

Institution: University of Nottingham		
Unit of Assessment: UOA17: Business and Management Studies		
Title of case study: Inspiring science and engineering researchers: entrepreneurial career development and economic impact from the YES programme.		
Period when the underpinning research was undertaken: 2009-2019		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Simon Mosey	Professor	1998-present
Hannah Noke	Associate Professor	2006-present
Lorna Treanor	Assistant Professor	2016-present
Martin Binks	Professor	1979-2019
Period when the claimed impact occurred: 2013-2019		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact		
<p>Research by Nottingham academics led the pedagogical and structural innovation of the Young Entrepreneurs Scheme (YES), an integrative learning intervention for early career researchers (ECRs) to experience how to commercialise research and be inspired to explore more entrepreneurial career paths. 2089 ECRs from 88 institutions participated and an external evaluation of the scheme highlighted that YES contributed up to GBP1,800,000,000 in economic impact through participants' salary uplifts attributed to YES. Support was provided from 400 organisations such as Royal Societies, GSK and Syngenta and more innovative career destinations were realised from the creation of drug development and sustainable energy ventures through to social enterprises addressing biodiversity and science communication. For instance, following participation in YES, drug development company Puridify subsequently raised GBP8,000,000 in investment. By contrast, a participant was motivated to build a social enterprise in Malaysia to inspire schoolchildren within science and engineering and over 40, 000 children took part in 2019.</p>		
2. Underpinning research		
<p>In 2013 the Biotechnology Young Entrepreneurs Scheme (YES) was an established competitive programme for ECRs in the life sciences which provided an understanding of the commercialisation of research through experiential learning. It was co-organised by the Biotechnology and Biological Sciences Research Council (BBSRC), the Natural Environment Research Council (NERC) and the Medical Research Council (MRC) and led by the Haydn Green Institute for Innovation and Entrepreneurship (HGI - one of Europe's leading centres for entrepreneurship education). In planning for the 2013 competition the research councils posed two challenges to HGI. The first was to expand the entrepreneurial training of YES to other disciplines and encourage researchers to work across disciplines as a central aspect of their skills development. The second was to deliver the experiential education of YES at scale, with a significantly reduced cost per participant, whilst delivering the same learning outcomes concerning understanding the commercialisation of research and exploring more entrepreneurial careers.</p> <p>Three strands of research within the HGI were incorporated into the subsequent growth plan [1-4] and each year this plan was revisited, together with the research councils and industry sponsors including GSK and Syngenta and augmented using contemporary research [5,6].</p> <p>The first strand was a longitudinal international study that followed academics attempting to commercialise their research, aiming to isolate the specific entrepreneurial competencies necessary to support academic entrepreneurship when controlling for variances in discipline, university support and national context [1]. This highlighted the significance of developing opportunity identification, resource acquisition and championing competencies amongst aspiring academic entrepreneurs. The development of these competencies was incorporated into the learning outcomes for the competition from 2013 onwards.</p> <p>The second strand was an empirical pedagogical study investigating how best to develop such competencies at scale through challenge based integrative learning [2]. This integrative</p>		

learning model was adapted for the 2013 competition and revised annually based upon participant feedback.

Subsequent empirical work [6] investigated how to increase the scale of integrative learning, whilst reducing the cost. This showed how to use online tools to encourage researchers to understand the complex systems they were attempting to change, before developing their ideas. By encouraging researchers to work virtually together in this way, with expert mentors from the different networks of commerce and industry, it was demonstrated that the subsequent venture ideas were more innovative and more sustainable. This online integrative learning model was shown to be more cost effective and scalable, especially for researchers in a non-commercial environment. Additionally, the model was effective whilst still maintaining, and even enhancing, the learning outcomes and subsequent impact upon participants' entrepreneurial behaviours and was therefore adopted by the programme from 2015 onwards. Ongoing empirical work interrogated the annual feedback from participants and conducted case study interviews to isolate the pedagogical practices that were most effective at nurturing long term career outcomes for science and engineering ECRs [7]. This resulted in a greater diversity of past participants being invited to the workshops and competition finals in 2019, where these role models shared candid narratives about their career journeys from ECR to entrepreneurship, finance and intellectual property law.

