EDGE FOUNDATION

A contemporary approach to employable graduates

Cardiff National Software Academy

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Foreword

In recent years, employability has become a key priority for many educational institutions – and for good reason. Increasingly it is recognised that to succeed in the workplace, technical knowledge alone is not enough; transferable skills such as problem-solving, team-working, and the ability to apply theory to the real world are also vital.

The need to cultivate employability is particularly acute in STEM, where longstanding skills shortages threaten to undermine the valuable societal and economic contributions of the sector. According to the Institution of Engineering and Technology, in 2019 nearly three quarters of engineering employers reported problems associated with candidates having the academic knowledge but not the required workplace skills, and three in five saw this as the biggest barrier to achieving their business objectives over the next three years.

It is therefore heartening to see institutions such as the Cardiff National Software Academy take a pioneering approach to employability, with explicit consideration of the myriad factors – from pedagogical method to physical environment – that can contribute to the work readiness of graduates. And it is especially encouraging to see these concerted efforts taking place in deprived areas such as South Wales where many talented young people might otherwise struggle to cultivate such skills. If we are to address the UK's STEM skills shortage and harness its full potential, we need both more and more diverse people working in these industries.

The findings of this report make clear the mutual advantage for students and employers in putting industry at the heart of both the development and delivery of the curriculum. In doing so, it provides a compelling model for the engineering community and beyond, demonstrating the potential power of partnerships to address skills shortages.

These findings are particularly important to consider when graduates, more than ever, will enter a difficult labour market where employability skills alongside the need for digital and STEM innovation will be paramount. In these unprecedented times, this report provides real food for thought for those working in education and industry.

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Students showcase their final projects to employers.

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Reference as: Emms, K. & Laczik, A. (2020). *A contemporary approach to employable graduates: Cardiff National Software Academy*. October 2020. London: The Edge Foundation

Executive Summary

INTRODUCTION

Cardiff National Software Academy (NSA) was established in 2015 jointly by the University of Cardiff and the Welsh Government. The NSA was set up to address the skills shortages in the local technology sector, where local employers had expressed concern about the lack of graduates who were prepared with the skills to contribute sufficiently to the sector. This sentiment has been found to be an issue more widely across the engineering and technology sector, with IET (2017) finding 70% of employers expressed a concern in the supply or quality of young people entering or seeking to enter the industry. The NSA partnership drew on close collaboration with industry partners to support its realisation.

The NSA offers a three-year undergraduate (UG) degree (BSc) in Applied Software Engineering. It claims to offer an innovative approach to undergraduate education in order to better prepare students for the world of work when they graduate, and to even have students ready for employment before this point. It does this through continuous close links with employers, project-based learning approaches, hands-on experiences with industry, a commercial-like environment, and the targeted development of employability skills.

Ensuring graduates are 'work-ready' or employable is becoming an increasingly pressing matter for universities. This research investigated the NSA as a model of higher education delivery to establish whether it could present an example for set up and delivery of higher education which supports the employability of students, and could be applied elsewhere across the sector. Specifically, we sought to research:
How does the National Software Academy build in employer engagement and develop innovative curriculum and teaching delivery to ensure that graduates are work-ready?

METHODOLOGY

The research was based on case study methodology, using qualitative individual and focus groups interviews, and observations at key student-employer events such as student project showcase events. The data collection provided an in-depth understanding of the process of setting up the NSA; their approaches to teaching and learning; and the experiences with the NSA of different stakeholders. Field research took place in the 2018-2019 academic year. Semi-structured interviews were carried out with senior leadership staff at the NSA, NSA lecturers teaching on the UG programme, three employers who have worked with the NSA or NSA students, and a government representative involved in the establishment of the NSA. Eight focus groups were also carried out with students across the three levels of the UG programme. All interviews had written consent from participants. They were audio recorded and transcribed and these transcripts were analysed using a content analysis approach to draw out key themes.

FINDINGS

Interviewees, significantly the employers we spoke to, held the NSA in high esteem in its ability to prepare students with the skills and knowhow needed for the labour market. Employers highlighted that both students and graduates they had worked with from the NSA were contributing significantly in their roles in the workplace, exhibiting both a faster pace and a higher quality in comparison to non-NSA graduates and student interns. A number of employers commented that those from the NSA joined the workplace and '*hit the ground running*'. The NSA was found to have several aspects of its establishment and delivery which contributed to this graduate 'preparedness' for work. These were:

- All students take part in regular **authentic client-facing projects** in student teams. The 4-week projects in every semester are set by employers or other external partners and address a real-world issue that is pertinent to that client. Projects are also carefully considered by the teaching staff to ensure the project 'brief' is relevant to the current teaching material and learning objectives. These projects were shown to develop key skills in students, namely team working and problem-solving skills. Significantly they also gave students the opportunity to develop their communication skills, particularly with employers, as students established lines of communication throughout the projects to ensure that they were responding accurately to the clients' needs. Students also presented their final 'product' to clients and NSA staff at the end of the project.

- **Curriculum content at the NSA has been developed in partnership between academic staff and industry experts**. Industry experts (employers) were brought in from the outset to support NSA's initial design of the curriculum, yet are also continually involved to ensure this design remains up to date and relevant to the needs of industry. This was viewed as particularly important given the rapid pace of change in software engineering. It is regarded as a responsibility of NSA staff to foster close relationships with a wide range of industry partners to encourage their continuous input into the curriculum content and to encourage employers' visits to the NSA, for example, delivering guest lectures and attending networking events. Networking with industry also kept the teaching staff's industry knowledge up to date.

- The methods of teaching employed at the NSA are not regarded as traditional in higher education settings, which are typically theory-heavy and largely lecture-based. At the NSA two- and-a-half-hour **teaching blocks are set up based on a continuous cycle of theory and practice**. Often a flipped-classroom approach is taken whereby, students read or watch theory before the class sessions take place or are introduced to short 10-minute lectures of content when in the classroom. The majority of the sessions involve students individually or in teams putting into practice the content they have learnt in a semi-live environment, with the support of teaching staff, peers and, at times, tutors from industry. This approach contributes to the development of strong problem-solving skills. One issue that was highlighted here was that students at times felt that they were lacking some theoretical content they needed as software engineers. In response staff emphasised that, in an ever-changing industry such as software engineering, students are being equipped with the skills to teach themselves to supplement any gaps in the curriculum content.

- Students at the NSA further develop employability skills through its **explicit teaching**. For example, external experts are brought in to run workshops, such as a day's workshop on effective presentation techniques. Employability skills are also referenced in module objectives to ensure they are developed throughout the course. Consequently, these skills are then being put into practice on a regular basis in both a safe learning space with peers and a 'live' environment, such as with employers.

- The **physical environment of the NSA is set up to emulate a workplace** rather than a traditional university teaching environment. The teaching spaces are open-plan office style classrooms that support collaborative working approaches. Practices that exist in industry are also integrated into the NSA environment, such as daily briefings, walls that can be written on to plan and inspire, and bookable meeting rooms.

- Students are strongly encouraged and supported to take up **opportunities to work in *relevant* placements** either short term during holiday periods or on an ongoing basis. Staff noted that there was a noticeable difference between the students who took part in placements and those that did not. The NSA is open to the fact that students can bring their learning from the industry and feed this back into the teaching to ensure that it is more up to date. Staff help with finding connections for potential placements and mentoring, they visit students during the placement, and foster placements' utility.

