Transition Zone: a training ethos designed to scaffold a PhD degree

Abstract

The Transition Zone is our bespoke training programme to support transitions through different stages in a researcher's career: (1) into doctoral studies as a high performing researcher, (2) through doctoral studies to make the most out of their doctorate and associated training and, (3) on exiting, to empower and equip them as highly employable graduates. This paper focuses on the first (i.e. 'Transition In') and the second transitions (i.e. 'Transition Through'). The purpose of this paper is to offer a programme evaluation of these two transitions in order to assess whether the training ethos fulfils the three strategic aims (i.e. continuous learning as second nature, reflection in/on action, and deliberate employability boosters).

Students have been encouraged to take *ownership* of their PhD and personal development from the outset (e.g. each student manages their own time, training, travel and consumables budget). The nature of the training activities has also been varied, accounting for to the student's learning preferences, exposing students to both individual and group work, technical and non-technical training and with a strong flavour of externally-facing industry experience. A series of tests and self-awareness exercises have allowed the students to explore their own objectives and those of the program so that they dovetail, and allow an informed decision on training components to deliver a rounded engineer and/or scientist who not only is an expert in a research area but also possesses business acumen and industry-readiness that are much sought after by employers in the current global market.

1. Introduction

The UK is an innovation-intensive economy competing globally through high value products and services [1]; this can only be sustained by empowering the absorptive capacity[I] of companies through the deployment of technology and data-literate engineers and scientists. The demand for these employees is growing by 4% per year [2]. There has also been an increasing demand for complementary skills, such as entrepreneurial, leadership and business acumen. Future employers will require an appropriate mix of these and current education and training systems are not yet fully addressing them [3, 4]. The 2017 Industrial Strategy 'Building a Britain fit for the future' [5] has emphasised the need to address skills to drive economic growth and productivity, identifying also ideas, people and business environment as main drivers to achieving the UK's full potential.

As per the World Economic Forum Report 2016, the top 10 skills sought after in graduates in 2020 will be: 1- complex problem solving, 2- critical thinking, 3- creativity, 4- people management, 5- coordinating with others, 6- emotional intelligence, 7- judgment and decision making, 8- service orientation, 9- negotiations and 10- cognitive flexibility. Critical thinking and Creativity are two prominent skills that have been promoted to the top 5 compared to a

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[I] Def: *'absorptive capacity' is the ability of businesses to understand and exploit cutting-edge research via human capital*

similar survey reported in 2015. On the other hand, it has been widely recognised by employers of large or small companies that finding and keeping talent is no longer a challenge that belongs in the HR department, but is a "strategic business priority" [6].

Our training programme has brought together complementary technical aspects, industrial/externally-facing and non-technical training. It has supported a generation of 'T-shaped' professionals, with a focused technical expertise, credibility and depth of enquiry (the vertical bar) and fluency working and communicating across multiple Embedded Intelligence disciplines, together with the leadership skills to manage the delivery of commercially and multidisciplinary viable applications using creativity and emotional intelligence (the horizontal bar).

Attracting the brightest minds to a PhD degree has proven to be more effective if a PhD project has a close relationship to industry, if there is financial assistance and if the student is exposed to real world experience [7]. Diversity in our overall cohort has also ignited proactive strategies to reach to potential candidates from minority groups (e.g. females, non-white). Our efforts to mitigate high attrition rates [8, 9] have been addressed with a positive and proactive approach to supporting our doctoral candidates at all stages throughout their degree and through overt interventions to palliate the high occurrence of mental health issues that have been reported in higher education [10].

In 2013 we started developing an innovative training program not found in other PhD training degrees in the United Kingdom. Brunel University's New Route PhD™ has been a 4-year PhD degree with an Integrated Postgraduate Diploma that recognises the student's development as a professional researcher, with an explicit training in *effective* research skills. This has been a degree managed from the Graduate School (i.e. at University level, not specific to any School) representing a generic approach which could apply to any PhD student in the University. The University of East Anglia has been delivering a 'Rotation PhD' in which students visit different labs in 10-week long research mini-projects, directed by different supervisors and trained in different techniques. The 'Integrated PhD' at the University of Southampton has offered 3 laboratory rotation projects after which the student is awarded an MRes (Master of Research) and they then spend 3 more years deepening their expertise towards a PhD degree. These approaches have been successful over the years and demonstrate an appetite for very varied, skills-training focused programs that provide the researcher with broader knowledge and varied competencies that prepare them for employment. However, these programs are typically found in biological, medical and chemical sciences, and are infrequent in engineering degrees.

The Transition Zone is a tailored program for PhD students in the different aspects of Embedded Intelligence in all areas pertinent to the 'supply chain' of their application (e.g. hardware, software design and user-friendliness, business models, end-user experience, data protection, etc). It has aimed to fulfil the training needs for industry-ready PhD graduates in digital technologies, to become Embedded Intelligence practitioners, those who for the first time will create wealth from data as a product and a service, along with other skills expected from graduates employed by businesses that wish to maintain competitiveness globally. We have emphasised the journey of the student through their PhD training and the inter-year cohorts of students that have allowed formation of a common understanding which has been crucial to the personal development of the individuals and their future careers. Therefore, the

strategic aims of the Transition Zone have been: (1) to instil in the students continuous learning as second nature, adapting and adopting learning experiences to their personal preferences to create a portfolio of activities that best suit them; (2) to encourage Reflection *in* action and *on* action; and (3) boost employability readiness (i.e. both technical and non-technical) of the graduates, a concern amongst employers and co-sponsors. This paper focuses on the evaluation of these aims in view of the Transitions 'In' and 'Through'.

2. Theoretical Framework

With the intention to implement the latest innovations in Learning and Development, we developed and have continued evolving a training ethos based on Vygotsky's social constructivism [11] and a multimodal learning approach to fulfil the strategic aims of the Transition Zone. Training a cohort of students researching the different aspects of the PhD degree in Embedded Intelligence has lent itself to *blended learning*, the preferred learning approach by the students as replicated how we have actually learned on the job (through experience and interactions with co-workers) utilising different training methods to suit individual researchers' styles (e.g. instructor-led training, interaction and role playing, coaching and group discussions, competitive challenges and exposure to other PhD networks). This has encouraged the students to construct the programme cohort, so they could help each other whilst helping themselves.

Collaboration is important in learning as well as in innovation. Individuals construct knowledge through their interactions with others and through problem solving. Through social learning people learn from one another via observation, imitation, modelling, with and through other people, participating in a community, and action learning. We have exploited the advantages of Analogous learning through activities such as group projects and on-the-factory-floor training. By exposing them to activities to engage their problem-solving talents, although through case studies not directly related to their own PhD project, students have practiced resilience, fostered self-confidence and practiced situations in which they reinforced their Identity, of much recognised importance to curb doctoral attrition [12].

The pool of students we have attracted and from which we recruited, our PhD candidates, has been varied and diverse, therefore exhibiting different motivations and displaying varied learning styles preferences depending on their first degrees and their industrial (or inexistent) experience. A tightly-defined and rigid training program has not been possible to implement. This has carried pedagogical implications in the delivery methods: we based our model on Andragogy principles (i.e. a learning approach more suited for adults who are autonomous, self-directed, motivated, problem/goal-oriented and have experience to draw from) and Heutagogy principles of self-efficacy. These principles are best suited to individuals willing to increase competencies while concurrently developing their capability to learn. We have designed a multimodal blended learning approach in order to embed a culture of continuous learning, reflection and strategic thinking towards high employability. In the Transition Zone training, which scaffolds their PhD degree studies, individuals have selected what they wanted to learn. We fostered Adaptive learning, ideal to cater for a heterogeneous pool of researchers with different backgrounds. This allowed them to learn at their own pace via training delivered based on individuals' learning styles preferences and inputs. Students decided course content in negotiations with their supervisors, co-sponsors and other

stakeholders. The assessment methods have been varied, from diagnostic and formative, to compulsory summative assessments. Therefore, our training ethos has been student-centric, has inculcated a sense of ownership and responsibility and motivated the PhD student towards high levels of performance and industry-led academic relevance of the topics in their research.

