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Training the Next Generation of Designers for a Sustainable Future: Action Research on the Circular Design Internship

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This paper introduces the first internship programme in University of Limerick (UL), Ireland, which is a part of two-year collaborative action research of four subsequent internships, co-funded by the Erasmus+ Programme of the European Union. The research focuses on training novice designers for challenges and real-life complexities in addressing issues of sustainability through design. The internship aims to create the environment for interns to self-learn and experience tools and techniques for Circular Design and present the potential of these tools and techniques in real-life innovation processes. Through this internship, interns were able to experience real-life challenges of creating innovative design solutions to address issues of sustainability and to develop their practical approaches to overcome these challenges. The internship is structured to convey *general design practice* and *design for sustainability* competencies to the interns, while gathering their insights throughout this internship and providing directions for improvement in the following internships in Universitat Politècnica de Catalunya (UPC) in Spain, NHL University of Applied Sciences (NHL) in the Netherlands, and Linköping University (LiU) in Sweden.

sustainability education, design education, action research, industry collaboration

1 Introduction[1]

There are different levels at which universities can build the relationship between design practice and sustainability. Some of these suggested approaches are: mainstreaming the sustainability inherently throughout the design education (O'Rafferty *et al*, 2014; de Eyto *et al*,2008), introducing modules focused on sustainability incorporating design practice (Boks & Diehl, 2006), and acting as

[1] The work under discussion in this paper took place from September to November 2017 and is part of a larger three-year research project.

intermediaries in industry through utilising the expertise of academics on design for sustainability (Küçüksayraç, Wever & Brezet, 2017). Integrating principles of sustainability, and its design-related competencies, throughout design education is a more holistic approach that can result in deep learning over an extended period of time. Such integration, however, should involve differing perspectives of academic staff in a holistic manner, while at the same time ensuring that core competencies related to design education are still being conveyed to future designers (O'Rafferty *et al*, 2014). In order to ensure that issues of sustainability are addressed properly and not just as an additional consideration in design courses, a more hybrid approach should be developed and adopted in education (O'Rafferty *et al*, 2014; Boks & Diehl, 2006). In addition, continued professional development of academics is also necessary to keep up with ongoing changes and advancements around the topic of sustainability (O'Rafferty *et al*, 2014). Collaboration and knowledge exchange among different institutions to build educational capacity (O'Rafferty *et al*, 2014; McMahon *et al*, 2012) and between universities and industry to transform business practices (Küçüksayraç *et al*, 2017) is crucial.

During the United Nations Decade for Education for Sustainable Development 2014, the role of higher education institutions was discussed widely through capacity building (O'Rafferty, Curtis & O'Connor, 2014; Lozano, 2006), changes in learning outcomes (Shephard, 2008) and facilitating change in practice (Zilahy & Huisingh, 2009). As for adoption of sustainability in general education as well as university-level design education, there are many barriers that can be grouped under overcrowded curricula and limited expertise or awareness of staff (Sterling and Witham, 2008; Boks & Diehl, 2006; de Eyto,2010). However, these challenges need to be overcome through a collaborative approach in education and novice designers should be trained to address issues of sustainability inherently in their future design practice. Following this line of thought, this paper will introduce an internship programme that builds such a collaboration among institutions and businesses, while enabling novice designers to experience this complex relationship first hand in developing sustainable design solutions that can transform business practices.

As part of the Learning for Innovative Design for Sustainability (L4IDS) Erasmus+ Knowledge Alliance project, four European institutions with design departments [University of Limerick (UL) in Ireland, Universitat Politècnica de Catalunya (UPC) in Spain, NHL University of Applied Sciences (NHL) in the Netherlands, and Linköping University (LiU) in Sweden along with four design led SMEs (Small to Medium Enterprises) and three National Design Agencies] aim to develop a training and exchange programme for Circular Design with an adoptable schedule conforming to the structures of these schools. The aim of the programme is to promote a culturally-diverse, interdisciplinary working environment for students from varying backgrounds (i.e. Product Design, Business, Materials Science). There are two main goals for this internship:

1. to develop an adaptable training programme with standardised educational tools and techniques, which can be integrated into many existing design departments around Europe. This, in turn, can build interdisciplinary capacity within those departments to train future designers with a comprehensive understanding of sustainability, as well as ways of undertaking innovative design practice to tackle its issues.
2. to create training opportunities for novice designers and other disciplinary students on working in multi-cultural training environments and tackling the issues of different local contexts and local industry, through setting up student exchange programmes and bringing industrial partners into the training programme.