- **Relationships are developed and sustained through open and respectful lines of communication**, including between staff and industry partners as well as between staff and students. Staff at the NSA saw it as their responsibility to foster relationships with industry partners. Students were also encouraged to feed into the NSA and their views about the course and industry were welcomed.

CONCLUSION

Although a number of the findings may not be unique to UG delivery, for example a number of institutions are beginning to use client-based/project-based learning approaches as part of their courses, it is thought that the NSA successfully develops the employability of its software engineering students through a combination of these factors. Employers were extremely positive about the students they had worked with, for example, either through placements or the client-facing projects. Employers who had recruited NSA graduates also praised their readiness for the workplace and the imminent contributions they were making to the organisation. This research was carried out when only one graduate cohort had gone into employment and therefore further investigation is necessary to assess the long-term success of the NSA graduates in the workplace. However, findings of this research suggest that the NSA's inclusive approach to employability development, and the intensity with which this approach is carried out, contributes greatly to their graduates being highly employable.

Students work in teams on client-facing projects.

Introduction

The National Software Academy (NSA) was established in 2015 by Cardiff University in partnership with the Welsh government and industry experts, aiming to respond to the unmet demand for skilled software engineers in the region of South Wales. In 2015, the NSA recruited their first cohort of undergraduate students on their Bachelor of Science (BSc) in Applied Software Engineering course. The course claims to take an innovative approach to higher education delivery, working in close collaboration with businesses in order to "*not only … strengthen [students'] professional skills, making [them] ready for work, but it will also increase [their] employability through consistent engagement with practising professionals*" (Cardiff University, 2019). This research explores the approaches used by the NSA which include design and delivery of the curriculum in collaboration with employers; student team-based client facing projects and building student relationships with employers; the explicit teaching of key employability skills; and a learning environment which replicates that of a work place. The NSA believes that these approaches contribute to the employability of their students. The current research examines this claim and considers whether these approaches can be replicated across other institutions.

Background – Why is there a need for a National Software Academy?

FILLING THE SKILLS GAP

The NSA is part of Cardiff University but is based in Newport, South Wales, a town 14 miles from the main university campus. South Wales is an area of high deprivation, with a high concentration of deprivation located in Newport itself. The Welsh Index of Multiple Deprivation indicates Newport as the second most deprived area in Wales for children, with other issues being of concern such as above average levels of unemployment (Newport City Council, 2014). The skills level in Wales is generally low compared to other parts of the UK, with the proportion of low-qualified adults in Wales being higher than in Scotland and most parts of the UK (Welsh Government, 2019).

In the UK, the skills shortage is particularly significant in the technology sector, especially since it is growing and creating jobs twice as fast as the non-digital sector (TechUK 2018, cited in Edge Foundation 2018). The technology sector is very broad and includes businesses involved in the research, development and distribution of technological goods and services. As well as large tech companies such as IBM and Google at the forefront of this industry, there are numerous small and medium sized companies working in this sector, as well as jobs across other sectors which require tech specialists, from public services to broadcasting. According to Tech Nation's 2020 report, UK tech employment grew by 40% in the last 2 years, now accounting for 9% of the national workforce with 2.93m jobs created (Tech Nation, 2020). Furthermore, there has been significant growth of the tech sector concentrated in parts of South Wales, with increasing numbers of larger industries and start-ups in the region, as well as increases in wages for these professionals. However, the report also highlights the existence of challenges for the sector, with 46 per cent of surveyed start-ups and professionals noting that there is a lack of high-skilled workers in Wales (Tech Nation, 2020). Research by the Open University further found that the digital skills gap is distributed more widely, with nine out of ten (88%) organisations they surveyed across Great Britain feeling that they have a shortage of digital skills. The skills most lacking relate to cyber security, cloud-based development, and emerging technologies, with mid-level and advanced digital skills in the shortest supply across all disciplines (Open University, 2019a).

To keep up with this pace of change, the current and future workforce need to be equipped with appropriate, up-to-date skills and technological know-how to thrive in the tech industry. However, many employers are concerned that the workforce is not currently being prepared sufficiently to meet their needs. The Institution of Engineering and Technology (IET) found that, of those employers reporting a lack of skills in the labour market, 70% expressed a concern in the supply or quality of young people entering or seeking to enter the engineering industry (2017), suggesting that new graduates need to be better equipped to enter the workplace. Since the establishment of the NSA, their aim has been to address the digital skills gap and the lack of qualified software engineers available in the region.

EMPLOYABLE GRADUATES

Universities are in a strong position to help address these skills shortages by preparing students to be productive members of the workforce and equipping them with the skills that are required in industry. Despite software engineering courses being available at Cardiff University and elsewhere in the region before the establishment of the NSA, it was felt that these graduates were not 'work-ready' upon graduation and the courses not necessarily matching up with the needs of industry. The Shadbolt Review (2016) found a mixed and somewhat contradictory picture of graduate outcomes for computer science cohorts (of which software engineering falls into) in general across the UK. They reported relatively high unemployment rates for computer science graduates, yet a significant demand from employers and the needs of the burgeoning digital economy. A contributing factor they highlight is the varying nature of the demand for skills from employers. Their evidence also found commonly reported issues of employers include graduates lacking work experience and commercial awareness, a lack of soft skills and insufficient technical knowledge.

Universities are well placed to address some or all of these issues. It has been claimed that in the 21st century, universities should be taking a greater role in ensuring their students develop employability, so that they are better equipped to enter the workplace *and* be successful once in a job (Prokou, 2008, Watts, 2006). Recent debate around the role of higher education has shifted, arguing that all academic courses at universities, not just those which are vocationally focussed, should include 'employability enhancing content' (Crammer, 2006). As a consequence, employability is increasingly becoming a means by which universities are being measured (Boden & Nedeva, 2010). The NSA aims to ensure all their students develop their 'employability'.

Definitions of employability have been numerous and evolving over the years, with no single agreed definition or model. Small et al., (2018) attempt to synthesise the debate surrounding graduate employability. They acknowledge that the nature of employability has changed over the past century driven in part by the changing and competitive nature of the workplace and the growing higher education (HE) sector. They outline the following definition: '*the capacity to be self-reliant in navigating the labour market, utilising knowledge, individual skills and attributes, and adapting them to the employment context, showcasing them to employers, while taking into account external and other constraints*.'

So, what are employers looking for from their employees? Yorke and Harvey (2005) highlight that one of the key factors is an employee's ability to respond to rapid change, since nowadays graduates cannot expect to stay in a job for life. In recent years, much research has been done to identify what specifically employers are looking for when recruiting. Communication skills is often most highly cited, for example an analysis of 1000 UK job advertisements across 2000 and 2001 found that communication skills were the most mentioned, team working was fourth and interpersonal skills was fifth (Bennett, 2002). In Australia, a large scale Graduate Outlook Survey in 2015 ranked interpersonal and communications skills (written and oral) as the most important criterion, cultural alignment/values fit ranked second (34.3%) and emotional intelligence was third (26.2%) (Matthews et al. 2016). Along with transferable skills that contribute to the employability of students, certain attitudes and behaviours of individuals

have been emphasised as supporting success in the labour market (Clarke, 2008). In 2017, CBI cited the most important factor for employers when recruiting graduates was their attitudes and aptitudes for work. This was rated more highly than their degree result, the university they attended or even the degree subject (CBI, 2017).