2.1. Implementation of the theoretical framework

The implementation of the Transition Zone ethos was instantiated via four main pillars that scaffolded the student's transition into the program, during the studies and out to employment upon PhD graduation:

(i) Grounding yourself

We organised induction sessions at the start of the program (i.e. first week upon enrolment) as well as refreshers (called 'orientation' days) throughout the program. The content covered in those sessions had the intention of assisting their 'transition in' and aiding their 'transition out' into employment after graduation. With these events we intended to foster a sense of 'togetherness' to face the uncertainty of the early months ahead.

Since identity can be one of the strongest motivators in one's (professional) life, we devoted a significant amount of time to delving into the students' perceptions of themselves as graduates, as professionals (particularly relevant to those with industrial experience or mature students), and as researchers. A 'Values' identification exercise allowed the year cohorts to figure out and share with the group their judgement on what's important in life. In that way we could initiate discussions on how personal objectives dovetail with those of the program. We used Lego® in an exercise to provide them with an extra channel of communication in an environment that recalls childhood memories [13] to describe 'Why a PhD?'. Because some individuals have a preference for one learning style over another, tailoring learning activities to the natural style of the individual is strongly recommended. The four classifications were: (i) Activist; (ii) Reflector; (iii) Pragmatist; and (iv) Theorist. The Activists will learn best from activities where there are new experiences, opportunities, an unconstrained ideas generation process, competitive team-work and role-playing exercises. They are energised by the 'give it a go' approach. The Reflectors are more open to experiences that allow them to listen, observe and "chew over" things, think before acting, collect information to prepare in advance and have the opportunity to review what happened. The Pragmatic style is characterised by a preference in the link between technique and practical benefit. They like demonstrations, good simulations of 'real' problems, such as how to save time, how to deal with difficult people. They dislike not having clear guidelines or dealing with too abstract concepts. In contrast, the Theorists thrive in the methodical exploration of concepts and models, in the association and interrelation of ideas, events and situations. They enjoy probing basic methodologies and engage in logic to understand complex systems [14].

How we obtain, perceive, interact with the information we take from the world around us was another topic for raising self-awareness. The Myers-Briggs Type Indicator (MBTI) was used as an excuse to discuss the ways in which different people process information and how that could affect work relationships and team dynamics. The four dichotomies make up 16 types referring to: (1) The source of one's 'energy', Extraverted (energised by the world outside the

self) or Introverted (by one's inner world); (2) How information is processed, Sensing (data obtained through the five senses, focused on the present) or Intuition (a keen interest on the meaning and patterns behind information and how this may affect the future); (3) How decisions are made, Thinking (based on objective and hard-logic facts) or Feeling (based on principles and personal values); and (4) how people display themselves when making decisions, a lifestyle, Judging (outwardly, they find the outcome more rewarding than the process)versus Perceiving (a spontaneous life, open to new options and experiences, preferring the process over the outcome). The four dichotomies self-description sheet was based on [15].

(ii) Working with others

During the first year of studies we expose the students to compulsory activities in which participants learn face to face while solving industry challenges as a team. Companies approached by the executive proposed small self-contained R&D projects with set milestones and deliverables for a multidisciplinary team of students all in their first year of studies. Students spend approx. 100 effort hours on the project for the duration of 12 weeks and none of them have a prior background in the topic under study. These group projects expose the students to a highly-pressurised environment in which not only they find themselves having to learn a new discipline or application from scratch, manage others they know very little about (if anything) but they also have to manage their PhD studies and other aspects of the training in parallel. Every student undertakes 2 projects and there is a directed reflective exercise in-between the 2 projects that encourages them to reflect both *in* action and *on* action [16].

From an information processing perspective, the students were introduced to the work done by M Belbin on team talents and effective team dynamics [17]. This model describes an effective team when all the 'talents' are present and harmoniously complementing each other. The talents or roles have been defined as the coordinator, the team-worker, the resource-investigator, the implementer, the completer finisher, the plant, the shaper and the monitor evaluator. We refer the reader to [17] for a full description of the team talents. Belbin et al. refers to a ninth talent, the specialist, but this was not used in these exercises due to the fact that all members of the team execute technical tasks, in some cases, of high specialism.

In order to ensure success, which is defined as the developmental progress in their skills and knowledge, in the group activities, we equip them with tools such as project monitoring tools, introduce them to different leadership styles [18], conflict management [19], coaching techniques [20], icebreakers and team consolidation aids such as the 'Team Mandala' exercise [21], motivating self and others [22] and the Tuckman's team development model (i.e. forming, storming, norming, performing) [23].

(iii) Managing your stakeholders

Each student was co-sponsored by a company. This triangle relationship (i.e. the student, the academic supervisor(s) and the industrial co-sponsor and supervisor) required the student to work proactively towards all vertices, holding on and not dropping their node. Students were trained on skills such as meeting organisation, minute taking and giving presentations to different audiences (e.g. non-specialist, marketing or financial audiences). Awareness raising sessions for the students to understand the sources of funding for their scholarship, the

institutions and organisations that contributed to the training, and how companies trained employees on the factory floor. Students participated in visits to company sites and production plants, held networking sessions with industrialists and at Open Days at the university presented their work to other companies that were not directly involved with their own sponsors.

(iv) Connecting to your purpose

If any organisation defines itself by its mission, vision and values, its' business plan is how these are implemented. In order to instil a sense of ownership of the student's PhD and development journey we have used the metaphor of letting them become the CEO of their own small company, 'My PhD Ltd'. Both as an identity definer as well as an impetus forwards, they worked on a business model for the company for a number of months, using the template provided in [24] adapted to 'Business Canvas You', updating the different aspects of their 'company' (e.g. suppliers, customers, communication channels, costs and benefits, etc) as they discovered more about their PhD, their stakeholders, the impact of their research and how industry and society benefited from their development as researchers and added value as professional practitioners.

The students were introduced to the concepts of extrinsic and intrinsic motivators for themselves and to encourage others. Herzberg's motivation-hygiene theory was used to explore motivational factors [22]. To fulfil the psychological needs of competence (we need to feel we are good at something), autonomy (we determine what to do) and social relatedness (we need to feel we relate well to others) in order to motivate someone to do something [25]. Every student was given a 'Competencies matrix' template, based on the Vitae Researcher Development Framework[II], and invited to update it as they planned and attended learning activities. This served as a roadmap for their PhD training program, as a discussion/negotiation point with supervisors and as a strategic document for their personal and professional development in support of the technical aspects of their PhD research.

3. Method
   3.1. Participants

All students enrolled in the programme were participants to this study. Five cohorts of PhD students have been recruited to date. A year cohort is formed by the students enrolled into the programme during the same academic year (from October to July), typically those who enrol in October and those who enrol in January. The overall cohort includes all the year cohorts. A total of 60 students have completed year 1 and have progressed to year 2, 33 to year 3, and 18 students to year 4. The first cohort enrolled is currently completing their studies and defence of their PhD theses and we are expecting to graduate the first students in the summer of 2019. Our demographics for the overall cohort are distributed as 86% <30yo, 6% in the range 30-40yo and 6% >40yo, at the time of registration. We report 11% of female students. In terms of ethnicity, 66% are white, 8% are Asian, 8% Chinese, 5% Black, 3% mixed, and 10%

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reported themselves as from another ethnic origin. 6% disclosed a disability and 25% of the overall cohort decided not to make a disability declaration.

3.2. Assessment

The main forms of data collection were by feedback questionnaires to evaluate students' views, face-to-face, virtual or on-line feedback sessions (i.e. using flipcharts, post-it notes, software such as *Mentimeter*), semi-structured interviews, material (photos, videos) from model-making workshops, student self-reflection with a 'portfolio' style evidence-based reports at the end of year 1 and by staff observation.

The inventory of values, Belbin talents, preferred learning style and Myers-Briggs type indicator (MBTI) were surveyed via questionnaires and/or focus groups. The participants were allowed to select more than one preference. Students statements were distilled from the material submitted as part of the summative assessments, through their reflective logs and appraisal exercises at end-of-year 1, 2 and 3 timepoints.

4. Results
4.1. From activities related to 'Grounding yourself'

Through the individual reflective exercises and the group discussions, we enquired about identity and how this had changed from the entry point to current mindset. It became evident that identity is important to focus their minds and stay motivated on their purpose for the long run. For this, the induction week played a very important role as well as providing a sense of belonging to the centre which encouraged them to co-locate together, share resources and work under the same branded program. Students referred to these induction and orientation days in terms that varied from "reassuring" referring to them feeling they were not alone in their doubts, to "information overload" when it came to being exposed to new topics and concepts. Exemplars of statements are given below. More statements can be read in Appendix, Section A.