On September 1st, 2017 the first Circular Design internship started in UL, Ireland with the attendance of 10 interns (i.e. three interns from UL, three from NHL, two from UPC and two from LiU). With the start of this internship, a long-term collaborative action research process also started to further develop and optimise this internship programme that can be adopted by other European Higher Education Design Schools.

This paper introduces the action research methodology, the components of this internship programme and the assessment of the first internship through the participating interns' feedbacks.

2 Action Research and Design Education

This internship programme is being developed by four higher education institutions in four different EU countries, who share similarities on their approach to design education (i.e. practice-based learning in studio environment) and present differences in structuring of curriculum and content (e.g. duration of bachelor education, courses, trainings, access to workshops, etc.). This complicates the development of a standardised internship programme with respect to the students differing backgrounds and inclusion of the programme in existing curricula. On the other hand, the focus of the internship (i.e. sustainability and circular design) clarifies the common educational goals that help structure the internship programme. Hence, four higher education institutions agreed upon adopting an action research methodology through iterating the internship programme by reflecting on and building upon the previous implementation of it, and providing reflections and guidance for the subsequent internships.

Action research is a commonly used methodology in educational contexts for the continuous development of curricula and educational content, as the distinction between them (i.e. development and education) is removed, and they are brought together as research (McKernan, 2008). The educators' role changes significantly as well; they become researchers that perform continuous self-evaluation and work on the problems they identified (McKernan, 2008). The development and the goals of this internship programme are beyond the capabilities of a single researcher. The attempt to create a programme repeatable within different curricula and content, no less an exchange programme to bring together interns of different understandings on issues of sustainability and the development of the programme requires a collaborative framework.

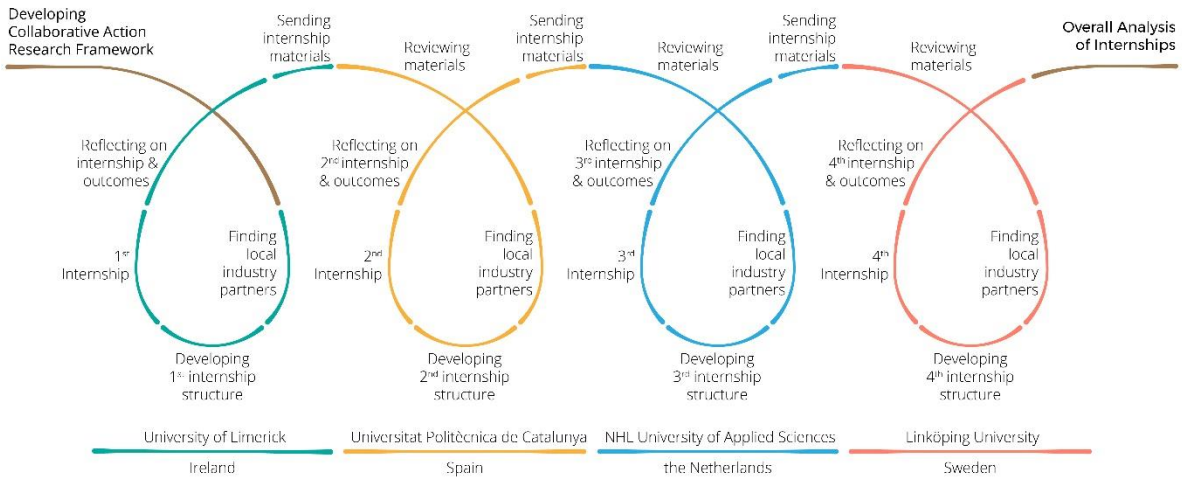

Figure 1 Collaborative Action Research Framework developed in Learning for Innovative Design for Sustainability Erasmus+ project, indicating the internship cycles.