The third strand (Mosey, Nottingham, Wright, Clarysse, Imperial) examined how best to encourage cross disciplinary working. Empirical research highlighted the utility of encouraging researchers to address societal and industrial challenges that cannot be resolved via single disciplinary research [3]. This was built upon by an evaluation of the historical impact of YES on participating researchers' career aspirations and subsequent career destinations [4]. This showed the efficacy of YES in providing bridging social capital where researchers can explore the possibilities for different career options. Furthermore, this exploration can be conducted with individuals from the external networks of venture capital, intellectual property protection, technology transfer and industrial research. Moreover, the study also showed that the impact of individuals from external networks to the typical university network make the most impact upon subsequent career choices if they share the disciplinary background of the participants.

Subsequent empirical work highlighted how successful academic entrepreneurs across different disciplinary and national contexts made much more effective use of social capital from outside the academic network to help grow their fledgling ventures when compared to those that did not do so [5]. As a result, in 2015, an increasing emphasis was placed upon encouraging participants to network with industrialists, lawyers and financiers at the events and to keep those networks active using a private linked in network (this network had 2656 members on 26th August 2020). Moreover, past participants who gave talks at the events were asked to explicitly share how they built and nurtured their networks to aid career development.

3. References to the research

1. Rasmussen, E.; **Mosey, S.**; Wright, M. 2011. "The evolution of entrepreneurial competencies: a longitudinal study of university spin-off venture emergence", *Journal of Management Studies*, 48(6), 1314-1345. <https://doi.org/10.1111/j.1467-6486.2010.00995.x>
2. **Munoz, C.**; **Mosey, S.**; **Binks, M.** 2011. "Developing opportunity-identification capabilities in the classroom visual evidence for changing mental frames", *Academy of Management Learning and Education*, 10(2), 277-295. <https://doi.org/10.5465/amle.10.2.zqr277>
3. **Mosey, S.**; Wright, M.; Clarysse, B. 2012. "Transforming traditional University structures for the knowledge economy through multi-disciplinary institutes", *Cambridge Journal of Economics*, 36(3), 587-607 <https://doi.org/10.1093/cje/bes008>
4. **Mosey, S.**; **Noke, H.**; **Binks, M.** 2012. "The influence of human and social capital upon the entrepreneurial intentions and destinations of academics", *Technology*

Analysis and Strategic Management, 24(9), 893-910.

<https://doi.org/10.1080/09537325.2012.718664>

5. Rasmussen, E.; Mosey, S.; Wright, M. 2015. "The transformation of network ties to develop entrepreneurial competencies in university spin offs", *Entrepreneurship and Regional Development*, 27, 430-457.

<https://doi.org/10.1080/08985626.2015.1070536>

6. Mosey, S. 2016. "Teaching and Research Opportunities in Technology Entrepreneurship", *Technovation*, 57-58, 43-44.

<https://doi.org/10.1016/j.technovation.2016.08.006>

7. Treanor, L.; Noke, H.; Marlow, S. and Mosey, S. 2020. "Developing Entrepreneurial Competences in Biotechnology Early Career Researchers to Support Long-term Entrepreneurial Career Outcomes", *Technological Forecasting and Social Change*.

<https://doi.org/10.1016/j.techfore.2020.120031>

4. Details of the impact

2089 ECRs from 88 institutions participated in YES and, in 2015, an external evaluation of the scheme, commissioned by the BBSRC, highlighted that YES contributed up to GBP1,800,000,000 in economic impact through participants salary uplifts attributed to the programme [A]. Corporate partners GSK and Syngenta hosted workshops annually throughout the REF period at the Stevenage Bioscience Catalyst and Jealotts Hill International Research Centre respectively. Here, participants were nurtured and inspired by the combination of working on real industrial challenges, being mentored by entrepreneurs, financiers and lawyers and working in cross disciplinary teams to develop and sell a new venture based on breakthrough research. The cumulative impact of the competition was summarised by the Director Academic Liaison at GSK: "YES is a unique intervention for early career researchers to engage with industry culminating in benefits not only for the students in relation to broadening their employability in the future but also benefits to industry in relation to knowledge exchange. We have subsequently employed a number of YES alumni" [E].