> *"The [induction] gives more than just the information about the PhD in a friendly and relaxed environment, it gives you the opportunity to be integrated as a group, to get to know other's students PhD] projects, to network and to [share] a flow of ideas with the participants of the induction"* C45CA

> *"The cohort has had a huge impact on my experience here. I think if I was in an office by myself sitting somewhere… [I would not like it]. It's the cohort and the integration of cohorts that works."* C2HG

> *"[I joined the program late and could not attend the Induction activities]. I felt [like] flying at the beginning, like not belonging but now [after attending the Induction activities] I can see more people excited about their PhDs and in the same field. That is a motivation point for me and more because now it introduces you to the group. Before this, my PhD journey was a bit lonely and couldn't identify myself with anyone"* C4CA

> *"The aim of the organisation of the CDT is to make researchers more efficient and employable. This is what I want to be - I don't want to be a nerd."* C3OG

Included in the syllabus of the Induction and Orientation Days were the self-discovery tests and questionnaires that helped them get to know how they processed and interacted with data and information in real scenarios. For example, *t*he survey on Learning styles preferences was carried out at the start of the program, prior to selection of their taught components and with the intention of informing their choices so that they could design a portfolio of training activities that best suited their styles. The compilation of the results is presented in Figure 1.
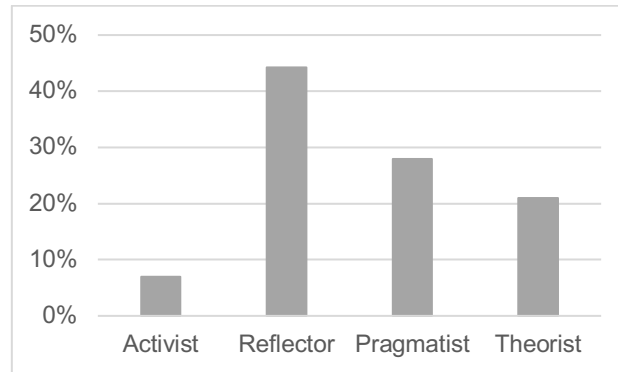
Figure 1: Compilation of results from Learning Styles survey

The MBTI results (Figure 2) reported a marked distribution in the overall cohort towards the NT pair, defined by Myers Briggs as the 'science, technology and management' cell. It is worth mentioning the preference for students to define themselves as ISTJ (in Myers-Briggs' words, the 'traditionalists', practical logical, methodical, dutiful) or ENTJ (the 'reformers', determined, innovative, strategic), both describing a focus on attention to detail, the use of analysis and organisation to get a task completed. Equally noticeable is the low incidence of the 'SF' pair, concerned with helping others and service-related preferences, or the 'NF' one, which typically cares for other's emotional or spiritual development.
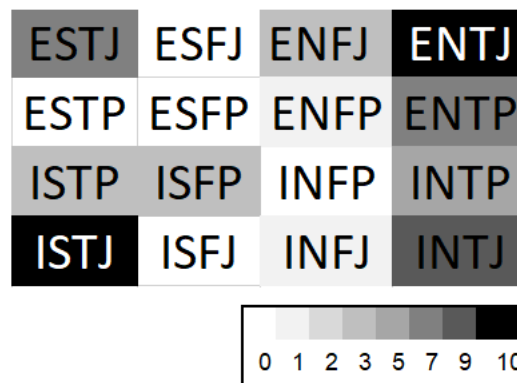

Figure 2: Compilation of MBTI results. (Colour tone indicates frequency)

The self-perception inventory on team member talents, aimed to configure an effective team, yielded interesting results with regards to how the students executed tasks when working in teams. The results from the Belbin 'Team talents' questionnaire are presented in Figure 3. The three groupings are as a function of preferences for the 'talents', i.e. whether they are task-oriented, ideas-focused or more concerned about people and their contributions.
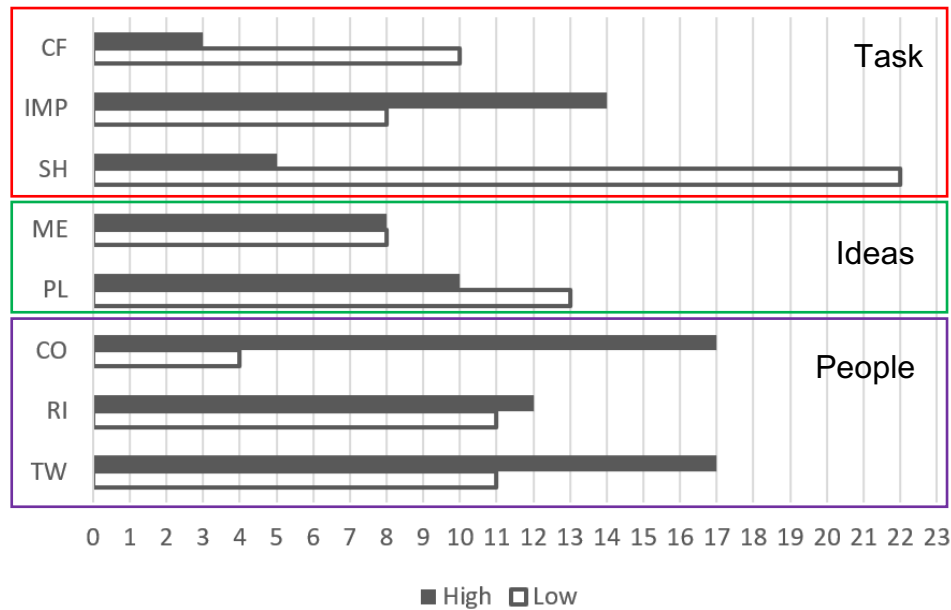
Figure 3: Distribution of team talents. Those appearing in high frequency are reported in solid blocks, those with the least frequency in a line block

The immediate observation is that 'people' talents (i.e. coordinator, team-worker, resource-investigator) present higher frequency than those talents devoted to tasks, more precisely to get tasks completed (completer finisher) promptly (shaper). The exception is the implementer, which most probably connects to the pragmatic approach to learning, as described in Figure 1.

The reflection offered by the students on how they used the information from these tests and self-assessment surveys to understand their own strengths and others', as well as to how to accommodate their natural inclinations in order to work with others towards a common purpose, or to configure a balanced team, was expressed in their reports and feedback questionnaires:

> *"As an active learner, I think that these tests give you an insight of the best practices you can apply to succeed and enjoy the PhD journey. Also, it was interesting to observe other personalities and the strategies they have taken in diverse situations. In my opinion, having such [information at hand] was incredibly helpful in settling in both academically and personally; moreover, it also created a dynamic working environment were, although while each of us were working on different things, a more cooperative climate was felt" C45CA*

> *"The group projects provide the most valuable experience for students (...) and improves skills such as time management, networking with industry, critical thinking amongst many others. (...) I could see aspects of the personality classifications e.g. Belbin roles, come to fruition during the two projects but more importantly, I learnt the key skill of adaptation and maximization of whatever group arrangement I was put in. All of these skills will be transferable in dealing with industrial partners of my [PhD] project" C54TJ*

> *"One of the most important lessons learnt was using each others' strengths to add the maximum value to the project, which it seems it had a really good outcome." C3YI*

> *"(...) we took the Belbin test, (...) in terms of that the teams were really balanced, the best way they could be, it helped us having someone who would come up with the ideas, someone who*

could find more details, and someone who could be the manager of the team. I think that's the key characteristic that made the group project work."C2UG