It has been increasingly disputed whether universities are adequately preparing graduates for the labour market. Some argue that this is a result of a strict focus universities hold on academic education at the expense of developing practical skills (Tomlinson, 2012). The CBI (2019) found 82% of the employers surveyed believe that teaching of employability skills should be prioritised by universities. However, a study by Fika (2019) investigating UK students' perceptions about their HE experiences, found that 42% of students believe that academia was not relevant to the real world and more than a quarter (26%) of students reported they worry their degree hasn't prepared them adequately for the world of work. Research with employers across 35 countries has found that the demand for, what they term 'soft skills', is also increasing, with 92% of respondents reporting that soft skills matter as much as, and in some cases even more than, hard skills when hiring new employees (LinkedIn, 2019).

Work experience has also been highlighted as contributing to employability for graduates. Specifically, computer science graduates who studied on a sandwich course have been found to have the lowest level of unemployment (6% sandwich vs 15% non-sandwich) and twice as likely to be earning over £20,000 compared to those who did a standard degree (Shadbolt Review, 2016). The Review recommends that HE providers and employers develop mechanisms and routes for students to gain work experience, including summer internships and shorter placements.

ESTABLISHING THE CARDIFF UNIVERSITY NATIONAL SOFTWARE ACADEMY

In 2013 the Welsh Government appointed a city task force to address the economic and skills shortage issues the Newport area was facing. The Newport Business Development Task Force aimed to develop a short to medium term plan for the regeneration of Newport. Following the publication of their report (2013), the Task Force recommended the development of a national software academy, within the framework of a university, in order to develop software engineers who are industry-ready upon graduation, therefore making a positive contribution to business and the economy as a whole.

The National Software Academy (NSA) offers a 3-year undergraduate course (BSc) in Applied Software Engineering and from 2018-19 a 1-year MSc in Software Engineering. This research focuses on the undergraduate BSc course. The course is developed with input from industry experts to ensure that the content is both current and relevant. All students take part in client-facing projects which take place over the second half of each semester throughout the duration of the course. The development of team working skills is strongly emphasised throughout the teaching of the course, as well as a range of transferable skills such as presenting, communication, negotiation and team working. The NSA claim their course ensures their students are well-prepared for their future careers. An NSA graduate will have worked on a good range of sizeable software engineering projects throughout their 3-year course and will have gained significant experience helping to improve their employability (Cardiff University, 2019).

If the NSA is achieving its aims, to effectively teach the skills and knowledge students need to develop into work-ready software engineers and ensure that graduates are being placed in suitable job roles, then it could be argued that the NSA could provide suggestions for set up and delivery of higher education which could be applied elsewhere across the sector. This piece of research sought to investigate the NSA, posing the following research question:

How does the National Software Academy build in employer engagement and develop innovative curriculum and teaching delivery to ensure that graduates are work-ready?

The research investigated:

- How is the NSA course designed, developed, and delivered?
- How do key stakeholders (students, lecturers, employers, Welsh Government) perceive the NSA and its delivery of the course?
- Are NSA students being prepared for the workplace, and if so how?

Methodology

A case study method was used in order to gain an in-depth understanding of the process of setting up the NSA; their approaches to teaching and learning; and the experiences of different stakeholders. Qualitative data was generated in the academic year 2018-19 through semi-structured interviews with the following participants:

- Three senior leadership staff, particularly those involved with the setting up and establishment of the NSA
- Five lecturers on the undergraduate (UG) programme
- Eight focus groups with UG students across all three levels of the course (Years 1-3)
- Three employers who have either been involved in the course design, provided placements for students, or recruited graduates from the course
- A government representative who has been involved in establishing the NSA.

In Semester 2 (April and May 2019) observations also took place at the students' project showcase event, which involved students presenting projects to employers, external stakeholders, and course lecturers. The observations provided insight and evidence of skills development and student-employer interactions. Observation data allowed triangulation of some of the findings from the stakeholder interviews.

Interviews took place in person with lecturers, NSA developers and government representatives. The interviews with students took place in small groups, usually between three to eight students per group. Employers were accessed through contact initially made by a member of staff from the NSA who invited them to take part in the research. For those employers that responded to the request, interviews took place over the phone. Each of the interviews lasted between 25-60 minutes, were recorded, and then transcribed. The transcripts were analysed using a content analysis approach to develop common themes.

Edge Foundation adheres to the British Educational Research Association (BERA) Ethical Guidelines for Educational Research (2018). While NSA is not anonymised with their consent, all participants were aware of the nature of the research and informed that responses would remain confidential and anonymous.

LIMITATIONS OF THE STUDY

The research is a case study of NSA and therefore findings are not widely generalisable to other university settings. However, the research aims to explore what NSA offers to ensure that their students are being equipped with the appropriate skills, knowledge and experience they need to be work-ready. Findings of this study could inform curriculum design and delivery approaches at other educational institutions.

The NSA is in the early stage of its development and there had been only one year's cohort of graduates when the data collection took place. Therefore, NSA graduates' perceptions of being work-ready is not represented in the study. Although invitations were sent to these graduates, we did not receive any responses. A number of employers were interviewed nevertheless, some of which had taken on graduates or had students on work experience during the course, and were able to provide insight on how NSA graduates have adapted to the world of work.

Findings

The following section presents the key aspects that have emerged from the data and that are deemed influential in contributing to students' employability. The overarching features that are being discussed are real-world projects, curriculum content, teaching and learning at NSA, the NSA environment, placements, and other employer input. Throughout all these aspects, the notions of employer engagement and practical learning constantly emerge. These themes will be explored in the following section using excerpts from the interviews to illustrate the findings.

REAL-WORLD PROJECTS

Throughout the three years of the course at the NSA, students carry out one 4-week client-facing 'real-world' project in a small team with their peers every semester (i.e. twice a year). In the final year students undertake a larger, 10-week, project. Therefore, by the end of the degree a student will have taken part in around six client-facing projects. The 'client' of these projects is any external organisation to the NSA, often being an employer from a range of sectors, including private and public organisations, charities, or for example, another university department. These projects are defined by the client on the basis of current relevance or priority to them. The collaborative nature of the projects ensures that the tasks to be solved are not only important to the organisation, but also scrutinised by the teaching staff. This is to ensure that the project is fully coherent with the course learning objectives and relevant to the students at that stage of the programme.

For example, one of the projects was set by the university's School of Dentistry, who tasked students with designing virtual reality (VR) content for children for their dentist's waiting room. Another client was a local bar that tasked students with developing a mobile app to use for customers ordering drinks. These projects are grounded in a real-world issue and require students to consider the wider context beyond their project brief. The client-proposed projects are verified by teaching staff to ensure the brief fits in with the academic modules and delivers on the learning outcomes from across the course. The fact that the client is external to the NSA, rather than academics devising the project, makes the projects more authentic and meaningful, giving students additional motivation in their studies:

> You may try implementation in a pseudo environment, but it's never really ... you never get that full experience. (Employer A)

The projects operate through a number of distinct stages which ensure the clients have continuous engagement beyond outlining the task. Students begin by meeting with clients and gathering requirements and have meetings throughout the projects to receive ongoing feedback, either through regular face-to-face meetings or other lines of communication, such as by phone and email. Such input leads to the development of strong and effective communication skills; networking skills, confidence, familiarity with the vocabulary of industry and the workplace. At the end of the project students present their 'product' to clients and NSA lecturers:

> We have contact details of [the client] if we need to clarify anything, and then the final meeting we see them to present, and I guess they give their feed back then, whether they like it, whether they don't, what they'd improve. (Year 2 NSA student)

The use of projects was highlighted as having measurable benefits to students. For example, developing communication skills from exposure to terminology used by businesses, and acquiring the ability and confidence to ask the right questions in order to understand the client's requirements. Students importantly gained the ability to communicate and present their products to both technical and non-technical stakeholders, since some clients with whom they are discussing and presenting their projects are not always software engineers, but may be other staff from the organisations. As one employer reflects:

> The terminology, they're already up to speed with. They just feel comfortable discussing their work because they've been discussing projects with companies, in their own environment. (Employer C)

Furthermore, the projects equipped students with the ability to build and manage relationships both with clients and fellow students as they were working in a team. Through the projects, the students who were interviewed claimed the high degree of teamwork within the course supported the development of more meaningful and sociable relationships between peers, which was claimed supported their learning. For example, students reflected on the fact that the relationship between students is more supportive and collaborative (compared to other courses they were aware of), whereby peers are aware of others' strengths and weaknesses, and help each other in line with these. Students recognised that this was preparing them to work in a team and collaborate when they reach the workplace.

> These client projects… [you can drive] the learning because I suppose you want to please the client and you have real motivation then to learn new skills in an environment where you can ask lecturers. (Year 3 NSA student)

> For securing employment, [the most important part of the course] I'd say probably the group projects themselves, just because the amount of communication you do, not only with your team but with clients, so you're able to see how they would normally run a team, you can gather from that how you would work, but you also learn teamwork, which is quite an integral skill to be doing computing in, so they're huge helps. (Year 2 NSA student)

Students work in a range of roles within their teams across the three years of their course, to ensure that they do not specialise too early. For example, lecturers noted that all students are given the opportunity to be 'scrum master' for at least one of their projects. Scrum is a framework for effective team collaboration used by the NSA. During the project, the development of team working skills is supported by weekly reviews with NSA staff, whereby staff meet with the project teams for half an hour each week. This gives lecturers a good indication of how different team members are engaging and contributing to the projects themselves and provides feedback and support on moving forward.

> If you do push them too quickly into roles, then the chances are they may not meet the learning outcomes of everything that you need to do within a module, anyway because they're specialising too quickly, unless you get an opportunity to rotate those roles. (NSA Senior leadership team (SLT))

Working in a team for a considerable amount of time has additional benefits in terms of relationship-building, including managing others, and learning about students' own strengths and weaknesses. Many of the students made comparisons to other university courses that they judged as giving fewer opportunities to develop these people-working skills:

> People at normal unis are less sociable just because their modules and their course makes them that way because you just have to read a textbook, but here you're actually put into an environment where you actually have to be a bit more sociable. (Year 2 NSA student)

> You actually have to get to know your team mates…you have to get to know like people's weaknesses, their strengths, and then you can help them where their weaknesses are, and they can help you where your weaknesses are, you can help each other, like teach each other. (Year 2 NSA student)

Lecturers and students also emphasised how team working took place throughout the semester, in addition to doing the real-world projects. Interviewees noted that there is an '*emphasis on the teamwork…all the way through the three years*' (NSA SLT). This includes taking part in small group activities during the lesson times at the NSA and group assessments.

The client-facing projects were therefore useful in providing an authentic opportunity to grapple with a real-world problem which is of importance to employers, authenticating the learning objectives that have been set in their teaching modules. Aspects of these projects actively supported the development of the students' skills, namely team working, communication skills and project management techniques.

CURRICULUM CONTENT

The staff and government representatives who were involved in the setup of the NSA strongly emphasised the input that employers provided in the design of the curriculum from the inception of the NSA. The distinctness of this approach was not tokenistic in a way that the content was simply 'checked' by employers to ensure that it was relevant to industry's needs, instead the designing of the curriculum was regarded more of a partnership between multiple employers, from public and private sectors, and across a range of sectors.

> I put 32 businesses in a room and said, "So, what are your challenges? What do you want?" and of course 32 businesses came up with 40 different ideas…What we were able to do was to take that forward and [the university] started to embrace that, "Okay, well we can change up to 40% of the curriculum," and this was how university was responding to us as industry, and as the Welsh Government. (NSA developer)

> [We had] a variety of different employers, large and small, so [we] were able to bring a really good perspective... Actually having those two viewpoints [academic staff and employers] around the table for an extended period of time was really key to putting the course together. Lots of late-night arguments, I remember, but tremendously valuable. (Government representative)

Employers were able to offer their expert viewpoint about what is relevant for their employees to know and be able to do in the industry. Not only were industry experts involved in the initial design of the course, but they also have continuous input into the curriculum content to ensure that it is kept up to date and relevant. This, it was stressed, is particularly important in the software development industry given the pace of change of technologies.

> It's not just one source of information, so job agencies that we work with, so they visited us and also they were very confidently saying that in the local area there is a demand for the knowledge of procedural SQL. So, from various sources from industry we received that information and we've added into our curriculum. (NSA lecturer)

The action the NSA has taken to ensure that these partnerships between industry and NSA are maintained was also highlighted by employers as being meaningful, in order to keep the course up to date, rather than being a one-off consultation with one or two employers.

> They don't just talk about steering groups and getting industry involved. Lots of universities will want industry participation in their programmes… They create steering groups but they maintain those steering groups. (Employer B)

> We're three or four years in and we're starting to be behind on some of the technologies. So, we've got to keep ourselves up to date with the technologies. (NSA lecturer)

Maintaining these links with industry is achieved in a variety of ways, such as both staff and students visiting companies, networking events, and engaging with clients who visit the NSA. The teaching, it was therefore noted, is generally aligned with the realities of the commercial world. Ensuring the course content does not become obsolete, and the links to industry maintained, is seen as the responsibility of all the NSA teaching staff. Staff from the NSA were generally found to be proactive in ensuring the course was relevant to industry, particularly through the development and maintaining of relationships with external stakeholders. Some lecturers we spoke to were aware that working in an academic setting, rather than working directly in the industry, meant that they had to put in additional time and effort to ensure their knowledge remains relevant in line with industry needs. Some lecturers expressed that this can be hard work and beyond perhaps what would be expected from traditional courses. However, it was also acknowledged that the investment paid off, both in terms of what it offered the NSA and contributed to the satisfaction of employers.

> I go out a lot in my own time and because a lot of these meet ups are in an evening and things, so I try and get to them, I try and participate in the online space for meet ups and chat. (NSA lecturers)

> They're [NSA staff are] always available for a coffee. Always available if we have any questions… If we want to run an event at the NSA, a lunch-and-learn, a networking thing. They are always willing to accommodate. …I can't really fault them for the effort they put in. (Employer B)

Many of the NSA staff, as well as having the relevant academic qualifications, were recruited directly from industry roles, rather than coming from a purely academic background. This is much more common compared to lecturers on typical undergraduate programmes, who to a greater extent, have worked largely in academia. NSA staff draw on contacts from their previous experiences to establish connections for the Academy, which was seen to be advantageous in bringing a different perspective from those that had only worked in an academic setting.

Ensuring the course content had a substantial input from a range of industry partners, and continually ensuring that this industry input is maintained, was found to be a key factor in developing a relevant and work-appropriate course. The relationship building between the NSA staff and partners clearly supported this ambition.