In the case of education in general, collaborative action research brings together lecturers, human resources and researchers in an attempt to improve pedagogical practice and contribute to educational theory (Oja & Smulyan, 1989). However, in this case of developing an adaptable Circular Design internship programme, different institutions from different cultural backgrounds and pedagogical perspectives are involved and the development of the programme requires reflection of the involved researchers on the existing design education. Hence, in line with the action research cycle steps of reflection, planning and action (McNiff & Whitehead, 2006), the collaborative action research framework in Figure 1 was developed. The first internship programme was planned in UL from September 1st to November 30th, 2017. Upon its completion, researchers will reflect on the

internship and its outcomes, and this reflection along with all the internship material developed will be sent to the next institution (i.e. UPC, Spain). The educators/researchers in the second institution will review the materials, reflect on the first internship and further develop the internship structure and content. The outcome of this process will be a comprehensive internship programme to train the next generation of designers for a sustainable future, which can be conducted in different design schools all around Europe.

For this framework, the knowledge transfer among lecturers/researchers needed to be well-structured to ensure the continuation of the action research cycle thus reaching meaningful outcomes. The internship programme was developed according to key learning outcomes that were devised at the beginning of the first action research cycle:

- Creating the environment for interns *to self-learn and experience* the necessary tools and techniques for Circular Design.
- Facilitating learning for innovative, sustainable design *for both the interns and the industry partners* throughout the design process.
- Present the potential of innovative design tools and techniques for sustainability and circular economy as applied to *real-life innovation processes*.

To enable clarity for the interns and industry partners, and to let the interns experience an innovative design process from the beginning until the end, the internship programme is structured in four phases (i.e. Research, Ideation, Detailing and Prototyping). In the research phase, the interns gain the experience of collecting different kinds of input from various stakeholders and develop a focused design brief through understanding the context around their projects. In the ideation phase, they develop various design solution ideas to explore potential solutions and evaluate those ideas according to their design briefs. In the detailing phase, the interns develop their idea further to address all aspects of their design brief and finalize the design solution. In the prototyping phase, they build prototypes of their solutions and develop communication material to convey their solutions addressing the sustainability issues defined in their briefs to industry partners.

These phases also provide researchers with a structure to collect and analyse data throughout the design process. At the end of each phase, a group discussion with all interns is conducted to gather their insights and provide feedback to the next internship cycle. These group discussions revolve around their experiences throughout each phase, with regards to the design tools and methods they use, their communication with various stakeholders – including their industry partners –, masterclasses they take, and any other process they go through. These group discussions are voice recorded for analysis. The analysis is done according to the topics that emerge from these discussions.

3 Circular Design Internship in Ireland

In this section, the internship programme that was underway at the time of writing this paper is explained with regards to internship projects and internship structure.

3.1 Internships Projects

In the scope of this internship, researchers decided to find three industry partners with diverse needs, who are capable of realising projects of different scales, in order to diversify the kind of projects undertaken, to observe the outcomes for these projects of different scales and to understand the potential of the internship to train individuals for diversely-scaled design projects. As a result, a craft-producer company (Mamukko, Kinsale), a furniture design consultancy (One Off, Dublin) and a government institution (Southern Region Waste Management Office - SRWMO, Limerick) agreed to become industry partners for the internship programme, and three different design briefs were developed, which are summarized as follows:

- **Material Explorations** with Mamukko: Exploring the potentials of a reclaimed material – used fishing nets – and developing innovative solutions on reusing it along with leathercraft.
- **Retrofitting** with One Off: Designing bespoke, high-end office furniture with a take-back system and reusable products/parts/materials
- **Preventing Food Waste** with SRWMO: Reimagine the food waste management in/around Limerick, and develop solutions for prevention and reuse of food waste.

These projects present three distinctly different scales in terms of circular design. The *material explorations* project focuses on the reuse/recycle of a problematic material that is discarded in oceans, contaminating the sea and endangering marine life. The purpose of the project was to explore ways of introducing this material into SME production processes thus giving it a second life. The *retrofitting* project focuses on the problem of underused, high-end furniture with valuable materials being discarded before their potential lifespan ends and aims to explore ways of reusing the furniture or the materials used in the furniture with the limited organizational capabilities of a design consultancy. The *preventing food waste* project identifies the issue of excessive amounts of food waste produced by citizens and the cultural implications of this issue. The project aims to intervene into existing models of discarding food waste and its waste stream to explore ways of preventing food waste in the first place.