A sense of ownership, of alignment with one's values and principles, owing their learning preferences and how one processes information exchanged with the world, is a perceived strong stand point when dealing with complex technical problems paired with the need to work in multidisciplinary, multicultural teams, sometimes located in different sites and with different work habits or routine. We asked the students how useful learning about these aspects had been to their progress and development within their PhD degree. The results are compiled in Figure 4:
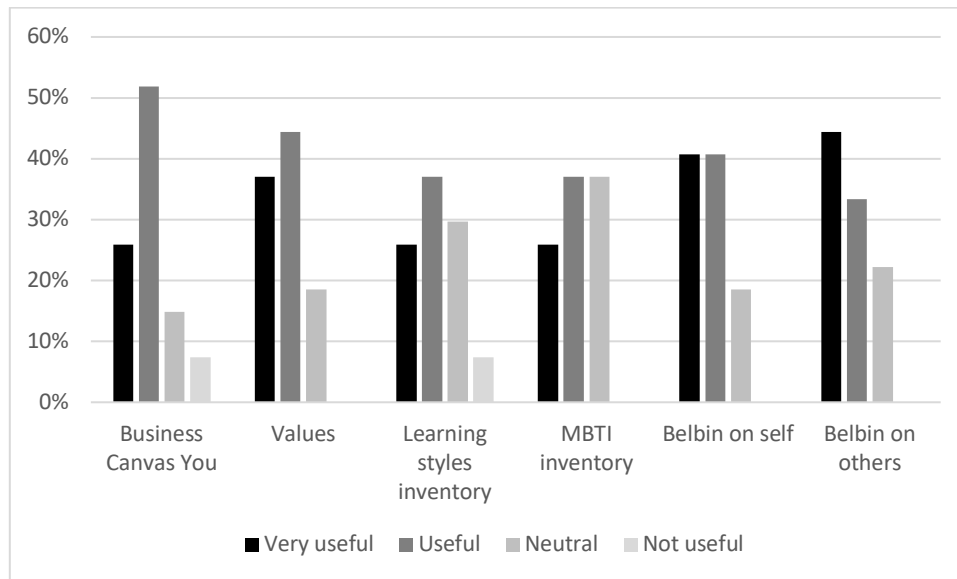

Figure 4: Inventory of skills and self-management tools usefulness evaluation

We explicitly addressed 'values' as an important aspect of their intrinsic motivation. A list of words representing individual and personal values was surveyed and collated and the highest frequency occurrences (i.e. the top 4 most frequently selected individual values) were discussed and presented as the governing values for each year cohort, Figure 5.
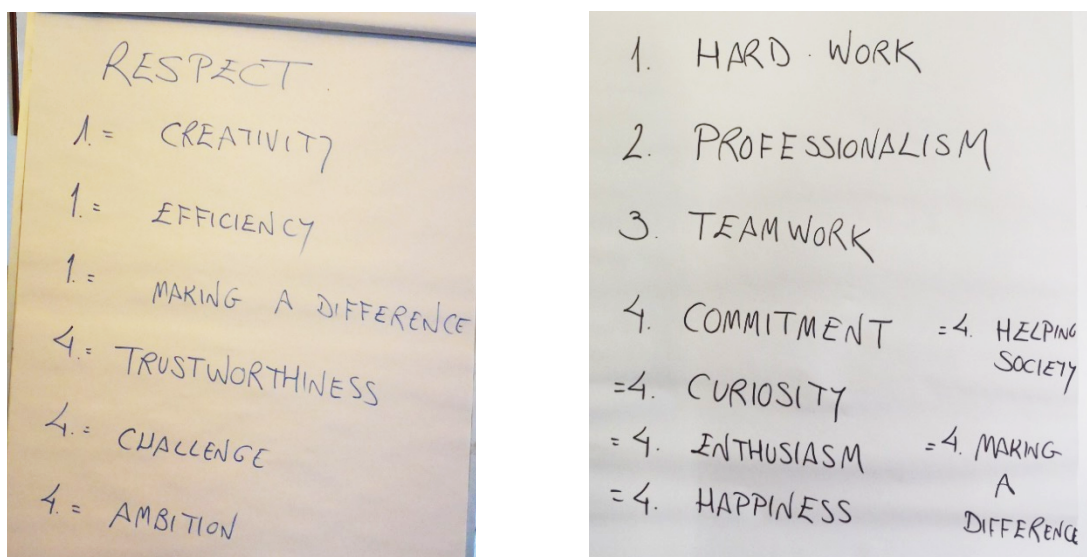

Figure 5: Inventory of most frequently selected personal values that were adopted by the year cohort as 'cohort values' (exemplars from two different cohort years)

Each student designed their own training portfolio (Figure 6), attending to the competencies matrix and considering a minimum %weight component of individual/group work, formative and summative assessments, scholarship, business and entrepreneurial skills.

Figure 6: Mapping of activities available from the Transition Zone program against the competencies matrix for the students to tailor to their own needs. (Logistic details in columns and rows not intended for readership)

Communicating "Why a PhD?" using Lego® resulted in a data-rich exercise for both the students and directors. Students used metaphors such as stairs, Lego® mini-people climbing or jumping hurdles, keys that opened doors, skeletons that represented fears and doubts, shiny objects representing knowledge acquisition, and bushes that depicted a desired work-life balanced lifestyle (Figure 7).

Figure 7: 'Why a PhD' described by the students using Lego pieces

Some student statements describing how they found the experience appear below, and more examples can be found in the Appendix, Section A1.

"The idea was excellent, it helped with visualising our feelings, having fun, laughing and returning to our childhood days while gazing at our futures. It helped in alleviating my fears and intensifying my optimism about the 4 years I will spend as a PhD researcher." C4DZ

"[It was] interesting to see what other's come up with in the same exercise and their interpretation on the journey they will take." C3KM

"I was a little sceptical when I first saw the LEGO, but it was a great task to first think about my own project in [an] abstract way and second to see other people's reasons for their project. This got over the initial introductions of "this is my project and..." where to be honest I don't think many of us understand our own project, let alone someone else's. Seeing the abstraction of the project helped me get to know the group better." C4RJ

"It was good to realise that everyone had similar ideas about why to do a PhD. Also it was interesting seeing how different people approached the [Lego® exercise] and this could have been discussed more - i.e. different people are good at being creative, others have to think more before they start, etc." C5LK

4.2. From activities related to 'Working with others'

The skill of teamwork and working with others was one characteristic of this training program that set it aside from other PhD-level programs. It was embraced by the students with varying levels of enthusiasm ahead of the activity, or with a polarised grouping of statements depicting a fruitful or unpleasant experience, as expected when compared to the results reported in the previous section (Figure 1, Figure 2, Figure 3). From the less constructive comments, communication (i.e. lack of or poor quality) was deemed as the most demoralising aspect remarked upon. They also demonstrated practice of 'reflection on action', when they used the experiences and lessons from the first group assignment to navigate experience in subsequent group activities. A longer set of statements can be read in the Appendix, Section C.

"The opportunity to work with such a varied team [was the best about this activity]. No one had the same expertise and therefore it was a challenge to come together as a group initially, but the team ran very smoothly after the initial stages." C1KF

"I enjoyed working in a business-like task for the first time and directly contacting them. Setting expectations, arranging meetings, negotiating was new to me." C34UJ

"The project exceeded the proposed time frame (only 12 days) significantly. Given that we were passionate about the project we did not mind this." C4KJ

"The main challenge during the group project was [to find] the contribution of [each member of the team]. Coming from different academic backgrounds, it presented a challenge for some members to find overlapping interests (...) and to [juggle] other academic priorities". C45CA

"[The assignment] highlighted the importance of establishing requirements early on. Also showed some of the benefits of having a team with a diverse set of skills even when they may not apply directly to the problem." C1JM

"In the first project I took [a manager's] role, I don't think I managed very effectively, in terms of giving people work, because different people have different backgrounds, different skills, and I'm unaware of their skills, I was hoping they'd tell me what they could contribute to the project, rather than me figuring it out. But in the second project, I took more of a leadership

role to keep the project on track and direct it. I set up all the meetings with the companies, all the communications, outlined all the reports and got the components and started building the system as soon as I knew that that was the direction, we were heading in. And then, tried to keep everyone informed, and see what they could add to the project." C23TC

"Completely disconnected work from own research [was the worst]" C23RT

"Communication throughout the project was poor, between the company and team, and between the team in general. Meaning the project was slow to start, and end goals could have been more clearly defined." C2RM

"Each team member was located in different parts of the country making it difficult to have effective progress meetings" C21JG

"Communication between [sites] turned out not to be an issue as regular skype calls kept [team member] in the loop" C4JH

"Extracting work from team members was, at times, extremely frustrating, especially from certain individuals. Furthermore, turning up on time for both team and client meetings for one member was very inconsistent. Perhaps a firmer stance and raising the issue up the chain earlier on may have been wise." C34DS

"[The icebreaker exercise] Getting to know the team and their backgrounds was more important/productive than attempting to find relevant literature" C4RG