TEACHING APPROACHES: THEORY AND PRACTICE

Most stakeholders were keen to point out that the methods of teaching employed at the NSA are unlike 'traditional' university courses, which they emphasised are generally lecture based and theory heavy. Instead, teaching at the NSA is structured into two-and a half-hour blocks per session based on a cycle of introducing theory and integrating this with practical elements, allowing students to both immediately and continually link relevant theory with practice.

> We'll go through slides with the lecturers, because we all have our own screens … take notes at the same time, and then we'll get a set of tasks on what we just learnt and we have to implement what we just learnt, so it's almost all based on what we just learnt, doing that, and then that task will last for X amount of time, and lecturers and people just help each other. (Year 2 student)

The delivery is seen as advantageous in terms of being a better way to learn material since the application of theory becomes concrete through the use of real-life examples and application.

> Every 20 minutes you are doing something practical, you are applying it and using it. It's much easier to learn. (Year 1 student)

Furthermore, taking an approach that cycles between theory and practice was credited with developing problem-solving skills in students which will be useful for employment. Some employers noted that during placements students had applied these skills quickly thanks to using a similar style in the modules.

> We go through these types of problems, which are, first of all, traditional computer science problems, we approach them in a theoretic way, in a mathematical way, and I make them understand these types of problems are not solved, although we have all of the solutions they're still open-ended and it's up to them to think of the next great solution. (Y1/2 lecturer)

However, it was noted by some students that the large amount of practical activity within the modules is at times to the detriment of sufficient theoretical content, where some students claimed the course had not always given them enough theoretical underpinning. However, many of the students also showed an awareness that the other opportunities gained from studying at the NSA, such as taking part in projects and working in teams, meant that they had to forgo a heavy amount of theoretical content.

> But what we gain on the practical side we lose on theoretical side, so [in job] interviews may ask you questions on things that are a lot more [computer side] based, and so we might not know that unless you actually go out of your way to learn it yourself, but then, you do gain the practical side, so it's more of an advantage. (Year 2 students)

Nevertheless, it was claimed by some students and lecturers that not giving students all the necessary theoretical content was in fact advantageous, since it encourages students to become 'self-learners' and to compliment the knowledge that had been given to them by lecturers with their own research and development. This was particularly deemed important given the nature of the software engineering industry. The technology in this area is constantly updating and therefore it is important to keep abreast of this to guarantee knowledge is up-to-date and relevant. It was noted that students would have to do this throughout their careers so in fact the NSA approach assisted this. Therefore, students not being spoon-fed all the theory by the lecturers, whilst being equipped with the skills to learn for themselves, NSA staff in particular highlighted as being essential, with a number of students stating this approach had helped them become more independent. For example, a software package that is taught to students in their second year of the course may not be used in the industry by the time they reach graduation and enter employment.

> [The lecturers say] "here's the basics. Now, go and teach yourself another part within a framework" … you need to be able to teach yourself, because things are always changing. (Year 3 student)

It was suggested that skills for independent learning are also developed through a 'flipped classroom' approach, whereby students are given content to either read or watch in their own self-study time, and they must be prepared with this knowledge before a particular session, which will draw on the content in terms of practical exercises. This is developed as students progress through the course and improve their ability to research where to find the necessary content to support their own learning.

> We get the skills here to teach ourselves, to know where to go, because after a while you think…"I don't need to ask them. I know where to look to find this." (Year 3 student)

> I think that getting clients in means that it pushes the students to understand that they're never going to stop learning. Everything is going to go out of date. That's the biggest thing we can teach them, "Go away and find out yourself". (NSA lecturers)

EXPLICIT TEACHING OF EMPLOYABILITY SKILLS

NSA explicitly teaches what could be classed as 'employability skills' and competencies; that is transferable, management-type skills, attitude and behaviours relevant for a range of jobs (not just as software engineers), rather than the technical and engineering skills which are also taught. Employers and lecturers mentioned a range of skills and competencies that NSA students develop well, including communication skills and dealing with a range of people, confidence, resilience, problem solving abilities, and the ability to self-reflect. Lecturers and students emphasised that, compared to other undergraduate courses, these were taught explicitly rather than developed as the result of other learning. This included bringing in experts to deliver sessions on, for example, a one-day workshop from a student union employee on 'how to deliver a presentation'.

Interviewees noted that a clear framework was established for the teaching of transferable skills. This includes exactly which skills and competencies will be taught and at what point in the curriculum. It was highlighted that integrating these into the theoretical modules is crucial in ensuring employability skills are fostered sufficiently. This means that the skills are developed in students from the initial explicit teaching of these skills (e.g. a one-off workshop with an expert), to the application and practice of these through the course modules. The skills are then further developed or 'showcased' in the client-facing projects in the latter half of the semesters, for example when students need to deliver their final product presentation to the client.

Furthermore, the skills framework is made explicit to students, as they are made aware of the skills and competencies which they should be developing in a particular module. This explicit teaching style means students are fully aware of the skills they are learning and are able to better reflect on their personal development. This outcome was displayed in the focus groups with students where they continually were able to demonstrate to the researchers the skills they were developing at the NSA, and give clear examples from their course of where they are demonstrating these.

> [I developed] a lot of confidence for talking to people. When I came here, I was the most quiet, shy person, and I didn't think I'd ever be doing an interview of anything, but especially at [company] we had to stand up in front of the CEO and present to them a presentation. We'd done some presentation skills here before, not quite on the same scale, but we'd been taught and well-prepared about how to present ourselves, how to speak confidently and properly and what to do in that sense. I feel like that's a skill that's often quite under-developed and it's something that's really emphasised on here. (Year 3 student)

> [Skills are] described very clearly in the module description, so it's not just coming out of the blue. (NSA lecturers)

As noted, it was made clear that this explicit teaching of skills is scaffolded as students progressed through their course and interlaced with practicing them in a real-world environment, whether that be in terms of carrying out projects or interacting with external stakeholders such as employers. Yet

although these were classed as real-world environments or situations, some interviewees deemed it to be a 'safe space' in which to practice. This helps prepare students to be ready to use these skills suitably when they reach employment.

> At the [NSA], businesses come in and they discuss a project and what they need and what they require. So, [students] are used to doing that on their familiar territory, so when they come into the business environment, it's just a small step away from what they're used to. (Employer C)

> They spiral up to give them this body of knowledge on different ways of managing projects, plus they've got these four short projects in order to practise it with, if you like, the leashes come the further into the course they go. (NSA lecturer)

Most of those interviewed evidenced through examples the skills that NSA helps students to develop and will need after graduation in the workplace. However, from some of the students' points of view, there were times they did not feel they were fully prepared with all the necessary skills before putting it into practice in their course.

> I felt they could have taught some project planning before they gave us our first project, because they taught us vaguely how to do it and then they gave us quite a large project and most people didn't know how to break it down. (Year 1 student)

Some lecturers countered such claims by remarking that from the very beginning of the course students would have interactions with employers, and from the first semester of year 1 students take part in their first client-facing project. Therefore, it is justifiable that not all skills are 'front loaded' and taught at the inception of the course, but instead are introduced and developed at interim times throughout the three years.

NSA ENVIRONMENT

The physical space of the NSA is intentionally designed to replicate a work-like environment, rather than a traditional university setting. Respondents were keen to highlight in many of the interviews that the NSA does not have lecture rooms. The main teaching spaces are similar to what would be expected in an open-plan office environment, along with the desks and technology expected in a business, and bookable meeting rooms.