Although the challenges of each project were quite diverse, they were regarded in the scope of the Circular Economy. These projects were well-aligned to observe the implications of Circular Design at different scales and how this internship programme can train the next generation of designers to respond to the diverse challenges imposed by a Circular Economy approach. It should also be noted that the industry partners for these projects were aware of the global and local issues related to sustainability, however, they needed assistance to respond to these challenges in the context of their businesses. The outcomes of this internship did not have to be applicable right away, rather these industry partners were interested in the Circular Design process and the opportunities it presented for their businesses. The enthusiasm of the industry partners is important to support the design process, and concurrently, the interns.

The internship programme was announced in the four partner universities, calling for students of varying backgrounds that were interested in issues of sustainability and wanted to experience design for sustainability in real-life contexts. The industry collaboration, interdisciplinary nature and multi-cultural approaches of the internship were clarified in this announcement. Students applied to this internship through a portfolio, an academic reference, and a short video addressing their interests in design for sustainability and their expectations from the programme. The applications were assessed according to academic and design performance, evidence of teamwork, interest in design for sustainability and demonstration of motivation to take part in this internship. As a result of this assessment, 10 interns from different backgrounds (i.e. Product Design, Business, Materials Science) were selected to participate. It should be noted that these participants were novice designers and accordingly the internship needed to provide two kinds of learning experience: *general design practice* and *design for sustainability.* In the next section, how the internship is structured to convey these is presented.

3.2 Internship Structure

As mentioned previously, the Circular Design internship was structured according to four phases (i.e. Research, Ideation, Detailing and Prototyping). Table 1 presents the general design practice related and design for sustainability related competencies the training programme aims to convey to interns, and the content created for this purpose. The table is divided into four parts in parallel to the internship structure on the left end side, and the content of the internship is presented on the right end side.

Table 1 Internship structure and its relation to skill development

	General Design Practice Competencies	Design for Sustainability Competencies	Internship Content
RESEARCH	Understanding the capabilities of industry partners & stakeholders	Assessing the potentials of these capabilities for sustainability	- Masterclass: Stakeholders and Material Flows - Open Educational Resources for data collection - Data Analysis Workshop
	Scoping the project, through research outcomes	Defining limitations and opportunities for sustainability (i.e. sustainability criteria)	- Assignment: Focused Design Brief - Presentation: Research outcomes to industry partner
IDEATION	Deciding on how to tackle the design problem	Developing a practical approach to sustainability	- Assignment: Approaches to Sustainable Design - Open Educational Resources for idea-generation - Mock-ups - Meetings with industry partners
	Generating ideas and assessing them		
At the time of writing this paper, the internship was at this stage. This paper includes reflections on the first and second phases.			
DETAILING	Selecting design solution ideas for further development	Assessing ideas according to sustainability criteria and clients' capabilities	- Presentation: Design ideas to industry partners
	Further developing the design solution	Understanding the implications of the design solution for sustainability	- Masterclass: Sustainability in the Broader Context
		Ensuring the design details are in line with sustainability criteria	- Assignment: Assessment of Final Design Solutions
PROTOTYPING	Using a digital fabrication lab and workshop equipment	Exploring potential sustainable production tools and techniques	- Health and safety training - Masterclass: FabLabs and Circular Design
	Developing design communication material	Conveying sustainability issues and sustainable design solution effectively and in a relatable way	- Masterclass: Presentation and Pitching - Presentation: Finalized design solution to industry partners and supervisors

As can be seen in Table 3, *masterclasses*, *open educational resources* and *assignments* were utilized as educational tools throughout this internship. *Masterclasses* are one-day activities conducted by outside experts on general topics of design for sustainability followed by workshops on how this information applies to the specific projects. They aim to provide fundamental information on different aspects of design for sustainability to the interns and create starting points for their further exploration of the subject.