Extracted from the most constructive comments was the importance of coaching others to keep healthy levels of motivation on self and others: (see Appendix, Section D for more statements)

"One of the most valuable takeaways of this [activity] was learning how to interact with others and how to be helpful even if the field or topic of the coaching session was not entirely known by the coach. (...) Another thing I learned (...) was on how to identify good practices in ourselves and others and consider a change for further personal improvement" C45CA

"[Coaching]: not only useful in a future managerial role and currently as a tool to resolve problems with current co-workers, but also as an insight into reflection and to help others in a constructive way" C1LU

"I would like to have a motivation review session with more frequency because it is one of those things that washes away very quickly" C5JG

"The pressure worked for me but it's hard to say - I quite enjoyed doing it. So the pressure didn't matter to me that much - if you put pressure [then] you move faster" C1PL

The evaluation of usefulness of the different tools and techniques provided to the teams was evaluated and the results are presented in Figure 8.
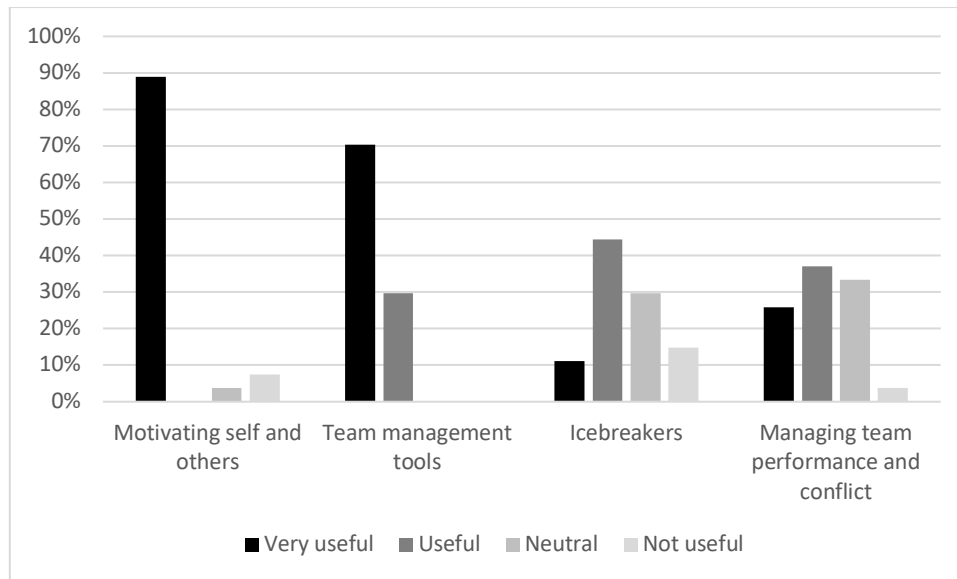
Figure 8: Team management tools usefulness evaluation

In 'working with others', the interactions with the companies (i.e. project providers and co-sponsors) played an important role and have allowed the students a view into real industrial settings, team dynamics and factory-floor environments.

> *"[The company] allowed a 'brainstorming' period and for a project with an 'open' agenda this was highly beneficial and appreciative. In fact the results from the brainstorming period [were] highly commended." C3RF*

> *"Utilising each other's skills in the right areas made the project run smoothly, met all the deadlines, offered the company a working prototype and report on specifications and cost analysis. C4LM (Note to reader: The prototype the students designed and constructed was the basis for a patent application that the companied filed after this work)*

4.3. From activities related to 'Managing your stakeholders'

Students were encouraged to reflect on who were the stakeholders in their PhD. For most it came as a surprise that there were individuals and institutions beyond their PhD academic supervisor(s) and industrial co-sponsors involved in the process of them obtaining a degree and receiving summative and formative training (e.g. governmental funding bodies, end-user groups, other non-academic beneficiaries) (Figure 9).
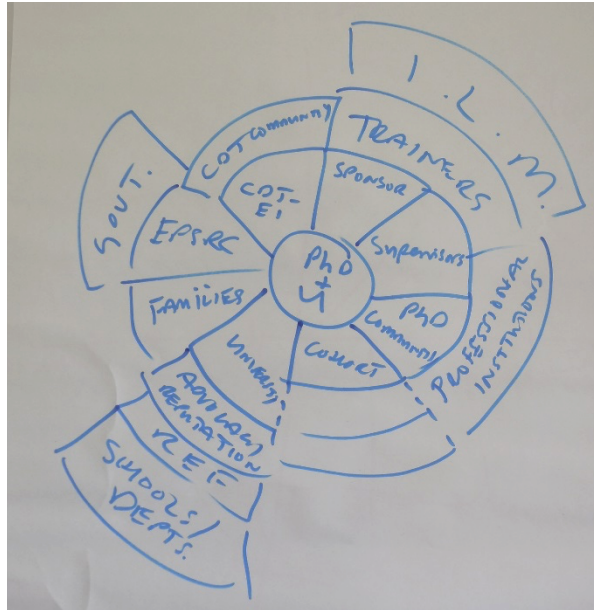
Figure 9: Stakeholders inventory, from the session facilitated in Sept 2016

Managing direct stakeholders (e.g. supervisors, industrial sponsors and group project clients) required them to hone communication skills and be proactive with networking. The examples below (more in the Appendix, Section B) present students reflecting on how important the skills taught in the course are:

> *"[In the course I learnt] the importance [of] proactivity within the enterprise. Also, how to prepare meetings so all stakeholders are included and [contribute]. (...) the importance of prioritising tasks and some strategies on how to [keep] them organised such that they get delivered in time. (...) the importance of creating networks within and outside the office and how to be open to people to create those networks (...) care must be taken when interacting with other cultures and nationalities. [The training] adds a lot of value not only in academic or industrial projects but also in daily life relationships" C4CA*

> *"if you want to develop a new product, what is the process (...) to design a specification for this, that might sound quite easy but it's not, we had to go through this iterative process, so [relentless communication] with the supervisor and the [co-sponsoring] company [was very important]. Because it's a 3-way collaboration it makes it that bit harder, so [training in dealing with stakeholder] definitely was really helpful". C2GT*

> *"Stakeholders are important nevertheless the PhD is ours and we have to find a balance between expectations and what we are really interested about. Also independency is important" C4LO*

The students reflected on the impact their work had on direct stakeholders, but also on other beneficiaries of the projects. A whole spectrum of interactions, from companies actively engaged in students' progress through to companies energised by their fresh approach to problem solving, to disengaged companies without a strong motivation to see the projects through.

> *"[we] gave them the opportunity to explore ideas they had [come] up with (open to input from us) but didn't have resources/time to explore."C34LS*

"Provided useful confirmation that the proposed project was not feasible and prevented further expenditure on the project". C12MA

"The company couldn't keep up with the speed that we had" C3CP

"I learned how to deal with a company not caring much about a project" C3MH

4.4. From activities related to 'Connecting to your purpose'

The advantages of a multidisciplinary, heterogeneous pool of students, diverse in its ethnicity and gender, with a broad age range and varied (technical, i.e. first degree or expertise) background, including disabilities (e.g. wheelchair users), were perceived by the students who celebrated this characteristic of the cohort:

"There is a friendship zone that the [program] provides". C45GO

"The [program] has a very important thing. It gives you an insight into almost everything around. So, a little bit of industry, a lot of research, and a bit of business qualifications, so it gives you a very good idea of what you want to do next. The most important part, the part that is most appealing to me, is that I get to oversee the businesses (...), which I find very important for my future, and also give me the insight of where I want to be next, because I might not just end up in academia, I know it might be frustrating for other students who just want to end up in academia, but to me, as a person who seeks a business opportunity after my PhD, I think the [program] presents me very well." C2JG

Students were invited to reflect on how the 'Transition Zone' has affected how they work, how they deal with others and how they organise themselves. The following statements (more in Appendix Section F) offer an example of the most frequently mentioned aspects described by the students:

"I have learnt how important it is to plan my strategies and skills. (...) Setting SMART objectives for myself" C5NJ

"Records - I keep various records of work/events and give extra details [on my competencies matrix] where I feel I have developed certain skills". C1DS

"[The program] give[s] you a good opportunity to reflect on some of your own past experiences, so for example managing a team, (...), it's something where you can go back and say okay, in hindsight, what went well, what went not so well, what can be improved." C2TR