> The students work in the correct environment, so like actually having computers and stuff as opposed to just being sat in a lecture hall…using technology that they're using inside a normal workplace. (Year 2 student)

This set up brings the realities of the industry into the teaching space, again in a way that ensures students feel comfortable and safe in an environment which prepares them for employment. Employers believed that having a modern work-like environment such as at NSA, encouraged more professional,

respectful relationships and communication between the staff and students, resembling workplace interactions between colleagues.

> They treat the environment as they're treated, so they treat it with respect. (Employer C)

> The [students are] being spoken to as adults and I think that's one of the most important components, I find. The expectations are different. (Employer C)

> Ownership, that degree of trust…they feel comfortable saying something. (Employer C)

Using ways that you would expect employees to operate in the workplace was also credited as supplementing the workplace-like learning environment. For example, they have special walls in the teaching space which can be written on and can be used for brainstorming particularly when working in groups. Within some modules, students also take part in daily stand up meetings, whereby students and staff would have a brief meeting at the start of the day for a short update in a way that a team may do in a business. The employers interviewed stated that as similar practices take place in their workplaces, this helps the students to understand the workings of a real workplace and '*helps them understand the bigger picture*' (Employer A). It was acknowledged that the benefit of the NSA environment eased the transition of students from a university setting into the workplace, as noted by employers and students who had taken part in placements with companies during their course.

> So, to move from here to an actual business, I didn't find very difficult. (Year 3 student)

> [Students are] using all the agile ways that these industries of today are working. Then, these students slot in [to a firm]. (NSA SLT)

WORK PLACEMENTS

Students at the NSA are strongly encouraged by the staff to take part in course-relevant paid work placements, with many students deciding to do so. These placements often take place over the summer holiday period or on a casual, part-time basis during the academic year. Placements can be beneficial to students as they gain more insight into how their subject area can be applied to the real-world, as well as an opportunity to learn and develop the employability skills they need in the future. Those that had taken part in work placements were credited with having an increased knowledge and understanding of the sector.

Although participating in work placements is not a compulsory part of the course at the NSA (compared to other university courses that offer formal sandwich years in industry), they are encouraged by the staff, who highlight the benefits of them to both students and employers.

> No, [not all students do a summer placement], we'd like them to. I think it's growing year on year, because the word is getting out, both with the students, because they see the difference in the

> students who've done a placement and then come back, and also with the employers as well. They can see the value of it. (NSA SLT)

The employers interviewed noted that they gained value from the students who were in placements with them and explained that the students were producing useful and meaningful work in the business and contributed well to the environment. It was additionally emphasised by employers that students contributed well even after a very short period of time in a placement. This was particularly reassuring in the early days of the NSA's operation, as they were getting feedback from employers immediately, and not having to wait three years for the first cohort of students to graduate and enter the workplace.

> There were also a couple of really tiny companies, including a four-person band who took on two of our students, and when they came back to say that the students were immediately useful, and they were able to add value in the three months that they were working there, that was really our proof of the pudding, that things were working. (NSA SLT)

> We had summer interns last year, they developed dashboards and they are still being used today… within week two were delivering ... Two weeks, it's just phenomenal. (Employer C)

As well as students making a difference to the companies that they had placements with, they were making additional personal and professional progress as a result. Placements give students opportunities to put their knowledge and skills into practice and understand how these can be used in relation to the sector needs. Additionally, placements act as a means for the NSA staff to develop and deepen relationships with industry. Lecturers often visit students during their placements, which is seen as an opportunity to liaise with industry experts and for the lecturers to gain up to date industry expertise. This, along with direct feedback from the students' experiences in the placements, has then been used to feed back into the course content to ensure that is being continually revised in line with new practices and technology in industry.

> So, I think you find in the summer placements that students are coming back and saying, "Well, this is all the language that's now being talked, it's moved on, and the industry say that". You're able to now review all of that and get a lot of that industry engagement helps you keep the currency of the curriculum. (NSA developer)

It was also clear that this feedback loop is supported by the open relationship between lecturers and students; the lecturers are willing to learn, not only from the industry experts themselves, but also from the experiences of the students.

> I went on a summer placement with [company X] and I had a catch up with my lecturer in-between time and they were really keen to know what did we not do that didn't prepare you for it…Like, "What can we do better? What were you not prepared for?" They really care about your input and they're all very supportive. (Year 3 student)

The placements have also benefitted the students as a networking opportunity to gain employment in the future:

> I think another interesting thing we've seen is where students end up doing a summer placement and some of the employers then want to keep that student on. (NSA manager)

All employers also noted that students were making contributions to their business at a much quicker speed compared to other graduates and students who were not from the NSA. The reasons given for this preparedness are the factors as outlined so far, such as NSA environment and the client-facing projects.

> We knew they would come in and hit the ground running. Potentially more so, say than anyone on a more traditional computer science degree. (Employer A)

> One of our students last year when he went on placement with [Employer Y] was actually asked to not develop code but manage a team. (NSA lecturers)

OTHER INPUTS FROM EMPLOYERS

We have already explored a number of ways in which employers engage with the NSA, including through developing course content, setting and collaborating with student projects and hosting placements. In addition, employers offer more causal, ad hoc activities such as 'lunch and learns' whereby employers are invited in to give a guest talk or session to students at the NSA. These are not all necessarily with software engineering experts but a wide range of external stakeholders whose contributions broaden the minds of students to the wider world of work. For example, one lunch and learn session included someone from an accessibility charity and an accompanying guide dog, who made the students aware of the diverse set of needs within society and thus equipping students with a greater sense of awareness of the accessibility issues they may need to consider when developing software. Employers and other external stakeholders may also provide longer sessions and workshops, which are specifically targeted at developing a particular transferable skill such as presentation skills.

Employers also offered guest lectures at the NSA, which allow students an insight into a particular company. From the employers' point of view this gives businesses the opportunity to sell themselves to the sought after 'employable' students. From a student perspective, they can '*broaden their horizon*' (NSA lecturer), help them understand about different sectors and what employers look for when recruiting.

> [Company X] come in and talk about what it will be like going off into work with them. (Year 2 student)

Industrial tutors are another way in which employers participate in the work of the NSA; in this case an industry partner would regularly come in and work with teams of students to support them with their work. This may be during the client-facing project for example:

> [The industrial tutor is there] to ensure that they are delivering what the partner needs. To ensure they are working to the timelines of the project…He can just guide them in the right direction, maybe recommend frameworks that they can use. (Employer B)

Interviewees explained that some of this tutoring support also took place in the classroom. Again, an industrial tutor could work with smaller groups of students such as those who needed additional support to learn or understand a particular concept.

> Whenever you have an issue [the industry tutor] used to come around, like you can ask him for help and he will sit you down and explain the basics of what you're doing…step-by-step what's actually happening, which is really useful. (Year 2 student)

> [The industry tutor] tend to provide more general advice for anybody on the floor. (NSA SLT)

Working with the smaller groups of students seems to be effective and reflects the workplace-like atmosphere:
So, when that team of four is suddenly facing a difficulty and it looks like a software house and the buzz that's going on, the mentor is the industry person in the room, not just the academic. (NSA SLT)

Some of these industry tutors were engaged over an extended period of time, building deep relationships with both the lecturers and students. The students interviewed mentioned external tutors by name and were extremely positive about their role in their learning. It was emphasised that there was also a benefit for the industry tutor and businesses in terms of professional development for staff, particularly recent graduates who are able to refresh and solidify their knowledge, as well as develop their interpersonal skills.