Open educational resources are readily available tools that convey information, methods and techniques on sustainability in general and on specific aspects of design for sustainability. A comprehensive and categorized list of these tools was developed by the supervisors of the first internship in UL and expanded upon by the other project partners. This list of educational resources was provided to the interns at the beginning of the programme and they were prompted to explore different sections of this list during the different phases of their projects. Interns have utilized these resources to find applicable research and analysis methods, to explore different approaches to

sustainability, to generate and evaluate ideas, to help make decisions, and to assess their design solutions.

Finally, *assignments* were used to ensure the progress of the projects. These assignments were not graded and aimed to facilitate progression of the projects by providing deadlines and articulation of the work carried out by the interns. They also proved useful for the action research aspects of this project, as the assignments enabled supervisors to document the process in a structured manner.

In addition to the above-mentioned tools, there were scheduled industry partner meetings to ensure client exposure and buy-in. The interns were encouraged to arrange additional meetings with their industry partners regularly to gather feedback and move ideas forward. Furthermore, department workshops and local FabLab training were included in the schedule to familiarize the interns with the fabrication capabilities they have access to for mock-up building and prototyping. Finally, supervisors met the project teams twice a week to answer any questions they might have or anything they may need. These meetings were not structured as *critiques* that can be seen widely in design education, but more like discussions about the interns' design processes, outcomes and next steps forward.

4 Discussion on the internship process

At the time of writing this paper, the Circular Design Internship was approaching the end of the third phase (i.e. detailing). Up to this point, two group discussions were conducted with the interns to gather insights and the researchers had the chance to observe the outcomes of these first two phases (i.e. research and ideation). Interns' insights on different aspects of the first and second phases of the internship provided much material for discussion, affirmed many aspects of the internship and presented directions for improvement in the following cycles of collaborative action research. In this section, the internship programme will be discussed through the topics raised by the interns in these group discussions.

4.1 Self-learning and Guidance

The internship programme was structured to guide interns in exploring how design practice can respond to sustainability issues and to develop personalized approaches to sustainability for different projects and issues. The variety of challenges in the project briefs supports the importance of developing practical, project-specific approaches. It often proves difficult for novice designers to sift through the wide-ranging and abundant information and example studies on sustainability and design available to them. On the one hand, the interns require core knowledge on design for sustainability and guidance on how to reflect that knowledge in their practice. On the other hand, they need to learn how to acquire deeper knowledge and to assess its credibility and practical implications. Masterclasses, assignments and open educational resources were structured keeping these in mind, and interns' insights were collected on these as well as the way they are structured in group discussions.

All of the interns agreed upon the illuminating aspect of the first masterclass, as it provided them with core knowledge to guide their explorations of the different considerations on sustainability and design. Through discussing the practical implications of the core knowledge they gained, the interns mentioned that they could understand the way theoretical knowledge can be applied to design processes, causing them to reflect on their projects brief from more critical perspectives. The first masterclass on stakeholders and material flows helped them question the relationships among stakeholders and their importance for developing innovative, sustainable solutions. Some of the interns regarded the first masterclass as crucial (1) to make sense of sustainability concerns and design for sustainability, and (2) to guide them through the research phase of the project.

It should be noted that the first masterclass was the only structured informative session in the research and idea-generation phases of the internship programme. From then onwards, the interns were encouraged to explore further knowledge on design for sustainability, its tools and techniques through assignments and open educational resources. Although interns generally found the task of

finding knowledge on design for sustainability educative and illuminating for research and idea-generation, their opinions on this process of self-learning varied. Some of the interns mentioned that they felt lost at times, trying to assess the applicability or credibility of the information, tools and techniques they found. As novice designers who do not have much – if any – experience with design for sustainability, this task of acquiring knowledge involved the trialling of found information on their projects to assess its implications and benefits (if there were any), which was mentioned as time-consuming. Lectures were suggested as a more time efficient way of acquiring knowledge. On the other hand, some of the interns found this self-learning process more engaging and exploratory. They placed emphasis on the importance of assessing information, tools and techniques, through which they could develop their design approach to the project at hand. The twice-weekly supervisor meetings were helpful for this process, in gathering feedback and consulting on the approach they were developing.