"Working in fast moving progressive subject areas, I have rarely had the opportunity to consider at length my experiences. Previous roles have required that I consider the development of others as primary, developing my skills to meet that primary aim." C1CF

"Some of the more advanced material in my mind is the enterprise stuff, (...) and how politics will influence a business decision, how do you bring a product to market, that is something I've never done, and before that time never really had an interest because it wasn't relevant to what I was trying to do, so I think I had more of a traditional mindset of 'I'm just a researcher, I just wanna do my research and let them deal with the whole making it into a product thing' but having a bit of more of a knowledge of how that process works, you automatically start to incorporate that knowledge in your research and think (...) how can I start to miniaturise the setup for the next iteration, and maybe even get it smaller to a box that big, which is in my case what it will eventually have to do." C1HJ

"Sense of ownership: sponsors have their own agendas that may not necessarily align with yours and that although they have significant influence, ultimately is it for me to decide which direction to take the PhD." C3DL

"The self-management tips (...) have been incredibly helpful throughout the year. (...) helped me prioritise research in a way that satisfies all stakeholders and have also helped in my daily dealings with academics and industrial experts. (...) the professional skills that I need long after my PhD" C4TJ

"You get to see a lot more of the overall industry management side of running training and projects and getting to network and talk to other people from other industries and other companies and other research areas. I think you get that a lot more than in a traditional PhD, where you could just be under one or two supervisors who are solely focused on this one research aspect, and this is what you're doing. You get a lot more scope as to where your research might tie in in the future, and the company and industrial interests as well as kind of marketing side of things as well."C34GC

In preparation for the 'Transition Out', a deliberate exercise to raise awareness of the importance of boosting employability but not in quantifying this, we asked how the training had influenced their future plans, in particular with regards to employability. Some exemplar statements (a longer list may be found in the Appendix, Section G) are listed below:

"Because of the non-technical training we get to have, the transition zone, (...) we have more opportunities afterwards, because at least before joining the centre, my aim was to go back to industry after I finished my PhD, so I feel that by doing the transition zone training, you get to have more opportunities of seeing how things work in industry, and don't restrict yourself inside the academia environment. That's a big benefit of this CDT."C1DP

"[the training has encouraged me to] expand my business consultancy services that I (already) provide"C1MA

"when I finished my undergraduate, I started to realise that there are a lot of things that I am missing. I am not good enough to go into industry yet. So this kind of PhD gave me the opportunity to develop those kinds of skills, which I found were important to get a job afterwards. The industrial experience element was very important in deciding this, because I wanted to see how industry works and the outside."C2EL

"We're being trained to become a more well-rounded researcher and I think it's more than that, I think they're trying to get us to become is a manager, yeah sure, a research manager, but a manager after all. So after I finish this PhD I don't see me in a white coat, I'm definitely going into industry. I'm definitely not going into academia."C1IP

"When I started my PhD in this program I started by thinking I might want to go into industry, but after having the opportunity to further develop my understanding about this and after my experience of industry within the [Program], I now believes this is no longer the right fit for me. I don't think this is necessarily a negative thing but through this opportunity I have been able to come to the conclusion that this isn't something I want to do anymore". C1PL

Extracted from the different interactions, questionnaires or feedback sessions held with the students, the directors have compiled a non-exhaustive list of operational issues raised by students that have discouraged or been found dis-empowering. This is presented below with the intention to continue informing changes in the program and experiences and to improve the suitability and effectiveness of the Transition Zone for each member of the cohort:

Conflicting messages between the Centre and their supervisors: *"Supervisors should be informed about what we are doing to understand what type of workload we have"*, *"We need negotiation skills [to apply] when dealing w supervisors and industrial co-sponsors"*

Extra training: *"Academic writing is a skill we need and we didn't get any training for it"*, *"Training on how to be an academic and do a PhD"*, *"statistics, how to write a literature review should be taught in the first year"*. One of the pitfalls of a complete training program such as this, is the expectation of the students to find <u>all</u> their training needs fulfilled and they become lazy when it came to exploring the opportunities around them and taking advantage of the broader training experiences at the university (e.g. Graduate School activities).

5. Discussion

The nature of the PhD topics in the Centre invited a heterogeneous candidate pool, which brought many advantages such as diversity, creativity and complementarity in the scientific research topics. It forced us to steer away from the *one-size-fits-all* training style and instead fostered an environment in which the student was placed at the very centre of the training experience. The mixture of recently graduated and mature (or industrial experience) candidates implied that we needed to manage the overall objectives for the training as well as cater for individual's objectives, supporting their development and scaffolding their learning depending on their individual preferences and styles. We have adapted (and continue adapting) the program to their learning preferences and the needs of the industrial employment market, based on surveys performed on the students in the early days of their PhD journey and by collating input and feedback from various stakeholders.

We have instilled continuous learning as a culture to develop attitudes and behaviours that are valued by most employers: collaboration, multidisciplinarity, cross-organisation working (i.e. industrial-informed research) and innovation have been exercised via formative, diagnostic and summative assessment. Our development scenarios and analogous learning experiences (e.g. 'hackatons', product development competitions, summer schools) have demonstrated a positive impact in the way our students have interacted with their peers, networked and managed their projects. Our observations and students' reflection on these agree with other examples reported elsewhere. Companies have acknowledged the significance of short-duration, focused, self-contained (i.e. with a beginning and an end), very dynamic assignments or competitions tackled by a multidisciplinary self-directed team [26] that encouraged *out-of-the-box* thinking, disruptive ideas generation and fostered problem solving. Examples of analogous learning, such as group projects or 'Engineering YES!' (a 4-day residential course and competition to produce a business idea, with an elevation pitch and a business plan to present to investors in a 'Dragon's Den' style) have been used in our program to foster development and social entrepreneurship. Learning from seemingly unrelated experiences helped our students appreciate the customer-centric experience and connected their research to the bigger picture of a business unit. These have given the students a sense of purpose and reignited their motivation.

The Lego® exercise "Why a PhD?" was an indirect way to describe their identity and how they were approaching their relationship with their stakeholders, as well as dealing with the prejudices and 'myths' of what a PhD is about and for. Other researchers have employed

similar metaphoric tools (e.g. Tolkien's Lord of the Rings characters) and reported conclusions in agreement with ours [27].

Working with the students and seeing them interact with each other or reflect on their own activities and progress, we found a direct correlation between identity and motivation (i.e. the MUSIC model of motivation was fulfilled – i.e. students felt empowered, useful, achieved a degree of perceived personal success, were engaged in activities of their interests and felt cared for [28]). This finding resonates with results from other studies [12]. Reflection was also observed to promote understanding and development of leadership, agreeing with other studies [29]

The large number of Reflectors identified in the year cohorts explained the push back of some students to certain reflective activities (i.e. reflection in action-type of activities, versus a preference for reflection on action (post-mortem), if possible, with some time in between action and reflection). For example, we stopped doing an exercise called *'3 things you are going to do differently after this session'* because students were unwilling to reflect in-action and demanded more time in between task and reflective exercise. The low incidence of Activists was somewhat surprising and at times it made it difficult to carry out activities such as icebreakers or team-building exercises, or to introduce new concepts that students had never seen before.

With varying effectiveness with icebreakers, when working with others, or meeting new groups of researchers (e.g. from a different centre or university), students showed a preference for structured sessions or facilitated introductions. It has been a recurrent theme that the students score highly networking activities (e.g. 'speed'-networking exercises, where students in a room are given a limited time, for example 5 minutes, to speak to another researcher they have never met before and when the time is up they move to another meeting station), versus 'lecturer-type' seminars or colloquiums, demonstrating they crave the social interaction, social acceptance (i.e. they are typically 'people' people, Figure 3) but lack the confidence or skills to come forward.

A recurring comment from the students was their managing of conflicting priorities. Their feeling of being pulled in different directions was managed by rekindling their connection with their intrinsic motivators (e.g. a coaching session to revisit their personal competencies matrix, Figure 6) as well as the importance of knowing their values (Figure 5), the overarching motivators of their purpose for personal development. These cemented their identity and they became more resilient to their busy research schedules and managed their PhD work as well as communicating it to stakeholders and wider audiences.