> It becomes a bit of CPD for the industry, and then they can put their recent graduate hires and their newly qualified staff who want to come and give something back and say, "Wow, if only I'd had this opportunity," and then you get the new graduates coming in or the people coming in to say that they're on call. (NSA SLT)

All these employer interactions give opportunities for students, as well as NSA staff, to network with industry experts, to establish and build upon relationships with potential employers and discover opportunities for placements. They also allow students to not only learn the employability skills necessary for the world of work, but practise using these in a genuine situation.

> They invite us into networking events with students, where we get to present our business and the students get to just mingle really, meet employees. (Employer B)

> They [students] demonstrate a lot of commercial awareness. (Employer A)

Throughout the interviews, all the employers were continually full of praise for the professionalism and 'work-readiness' of the students and new graduates from the NSA. Employers praised not only the

technical skill and knowledge that they brought to the job but highlighted that it was the application of this into the 'bigger picture' that was commendable, as well as their way of working through collaboration and problem-solving. These factors, they claimed, helped students on placements and graduates successfully fit into the workplace. Staff and employers also noted that the reputation the NSA has now gained locally meant that graduates from the NSA were becoming more in demand.

> the students that we've had from the NSA have been some of our best that have come through the programme. They are able to hit the ground running. They can actually build programme. It is not just about the theory, because they have that applied nature to their course. (Employer B)

> I think by the time they get to the third year I'm having conversations with them that I would be comfortable having in work. I can remember the conversations I'd been having after 20-odd years in industry with my peers really, and at the end of the third year I'm happy that I can have the same sorts of conversations, the same debates, the same arguments with the third-year students. (NSA lecturer)

> they're creating very, very good graduates. As more and more people find out about the NSA, it's harder to get hold of their students to bring them into your own employment' (Employer A)

Discussion

The findings revealed that the NSA prepares students for work in software engineering through profound employer engagement and uses pedagogical approaches which interweave theory and practice throughout the course structure. Furthermore, key skills that are relevant to the workplace are being developed to a high standard during their degree course, firstly through the explicit teaching of the skills and then supported by their continuous practice in safe and real environments. Feedback from employers emphasises that the NSA students and graduates demonstrate a high degree of work-readiness and understanding of the industry. It was specified that graduates are highly sought after by the employers, with many also keen to offer students placements while studying. Employers particularly emphasised the speed in which NSA students and graduates adapt to the workplace environment and the positive contributions they made to the company during their short placements.

There are overarching factors which traverse the key aspects of the NSA discussed above, and contribute to its success:

- Employer engagement
- Linking theory to practice
- Explicit teaching and development of employability skills
- Work placements
- Strong relationships

Employer engagement was a particularly strong factor which was underlined from the initial development of the NSA to the continuous running of the course. Employer contribution took place from the initial designing of the course content to the constant revision of it. This is particularly important given the nature of the sector, in that technology is developing at a rapid pace and it is therefore crucial that the knowledge and skills that are developed are kept current. Indeed, one of the main concerns from EIU's review of the global engineering capability gap (2020) is that there is a lack of collaboration between industry and academia, resulting in coursework or research that fails to address relevant industry challenges and few opportunities for students to gain hands-on work experience. It seems that the NSA is addressing one of these main concerns and managing to bridge the gap successfully. Given how technology plays a role in many jobs and across many industry sectors, it could be argued that this continual input by industry into curriculum content should also happen across many types of university courses. Client-facing projects offers one specific example where employers can have a continuous input into the course.

Employers did not only engage 'behind the scenes' with the staff in co-designing the programme and projects, but also built considerable relationships with the students. This included interacting with the student teams throughout the cycle of the client-facing projects, which supports the development of students' communication skills and confidence, as well as their knowledge of the industry. Additionally, many students take part in work placements which have been shown to be effective tools to enhance

the employability of students (Blackwell et al., 2001). The benefits of the skills and experience gained from a sandwich year course (Shadbolt Review, 2016) appear to be partially addressed at the NSA through shorter placements, whereby students are gaining work experience, commercial awareness and provided with real-world examples where they can apply the skills and knowledge of their degree. This offers a viable option for those not wishing to take an extended 4-year sandwich degree.

Linking of theory and practice has been another recurring theme in this research. At a micro level, this takes place within an individual two-hour teaching session, where there is a short introduction to the theory (e.g. 20 minutes teacher presentation) or the theory is introduced through a flipped classroom approach. During teaching sessions, the students are immediately given the opportunity to engage in practical exercises either individually or in teams. The complexity of the theory is then built upon with practical elements to concrete this knowledge.

At a macro level, when considering a semester and programme as a whole the balance between theory and practice also changes over time. Towards the beginning of the semester, teaching sessions have more theory than practice, and as the semester (and programme) progress, students are given more opportunities to apply this knowledge in a more realistic setting, whether this be through team or individual exercises, the client-facing projects or the placements with employers.

This link between theory and practice also prevails in the teaching of employability skills. Some skills were taught explicitly, initially by introducing the theoretical nature of a particular skill, for example, through outlining different team roles and their responsibilities. Students are given opportunities to apply skills firstly in a 'safe environment' at the NSA by playing different team roles with a group of students. They then refine their team working skills in their client-facing projects and during placements, each of which could be considered a 'live environment'.

Client-facing projects are attributed to building a great deal of transferable skills and competencies that are necessary for working as software engineers. In addition to communication skills, team working skills and confidence, stakeholders credited NSA students and graduates with having well-developed problem-solving skills, which included dealing with uncertainty, working in a logical method, reflecting, time management skills, as well as being able to come up with solutions to real-world problems. Communication skills are frequently highlighted as being the most important skills employers look for when recruiting (e.g. Bennett, 2002, Matthews et al. 2016). Team-working skills are also important amongst employers and are claimed to be well-developed at the NSA.

Furthermore, NSA students show deep awareness that these skills are being developed, naming specific skills frequently and giving clear examples of where and when they have developed these. Shadbolt (2016) highlights that unemployed computer science graduates reported they failed, during their degree, to appreciate the importance of experience of the world of work and the soft skills that employers need. The NSA's approach of making students explicitly aware of the skills they are developing seems to offer an advantage here. Indeed, Hillage and Pollard (1998) identify that in order to establish employability, individuals must have the capacity to exploit their assets, market them and

sell them. This self-awareness also allows them to navigate their way through the labour market and realise their potential.

Relationship building among peers, between both employers and staff and employers and students, and between students and NSA staff, are evident. Through project work and various teamwork sessions, students develop supportive and collaborative peer relationships as they become aware of others' strengths and weaknesses and help each other in line with these. Such ability to build relationships and having strong interpersonal skills can contribute to the transferability skills of graduates and can improve their employability (Snell, Gekara and Gatt, 2016). A strong and evidently sustained relationship exists between the NSA staff and employers. Relationships were developed in a number of ways, including building on the industry careers that many of the teaching staff previously had, through visits to places of work, and other networking events. The key to sustaining these relationships was the time and effort put in to making these relationships work and through each partner having open and available lines of communication. Finally, an open and trustful relationship was witnessed between students and staff. Students' expertise following an industrial placement has been acknowledged and considered valuable by lecturers, this in turn creates a more equal student-lecturer dynamic compared to a traditional HE environment and could be compared to reflecting a more workplace environment.