4.2 Idea-generation and Decision Making

The challenges defined by clients and supervisors for each project, to be addressed through the three-month project, were quite deliberately broad and open. The purpose of this was to provide flexibility for the interns to focus on a more specific aspect of these challenges and to train them on how to frame their design projects with respect to the research they conducted, the requests of their clients, their capabilities and team design approach. Being able to assess these three and decide on a direction to take was thought to be an important aspect of this internship programme. To this end, a workshop on data analysis and an assignment to create focused design briefs were included in the programme.

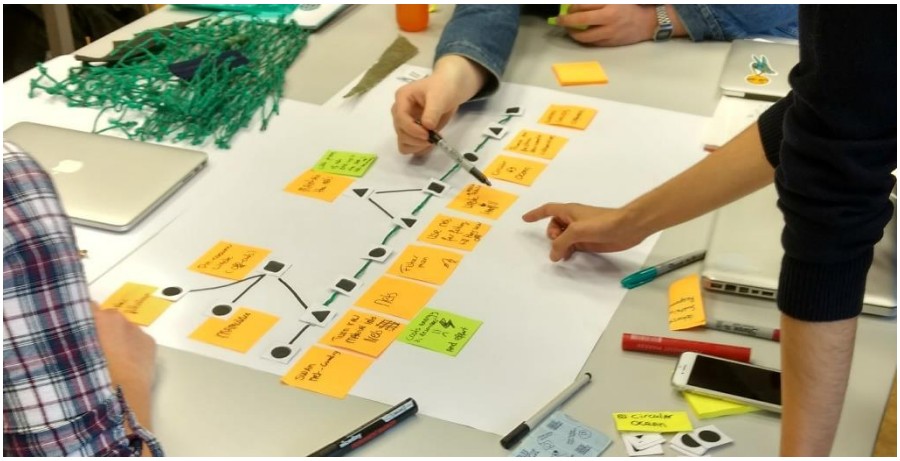

Figure 2 Interns categorizing the research data they collected, in data analysis workshop.

The data analysis workshop was conducted towards the end of the research phase of the project. The purpose of it was to demystify the existing processes of production, distribution, consumption and disposal for each project, through categorizing the data they collected according to actors, their actions and outcomes, and organizing the categorized data in the form of timelines to reveal possible design intervention points (Figure 2). The data interns gathered from the field initially overwhelmed them, as the relations among stakeholders were too complex to deconstruct for sense-making. Hence, this exercise was found to be illuminating as the interns began to grasp the complex relations behind the existing and often unsustainable processes for each project. Design intervention points they uncovered as a result of this analysis helped them decide on which areas they should focus. They evaluated each intervention point with respect to their capabilities as a team, the amount of time allocated for the project and the stakeholders they can influence. This was the first major decision the interns had to make, as they selected the intervention point at which their future design solutions could make a difference. This analysis workshop led to the focused

design brief assignment, in which they were asked to define their scope and plan to undertake the project, leading to an innovative design solution with potential real-life impact.

Upon defining their scope and building a tentative plan for their projects, the supervisors primed the interns towards developing their design approach for sustainability. At this stage, the interns explored different approaches and their practical implications through the approaches to sustainable design assignment. Through the assignment, supervisors provided the interns with a list of existing approaches to sustainable design, asking them to find out basic information about them. Later, each team was asked to select three approaches, which were inspirational for their own projects, to gather more detailed information on these design approaches, and to suggest the practical implications of these approaches on their projects.

The interns found this assignment useful as it inspired them to generate design ideas for their project and provided them different perspectives on the potential of design in facilitating change for sustainability. While some of the interns found the assignment engaging and inspirational, others felt that they may not have reached to right information sources and it was time-consuming to explore many approaches in the right way. Going back to the discussion in the previous section about self-learning, the purpose of the assignment was to gain experience in acquiring knowledge through various resources. This was an exhaustive task for some interns, and they mentioned they would have preferred lectures on different approaches to sustainable design. However, through these decision making (i.e. analysis of research outcomes and focused design brief assignment) and idea-generation steps (i.e. approaches to sustainable design assignment), the interns developed innovative approaches and ideas for their projects, which have been well-received by their clients up until the end of the second phase.