The students' experience interacting beyond their academic environment resonated with those of their stakeholders, in particular with the industrialists. Although the industrialists' (i.e. co-sponsors or other training providers) viewpoint review is not within the scope of this manuscript, the feedback collated from workshops and interviews highlights the importance they placed on exposure of the students to industrial and commercial activities, exploitation of research, multidisciplinary working, assignments outside their PhD topic area and the development of skills such as creative thinking, complex problem solving techniques, keeping records of work in such a way that it can be followed by others, and capability to lead other experts being experts themselves.

Lessons for the practitioner, facilitators and host institutions

- All students knew their PhD project title and supervisory team at the start of their journey, allowing them to reinforce the 'triangle formation' to aid the student identify opportunities for cooperation, collaboration and support. In our experience, cases in which the triangle is not formed brought much anxiety and unsettled the student
- All students faced the same formative, diagnostic and summative assessment through multimodal blended learning. Group tasks played an important role in stimulating empathy, minimising isolation and reinforcing/informing the identity forming process.
- Common experiences (whether positive -achievements- or negative – deceptions or difficulties -) helped them gel as a supportive team, helping each other understand feedback, reflect on actions and behaviours and meet deadlines
- All students had an equal rate of pay (i.e. fees, stipend) and training benefits. This transparency aided year and inter-year cohort building.
- Gender, ethnicity, religious beliefs and disabilities diversities were issues that we have not had to address; this new generation of researchers exhibited an exemplary inclusive and respectful mentality, and have attracted various awards for their social entrepreneurship and community-building initiatives.
- Students enjoyed analogous learning activities (i.e. assignments on 'real' applications even if not seemingly related to their PhD project) and developmental scenarios in which they networked with others.
- We have learned to be wary of students who sought to enrol on this program with the only motivation a generous stipend, and no intention of contributing to any of the activities outside their strictly defined PhD topic. Those people needed to be transferred to a standard PhD as soon as their true intentions were detected. Complexity arises when it was the academic supervisor whose intentions were to enrol their student on a course with a stipend but had no intention of encouraging the student to participate in Transition Zone activities.
- Tame 'spoon-feeding' behaviour: It was essential to maintain a healthy balance between providing material and encouraging students to seek it themselves. Portraying the message of a 'complete training program' was appealing at the recruitment stage but could backfire with some students expecting provision of resources went beyond training, e.g. money, travel advice for holidays, unfitting dietary requirements, personal counselling.

We continue evolving and honing our training program with valuable feedback and continuous input from our students and co-sponsors. It is our intention to remain flexible and relevant to those with whom we have created a platform for scientific advancement, professional development, business growth and realisation of impact. Future work will focus on the 'Transition Out', on quantifying the impact of their program immediately after their graduation and we will monitor their employment destinations. The first cohort enrolled in our program will graduate in the summer of 2019 and therefore there is no data on destinations yet.

6. Conclusions

A significant barrier that could prevent the UK's positioning as a global leader in innovation and advancement in industrial activities is the lack of talented PhD graduates who can operate in demanding jobs where 'soft' skills are as much needed as technical knowledge. Since the majority of PhD graduates end up in non-academic jobs, why do we train them through traditional PhD degree routes? An innovative training program that can scaffold the technical content is an effective way to recruit and retain PhD students, and prepare them as industry-ready, highly employable individuals. This program sought to cater for their personal and learning preferences. Through the evaluation of the programme's Transitions 'In' and 'Through', and the assessment offered by the first-hand users, our enrolled students, presented in this paper, we have concluded that students expect close relationships with their supervisors and frequent feedback from peers and mentors, a tangible purpose in their day-to-day lives and impact pathways instantiated by their industrial co-sponsor. Because they associate job satisfaction with free flow of information, strong connectivity and a flat hierarchy, they prefer intrapersonal and independent learning over group work, but want to work with others and never in isolation. These observations, that assess the fulfilment of our programme aims, allow us to continue adapting and honing our Transition Zone training, conceived to support the student through three main stages: the 'Transition In', when they first enrol in the program and require support to adapt to the new learning environment; the 'Transition Through', when the students develop, create, research and manage themselves and others; and finally, in the 'Transition Out', to employment upon graduation.

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Transition Zone: a training ethos designed to scaffold a PhD degree

Appendix

Section A

On Identity and Induction:

> *"The initial induction meetings have been quite fruitful. (...) allowed to meet other students, which was in particular valuable, as I was the only student from Computer Science. I enjoyed this induction training, which had [has] provided significant guidance for the upcoming months"*

> *"This is CDT's attraction - we are not all from the same academic background, in my lab, we are all from a computer science background, so when we talk we talk in a computer science way, but in the CDT we have all different people just like somebody from design path, they use a totally way of communication, if we meet together than means we can create more interesting things"*

> *"One thing I'd like to mention here is about Business Model Canvas. The first time, I was asked to fill the canvas, but I had no idea about what to say and didn't understand the meaning of doing this. I even felt a bit wasting time on filling it. However, after almost one year, when I recalled the memory and we had a chance to redo it, that moment I realised before I didn't see the value only because I didn't have enough experience to understand it. Now only can I treat doing a PhD is doing a business, I can understand how important and the value of it. Having a business model canvas is such an important strategic process and redoing it is a really important reflective action. [The trainer] mentioned a quote from 'The art of war', "If you know the enemy and know yourself, you need not to fear of a hundred battles". This can be applied into politics, business and sports, as well as can be applied into being a successful person. We should have this consciousness of knowing ourselves, knowing our situation. The Business Model Canvas is a useful tool for helping us to know ourself, to know our situation and to make a strategy."*

> *[An issue with Identity was identified] "There is no postgraduate community at _____. It was difficult to integrate in [various parts of the university] where we got no induction"*

Section A1

On Lego® model-making exercise

> *"It was quite awkward for me to build up something to describe the PhD path specially that I have never used LEGO before. But it was good to see what others built too."*

> *"It was an excellent exercise! Very good"*

> *"The Lego activity was very good, it was engaging and was a great medium to communicate a simple message with a memorable spin. The only improvement would be more time perhaps over an evening and also to have more pieces available."*

> *"Interesting and impressive"*

"It was really useful to know my priorities better regarding to my PhD and also to know a little bit more about my cohort."

"This was an entertaining exercise and forced one to consider more fully what ones PhD meant to oneself. This was something that some individuals may not have actually considered previously."

"It was fun and a good way to visualize your goal."

"Im not overly artistic so getting the concept of my PhD having little understanding of what my PhD focus was challenging. Seeing others' interpretations was good though."

"Interesting approach, enjoyed building and discussing it with others"

"When building my own work with LEGO, I made my every decision look like reasonable. Hence, I was thinking while I was doing my work. It gave me the chance to think the meanings of my PhD career."

"It was enjoyable, and I found it helped me to understood better what I am looking for in my PhD."

"The LEGO exercise was a nice interactive way of pointing out what do we think about the PhD. It is interesting because kind of shows how we think and what can we achieve with the things we have available. It was also really creative way of presenting something and relaxing because it promoted relations between the group"

"People inspired themselves from one another leading to recurrent metaphors and concepts however people seemed to embrace it for the most part."

"[It] could be more flexible, the story you tell has to conform to available Lego bricks"

Section B

On Managing stakeholders:

"learn that you need to communicate early with the people who are involved in the project, who have a say in what's going on or what they want, who you're doing the project for.

"getting the most out of meetings and conversations"

"communicating w industrial sponsors"

"professionalism and conduct"

"Negotiation and persuasion skills

"There are more stakeholders than just the obvious ones."

"The company was pleased to confirm its strategy with the work done in the project"

"More than anything I think the company used our project to think about their problem in a new way and seemed to be pleased with the results." C3AP

Section C

On Teamwork skills practicing:

"The group project was a good bonding experience and was a useful exercise in project management and conducting ourselves in an industrial environment."

"[It was positive] Experiencing and learning about a new industry that I've previously never been involved in and having a supportive team."

"Good opportunity of working with a very large company on a significant issue on their site."