Conclusion

The National Software Academy (NSA) presents a delivery model of higher education that is deemed to be successful in developing highly employable students and work-ready graduates. This research investigated how NSA built in employer engagement and developed a curriculum and teaching approach from the outset to ensure their students are equipped with skills necessary to secure and maintain employment after graduation. NSA is still a relatively new higher education centre, hence data about students' destination and success are limited. Nevertheless, all respondents, including students, NSA management, lecturers and employers reflected on their experiences concerning students' employability at NSA.

This study gathered those elements of the NSA which consciously and systematically targeted students' employability development during their undergraduate course.

At NSA, *explicit teaching of employability skills* (e.g. presentation skills, working as a team, how to network) is part of the course and these skills are referenced in module objectives. These skills are developed through, for example, workshops that bring in external experts. Furthermore, the NSA ensures these skills are being put into practice on a regular basis in both a safe learning space and a 'live' environment, such as with employers at the NSA or in a real work setting.

Students take part in *authentic real-world projects* addressing real-world issues throughout their time at NSA to encourage a continual cycle between theory and practice. Students are also engaged at the end of semesters through the 6-week *client-facing project.* These projects encourage students to practically use their knowledge and stimulate students to develop a behaviour that is required in the workplace.

The NSA *adopts practices that exist in industry* and integrates these into the learning environment. For example, students work in office style classrooms, they have open spaces to work in teams on projects and socialise, and they have daily briefings. The non-lecture style approach taken by the NSA was regarded as particularly beneficial.

Students are encouraged to take up opportunities to work in *relevant placements* either short term during holiday periods or on an ongoing basis throughout the term. Staff noted that there was a noticeable difference between students who took part in placements during their study and those who did not.

The NSA is open to the fact that students can *bring their learning from the industry* and this feeds back into the teaching ensuring that the curriculum is relevant and up to date. NSA staff work hard to find industry connections and industry tutors to support their work. Lecturers pay visits during students' placements, which furthers their own development and utility.

The NSA *fosters a close relationship with a wide range of industry partners*. It is to encourage their expert input into the curriculum content, help develop client-facing projects and pay regular visits to NSA offering, for example, guest lectures and participation in networking events.

Relationships are developed and sustained through *open and respectful lines of communication*, including between staff and industry partners as well as between staff and students. Staff at the NSA saw it as their responsibility to foster relationships with industry partners. Students were also encouraged to feed into the NSA, and their views about the course and industry were welcomed.

These elements of the NSA delivery model are purposefully built into the course to specifically develop student employability. Each element has a connection to employment, employers, and the workplace. They are not unique to NSA, however their combination and intensity within the course may add to NSA's successful outcome. Hence these elements could be replicated on different scales in other courses and other HEIs taking context, geography, and industry into account, consequently leading to more work-ready university leavers.

Afterword – one year on

The main data collection for this research took place in 2018–2019, much has changed since then. There has been the second graduating class of the NSA undergraduate programme; the school has had the first cohort of graduates from the MSc in Software Engineering; the school has introduced a degree apprenticeship (DA) programme, which builds upon the existing standard UG degree in Applied Software Engineering; and in 2020 a global pandemic has caused the closing of university campuses and a general shift to online delivery. All these factors are having a wider impact on the software engineering sector and the job market that NSA graduates would hope to join.

First and foremost, the NSA's excellence in the higher education sector in collaborative work and their positive impact on teaching and learning has been more widely recognised. Their achievement was recognised by Advance HE in 2020 and NSA received the Collaborative Award for Teaching Excellence (CATE). This prestigious award is a recognition and celebration of work which demonstrates impact on student learning and education practice at the highest level.

Over the past year, a key development that has aided NSA's already established employer engagement has been the expanding of roles across the School of Computer Science. In particular, assigning a dedicated member of staff as the 'Industry and External Engagement Manager' has made a significant difference in ensuring there is overall responsibility for industry linkage and the management of the student projects across the whole school. This Manager also oversees a small team who are responsible for the wider area of the employability of the students.

From March 2020 Covid-19 and the consequential lockdown has had drastic effects right across the education sphere. For the NSA, as for other education establishments, the switch to remote working had mixed consequences. The fact that students were already working together in teams at the NSA, and using online collaboration software, meant that the project-based learning aspects of the delivery were able to transition smoothly when going into lockdown. This was particularly the case for Year 3 students and MSc students, who were better prepared and used to working in this more self-directed way. It meant relatively few changes were needed to the way the students were assessed, and the fundamental elements of the projects were able to stay the same, such as working with peers and employers. In fact, the NSA held a showcase event over the summer for MSc students for the large team dissertation projects. The NSA Team Lead stated that it was *'really amazing to see what they had achieved and how they have worked even under these difficult circumstances, especially considering it is a one year masters, seeing how far they had come in a small space of time.'*

However, the lockdown posed a greater problem for first year students who were less prepared for the transition to an online environment and faced uncertainty with the projects they were working on. The NSA therefore moved to individual assessments for these students. These were linked to individual projects students had done earlier in the year, which allowed them to demonstrate the learning outcomes.

Student summer placements and graduates' transition into the labour market have also been affected. It was noted by staff that one of the employers who usually offers placements to the NSA students, had to pull all their placement opportunities this year. Many other employers did not have the capacity to support students due to the pandemic. Staff generally have found it more difficult to keep track of their student placements and job opportunities, one reason being the lack of informal 'corridor conversations' that usually take place around the NSA. This truly highlights the importance of social interactions and relationship-building which simply cannot be nurtured and sustained online in the same way.

Building and sustaining employer relationships has also been challenging. Normally the NSA staff would host and attend various network events and host student showcase events for employers. These provide good opportunities for industry engagement, as well as supporting the process of developing the student projects. Yet this year it has been difficult to maintain the same visibility, thereby revealing the benefits that these live networking opportunities have for both the staff and students.

The pandemic has potentially exasperated the skills gap in the technology sector. Everyone is suddenly much more dependent on technology and employers are looking for smarter and more efficient ways to work with technology, therefore increasing the demand for software engineers to support the changing needs of the world. The way we work has also changed, with many employers claiming that employees will not return to 100% of their time in an office. Instead a more blended, adaptive way of working will prevail beyond the pandemic. NSA are aware that they have a responsibility to ensure that their students will be equipped with the skills and ethos to work in this new environment both in their studies and careers. This includes preparing their students for more self-directed and responsive learning.

For the coming year the NSA will be delivering a minimum of one hour a week face-to-face, yet socially distanced, learning. The need for a high level of virtual content though means even more emphasis on a flipped-classroom approach, thus ensuring that the face-to-face time can be used as meaningfully as possible. For instance, sessions where students are given the opportunity to highlight areas they are struggling with should ensure that they can receive targeted and useful support from the staff face-to-face.

One of the key challenges the NSA recognises is ensuring that they will be able to build a sense of community, which was highlighted in this research as being a key aspect of the NSA. Staff hope to do this by spending more time connecting online with the students, checking their development, and ensuring personal interactions are maintained as much as possible. It is widely recognised that the graduating class of 2020 have been, and will continue to be, severely affected by the pandemic as they struggle to find jobs (IFS, 2020; ISE, 2020). Similarly, there has been (and will likely to continue to be) a reduction in the number of placement opportunities for students. Students would usually use placements to build their skills and make meaningful connections with employers. The 2019 cohort of graduates from the NSA, found employment reasonably quickly, particularly in relevant software jobs. However, how graduates will fare this year remains unclear.

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