4.3 Client and Stakeholder Exposure

The interns interacted with clients and stakeholders intensively throughout the first and second phases of the internship. This was challenging from two directions: (1) interns didn't have any previous experience in communicating design and sustainability relationship, and (2) the clients and stakeholders already had differing approaches and insights on what sustainability was and what role was occupied by design. These presented challenges in gathering data from stakeholders and communicating ideas to clients, which were important experiences for the interns throughout the programme.

During the research phase, the interns tried to gather information and insights from several stakeholders to grasp the relations among them and to understand the context of their projects. However, getting in touch with the stakeholders was mostly difficult due to the busy schedules of the stakeholders or their lack of interest on issues of sustainability. These issues were mostly overcome with the intervention of clients who introduced the interns with their stakeholders and facilitated the meetings.

The interns' insights on their interactions with stakeholders can be categorised into three groups: secretive, assertive and helpful. Interns mentioned that some of the stakeholders, when they found out the sustainability aspect of the projects, refrained from sharing information or giving insights about their processes. The interns believed these stakeholders were secretive as their practices did not reflect any concern towards sustainability. The assertive stakeholders are the ones that present a strong, often deeply embedded, perspective on how their practice should be and therefore their practices are beyond intervention. The interns believed these stakeholders were hard to reconcile with, and any design solution that involves a major change in their practices would be hard to realize. The final group is characterized by sharing information and knowledge, as well as providing a critical perspective on possibilities for change. The information they gathered from this group was crucial for them to make sense of the processes, to position these and other stakeholders throughout the processes, and to figure out how they can intervene in this process to develop realizable, sustainable design outcomes.

While the clients' interest in adopting sustainable practices was their common goal in this internship, their attitudes towards the projects were completely different throughout different stages of the internship. The interns talked about their clients' insights on different research outcomes, approaches and ideas from various perspectives, which provided insights on the progression of the projects. The clients of this internship programme were from three distinct backgrounds (i.e. craftsman, designer and governmental) with different sets of skills and capabilities. The interns needed to understand the capabilities and limitations of these clients through company visits and assess how these capabilities and limitations are related to the design solutions they developed. These capabilities and limitations were also visible on their perception of what the outcomes of this internship could or could not be. The interns mentioned the problems they faced while communicating their approaches, the potential outcomes and their real-life applications. The clients' expertise led them to evaluate these potential outcomes sometimes from a rather pessimistic perspective on their applicability, and other times with enthusiasm beyond the expectations of the interns. Although the variety of feedback from the clients was often found to be confusing, all the teams decided to adopt approaches that addressed the challenges through design solutions for immediate application and long-term application. The decision to implement the solution in its entirety or in parts was left to the client.

5 Conclusion

Much of the literature suggests why and how we could implement sustainable and circular design in industry; but practical examples exploring the realities of what this means and the resultant compromises, confusion, conflict and complications, are limited. It is necessary to introduce novice designers in education to the complexities of sustainable design and circular design, and the challenges in introducing it in real-world contexts. University is a great environment for this purpose as it provides the flexibility to build collaboration with industry and to enable novice designers to experience these challenges first hand. Through self-learning approach of the internship, interns learn how to access and critically reflect on the changing and advancing knowledge on sustainability and design, and then apply it to their work practice. Such an internship programme provides interns and their educational teams the opportunity to conduct the projects and offers some insight into the process and the potential for sustainable design to become a reality. As a result, a resilient approach to problem-solving for design for sustainability can be developed and the interns can be prepared for the real-world decision making.

The results presented in this paper only cover the first two phases of the first internship, however, it provides insights and considerations about the relationship between design departments, industry and novice designers, and presents many directions for improvement through the next internship. The Internship programme was beneficial to the interns, researchers, educators and industry partners, yet it is not without its challenges. Given these challenges and the successful elements to emerge from the first internship, the collaborative action research model ensures that the learning will be brought forward through the developments and improvements implemented in the subsequent internships planned for delivery in the next two years.

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