"Learning about something I had very little knowledge of [was the most important lesson]"

"The project was a great learning experience in IoT technologies and industry 4.0, it also gave the team a good opportunity to learn skills which otherwise might not have been developed but cannot be undervalued especially with the evolving industrial climate"

"[What I learnt] Learning the massive importance of clear communication between us and the company"

"[I] Used the experience from previous group projects to efficiently deliver the tasks [in other projects]"

"Learning how to manage/work with people in a multidisciplinary team [was the most important lesson]"

"I gained new skills and work with equipment I haven't before used"

"I felt there was enough to do for everyone and the team was well chosen (4 different people with different skillsets) I also learned how important communication is with the company as although we were working hard and did the project well, they thought we were disengaged due to lack of emails. Coordinating the project with members in both [sites], while the company was in a 3rd city was very difficult"

"Lack of definition of problem initially. A huge amount of time was wasted on traveling between [company site] and [University campus] throughout the project. A lot of time wasted by slow meetings early on and waiting for things such as IT accounts and permissions reduced what we were able to achieve in the end."

"The group projects are intentionally tailored in such a way that they have nothing to do with what you're researching. So, it takes you through this laid out course of, ok you don't know anything about it so you have to try and read read read and understand the problem they're trying to solve, in your first meetings, that specification that they gave you, is that still relevant, is that still correct, do they want something else, do they want to modify any bits, then start to build up that communication between yourself and the company supervisor and then start to develop your solutions and the testing. Do the testing, do it at the company or at the university, exchange the results and see how you're getting on, so it's basically like a mini research project on its own. It's isolated from the rest of your PhD. That gives you the awareness of what you have to keep in mind: good communication, if you have 6 people, you can't just have 3 people working

and the other one staring out the window, that doesn't help, so you have to keep them engaged, you have to motivate them, you have to target people's strengths, even though generally that topic you're working on has nothing to do with what you're researching."

"I had the opportunity to work with other (...) students and learn how to communicate my ideas effectively, particularly on a subject we were unfamiliar with. From the project I learnt how important it is to communicate with the company frequently and to follow up meetings. Additionally, I learnt that managing expectations and defining the outcomes of the project early, with repeated feedback from the company, were critical factors in a successful outcome of a project. I took this knowledge on board when approaching the second group project. (...) [For the second group project] I used the experience of the previous group project to become a more effective team member, with the primary goal of delivering [the company] work that could be used later. I found that being direct with questioning and effectively communicating was vital."

"Managing the team as well became a little better too, we realised that projects need stronger leadership, there needs to be one person who is taking charge and directing people, managing the project."

"So that was applied directly into the next project, where I made sure to communicate with all the supervisors, industrial academics, right away in my second project, as soon as we got briefed, clarify everything that needed to be done. And then in terms of group project work, some of the team aren't as motivated because it's not their particular area, so it's just trying to find ways for things for others on your team to become a bit more motivated and to do some work, so you can distribute the workload, because everyone's got their own research courses, and things to do as well, so that is a bit of a challenge when you're expecting people to be a bit more proactive."

"Consumes a lot of time and difficult to keep the entire project under 150hrs"

"[One of the most disrupting things] When working in groups, issues with passengers and differing motivations"

Section D

On motivation self and others via coaching:

"keep doing this type of sessions because they are really helpful in soft skills such as time-management and objective definition"

"The coaching thing has helped me mainly as a person…. You can see things like that coming up in real jobs. You can see it really helping"

"[Coaching skills] is also one of the things we learn (...) to see where we are going, and the type of views we get from each other."

"I learnt how to ask skilful questions to motivate and coach people in order to encourage independent thoughts. Besides, there are two types of questions: open questions which encourage conversation and closed questions which could block conversations. Never judge the person you are coaching or their situation."

"Provide an institutionally managed virtual working space: it is motivational and easier to communicate"

Section E

On Impact:

"[The] outcome of the project was used by [another student's] MSc at [the company]" – (Note to reader: the following academic year this student became a PhD student in this program)

"The company were excited with our approach and were looking to take it forward in their own time using what we had given them."

"We gave the company a rationale not to pursue the project further"

"It allowed to validate the viability of a path of improvement for the company's main product and provided a proof of concept. Potentially, this could be the basis of developing the company's next generation production."

"Set the initial foundations for future research and work to be carried out as well as give some insight into possible solutions."

"[Impact] Demonstrated new direction for the company to investigate"

"It served as a starting point and brainstorming face for the company to consider new avenues of research for their R&D team"

"I think the company were very happy with the work and gave them a new perspective. The ideas we put forward will hopefully help them in the future."

"From the outset we [team of students and company] suspected that there would not be a viable solution"

Section F

Reflections on efficacy of the program towards individual development:

"[As a result of the training I am] Things doing differently now: Planning, Networking, Prioritizing"

"[As a result of the training I am] Being aware of people's different learning styles and teamwork skills."

"[As a result of the training I am aware of] Transferable skills in teamwork and communication"

"[As a result of the training I am] Planning my work in a more physical nature, writing it down on paper or electronically for reference."

"I feel I have realised my roles/talents because of the [Induction/Orientation sessions] and how I can use them in all my projects."

"[As a result of the training I am] more aware of the different personalities."

"[Most importantly I learnt] the Act of setting SMART writing objectives"

"[At the end of every session the Facilitator] always let us to write down three things which you will do differently. This made me have a habit of reflection. During this year, I tried to apply this into all the events I attended. It is not sufficient to have an experience order to learn. Without reflecting on this experience, it may quickly be forgotten, or its learning potential lost."

"We found it difficult to manage [different priorities]"

"More training in project planning [is needed]"

"[As a result of the training I developed] New ideas of technology; Communication; Cooperation; coordination"

"[As a result of the training I learnt] To work on a real brief for a larger scale company that has the potential to progress beyond the project itself."

"[As a result of the training I learnt that] [maintained] Good communication between the group members was [very important] and [this is] something I would like to ensure in future work."

"Project management, I think the main thing is that industry is very much goal driven. So in PhD you just go and check this, maybe do that, and then eventually you may end up with a project you may not. In industry it's all about stage stage stage goal goal goal, make sure it works then move on, and if it doesn't scrap it don't spend much time on it. It [is] different really. Managing people - being pushier with people when you need stuff, learning how to get people to do what you want them to. I would go and see people in person, they can ignore an email or a phone call but they can't ignore a visit to their desk."

"[As a result of the training I learnt] Time management between PhD project and group project"

"Be the CEO. Plan 10 months ahead."

"[A lesson to myself] Use facilities and training opportunities. Also treat PhD as a step in your career"

"[It gives you] Perspective: skills provided throughout that time which gives any indication as to how all the things you learn will fit together or what to do at the end of your time studying."

"[The program ethos] is a proper culture to let us grow into well-trained, commercial aware and experienced graduates by fostering a culture of business awareness. [The program] is a family. [The program] educates the all-rounder PhD from heart as well as mind. Cohort program offers networking opportunities and collaboration opportunities"

Section G

On the Transition Out, employability and career plans:

"It helps in a way that you are more prepared for the things to come, you can expect a little bit better what you have to do in comparison [if you had not been in the Transition Zone training]."

"It's getting me to think a lot more about industry and communicating with industry. (…) I'm realising that a lot of the people I'm dealing with don't know as much as I do about some of the specific technical aspects to do with it, and they're interested in knowing the general concept and then how it can be applied later on in areas such as marketing, so that's been quite helpful, just to break down the explanation of my work to people who are not as familiar to it. With technical backgrounds, but not technical backgrounds in this area, so I'm finding that quite helpful, a lot of the written material and reflecting back on the work I've done, like the group projects, there's some (summative assignments and analogous learning activities) components that are reflective on group projects, to go back and think about the management, and what things you could have done better, how you do things differently, those are quite helpful, and I can apply those sorts of skills to my own projects in terms of setting goals and being a bit more accountable, and general communication with the company and my supervisors to make sure we stay on track, and that everyone is up to date on the project."

"[The most valuable aspect] Industry Experience, dealing with industrial partners"

"[Dealing with stakeholder and industrialists] When you'd finish your PhD, you'd have no idea how to do those things. I think that kind of things will be very useful in the future."

"I really enjoyed the [Transition Zone's enterprising and business-facing] element of the programme especially working on the projects with companies and I have seen the benefit offered through these experiences such as team building etc."

"[The] advantage of working on a group project is to 'get you out of your comfort zone'. Thi helped me as I made connections as a result of the work that helped me with some knowledge and understanding at a later point in his research."

"One of the takeaways from these [analogous training activities] was to have a willingness to explore research areas outside your field. As solutions and methodologies for one set of problems may be applicable to other areas. Or generate ideas for new application for existing technologies to other sectors, creating new opportunities."