unfortunately remains of very limited use as it requires such significant buy-in and like-for-like compatibility.</li> <li>• Using only e-mails and text messages caused <b>misunderstanding</b> and did not contribute to cohesion</li> </ul>
Organisational matters	<ul style="list-style-type: none"> <li>• <b>Time difference</b> principal organisational issue for global teams.</li> <li>• Various parts of teams might be in workshop together while counterparts are at home many hours after leaving <b>practical spaces</b>.</li> <li>• Access to web conferencing equipment may also be influenced by the <b>space</b> team members are operating in.</li> <li>• Cloud based storage influenced by institutional and team member <b>personal preferences</b>.</li> <li>• Accommodating <b>different curricula</b> and academic cycles across partners has implications not only in organising the structure and delivery of the class, but for individual team members in co-ordinating meetings and collaboration.</li> </ul>	<ul style="list-style-type: none"> <li>• Time differences remains significant challenge however <b>equipment access</b> less of a challenge post-pandemic.</li> <li>• A challenge still remains with <b>practical work</b>.</li> <li>• Increased concern for <b>cyber security</b> has driven greater security steps, notably 2 factor authentication and similar. While these are necessary, they present challenges for shared resources; benefits of particular tools cannot be realised, unless all institutions have the <b>reciprocal tools</b>.</li> <li>• <b>Licencing</b> arrangements for each institution, even on the same platforms, present challenges, significantly more so than in previous years.</li> <li>• Varying levels of <b>commitment</b> among students can led to low engagement and the formation of subgroups.</li> <li>• Differing understandings within the team regarding the problem to be solved resulted in a suboptimal solution. Additionally, the organizer/project owner did not sufficiently <b>clarify the purpose</b> of the expected solution, which compounded the issue.</li> <li>• The gap between what the organizer expected for a solution and the existing research in the problem area was not optimal for the solution</li> </ul>
Cultural aspects	<ul style="list-style-type: none"> <li>• Value is really gained in <b>cultural exchange</b> and co-working on a design challenge that is global in nature.</li> <li>• There are challenges of <b>integrating the unique cultural natures</b> of teams that have principally been most valuable but potentially problematic challenges in mapping institutional expectations to assessment and outcomes.</li> <li>• Attitudes and <b>approaches to design work</b></li> </ul>	<ul style="list-style-type: none"> <li>• Use of <b>translation tools</b> to overcome language barriers, which are increasing in accuracy, however these are still literal, and are limited in terms of subtleties, e.g. cannot grasp <b>subjective regional expressions</b> and turns of phrase and can lead to misunderstanding.</li> <li>• Differences in <b>communication culture</b> especially in live communication intensity can cause frustrations among participants.</li> <li>• Differences in <b>time management culture</b> caused uncomfortableness among teammates. Preferences for a planned schedule versus working intensively when the deadline approached.</li> <li>• Differences in <b>decision-making process</b> culture confused teammates. Some were used to adjust the agile approach and others were more used to the waterfall approach.</li> </ul>

## 4 DISCUSSIONS

Improvements in the equipment and software available to designers and students has rapidly transformed the pace at which design projects can be completed in a distributed setting. However, challenges of working in a cross-cultural international team remain. Shifting attitudes towards certain software and their parent companies has become a much more prevalent concern particularly among student teams. Regional variance in preferences has also become more noticeable since early iterations of the class. Unfortunately, many of the most advanced and impressive features of particular software and hardware remain prohibitively expensive. For example, many teams have indicated that they would wish to experiment with AR/VR capabilities, and while they have access to particular hardware and software to achieve this, it requires corresponding resources at partner intuitions, which are frequently different or bound by separate licencing agreements, in some cases even where the same suppliers and providers are involved. Those teams which did persevere had some success but it served more as an accompaniment to other design tools rather than a critical tool in itself, and was seldom employed in the convergent design tasks, where critical design decisions are made, it was a general observation by those student teams that if there was greater ubiquity and/or cross-platform options available this would have been a more useful avenue to pursue, perhaps this will be more of a significant shift in the next decade, with costs reducing as time passes.

Time differences remain a significant challenge. Night and day patterns mean team members may be at home rather than the office and do not have access to same equipment as their counterparts and vice versa. Some students also drew attention to having to set very clear boundaries around communication, particularly what types of communication were appropriate and at what times, or indeed what 'out of hours' times should be agreed upon by team members in different regions. Variance in cultural expectations around working patterns and a need to establish trust and confidence early in the project have also been key factors to consider, to facilitate this "ice breaker" activities have been employed. Other studies into distributed student work make similar observations on the influence of team cohesion, identity, trust, and credibility early in the project [10] and the challenges presented by physical separation in design teams [11].

When considering the value of teleconference or telepresence systems, video chatting is frequently highlighted as the preferred option when time allows. When considering why this is the preference teams cite the value of being able to see and read facial cues and to be able to gesture when communicating. The ability to screenshare was also highlighted as a key benefit. Interestingly the advent of another technological assistance, live transcription and translation, has added a compounding layer to this mode of communication. While it has been immensely powerful at assisting communication it has also led to complications with distraction meaning that some facial cues are missed while reading and that regional expressions or idioms which are translated literally lose some of their subjectivity and subtleties. Many teams also highlighted that while such tools are useful, they should not be trusted without question as this can lead to misunderstandings.

Almost all teams reflected on the value of taking the class. Many participants cited the unique experience of being part of a cross-cultural team [12]. Comments frequently arose that it forced team members to consider problems from different perspectives and that this frequently led to potential solutions they would not have considered otherwise. In some cases, this was highlighted even in terms of the different languages involved, where expressions, once understood, provided a different interpretation of a product feature or function.

## 5 CONCLUSIONS

Challenges of time difference, choice of communication tools, cultural issues, variance of team member experiences, variance of outcome expectations, language and communication barriers remain a consistent feature of collaborating for students in globally distributed teams. We learnt the methods and tools employed by teams have evolved; in many cases reducing the level of challenge. However, none have been eliminated completely – arguably indicating that the challenges of operating in a global team still exist, and while new tools are positive in minimising these challenges, they are still only effective if used purposefully, with consideration, and with an understanding of their limitations. In reflection the academics involved from the participating universities make a number of recommendations; communication is still the most significant factor in the success of globally distributed projects. Various software and hardware can improve quality but cannot alone replace the fundamentals of good communication. Care should be taken to ensure that such tools do not inadvertently amplify

misunderstandings. This can take many forms, loss of versioning control, cultural misunderstandings and possibly break downs in team moral. It should not be assumed that a team will adopt a suitable default means of communication, preferences and concerns can heavily influence a student team's success, academics and prospective employers should take significant care in establishing appropriate modes of communication: and aspire to create a functioning eco-system where the team can operate. This is best achieved when co-created with student teams themselves.

The longevity of the class is a highlight of the value of collaboration and its success in meeting educational needs in a global society and employability of graduates of the future. There has been a willingness on the part of staff to facilitate the global experience and for students to embrace it as part of their learning journey.

Throughout this study, we have identified further research avenues, such as the development of teaching tools and support for international courses to minimise identified hurdles; exploring how the involvement of global companies can potentially enhance teaching activities and student engagement; and investigating how courses spanning longer durations can potentially cover more activities towards a fully developed solution ready for implementation.

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