Below is an overview of each competition year, a summary of the research informed changes incorporated and examples of the subsequent impact upon participants' career aspirations and destinations.

In September 2013, the Royal Society of Chemistry became sponsors of YES and the disciplinary focus of the competition expanded to include chemistry researchers working together with life scientists to realise the new competency-based learning outcomes [1,3]. A previous YES alumnus (2012) inspired participants by explaining how, 5 months after taking part in YES, he founded Puridify - a novel biotherapeutics start-up. Between 2014 and 2017, Puridify raised over GBP8,000,000 in investment and grants and he explained the value of the YES competition to this process "It was good to make new connections...some judges faces came up again when we went for funding. Lots of world-renowned academics and entrepreneurs devote their time for free. It's only fair to pay this forward." [A, p. 20] [4].

In 2014, Alstom became sponsors and hosted a workshop to address the challenge of sustainable energy generation and distribution, attracting engineering researchers to join the programme [3]. Participation in the programme had an immediate effect upon the founder of Kinewell Energy, a software company that increases the efficiency of energy transfer from wind turbines. When interviewed in August 2019, the founder explained how taking part in YES had helped him develop Kinewell Energy, which had grown to employ 7 people and had experienced 400% turnover growth from the previous year, and had taught him about pricing services and how VC investors calculate equity valuations [B].

In 2015, Unilever became sponsors and hosted a workshop to address the challenge of improved nutrition and wellbeing, thereby attracting researchers from new areas [3,4]. The value of the increasingly diverse network was illustrated by a participant, who was advised to apply to be the first employee of start-up Cambridge Cancer Genomics by her mentor from

YES [C][4]. This participant was instrumental in CCG going on to raise USD4,500,000 to use AI for personalised cancer medicine. Interviewed in 2019, she explains how YES contributed to her career, “I think YES should be mandatory! It just helps you to be a bit more rounded and aware of other opportunities. You don’t have to want to go into business to take part; YES helps you develop the skills needed to collaborate with businesses in academia. It’s also about general life skills and takes you out of the academic bubble. YES allows you to expand your horizons.” [C].

Additionally in 2015, the BBSRC commissioned a 20 year review of the impact of YES and the Chief Executive concluded that “I believe that the success and longevity of YES is the result of a genuine partnership...all aimed at the common goal of developing an entrepreneurial culture amongst researchers for the benefit of the UK economy” [A, p. 3]. This review captured the impact of YES upon the careers of past participants pursuing careers ranging from entrepreneurship to technology transfer, intellectual property law and business development. The interviewed candidates all articulated the positive impact YES had made upon their career choice and transferrable skills necessary to gain that position. The evaluation concluded that ‘the programme is financially efficient and effective in how it develops entrepreneurial skills and raises the aspirations of young scientists. Every £1 of Research Council funding is matched by £2.89 from other sources’ [A, p. 22].

In 2016, new areas were pioneered leading to a record number of 520 participants taking part. Proctor and Gamble joined the competition with a workshop based in Singapore looking at health and wellbeing in the Asian context and this interaction was enabled by the introduction of online blended learning for the first time [6]. The briefing session for all participants was conducted via an interactive webinar and a series of online mentoring sessions were held via a private linked-in forum. In this way, all participants could make use of remotely distributed expert help and advice prior to arriving at their respective workshops [5,6]. The burgeoning cross disciplinary expansion of YES was typified by a team that took part in 2017, with backgrounds in electronics as well as materials engineering, aeronautical mechanics and electro-chemistry [3]. Taking part supported one member of the team in starting up a new business in 2018 to develop an online three-dimensional multispectral crop analysis tool. Between 2017 and 2019, the business raised GBP400,000 in funding and attributes the workshops given during YES for providing the inspiration and knowledge needed to start commercialising this idea [D]. When interviewed in 2019, the YES participant stated: “The pitch mentoring was so helpful. We learned to dump the science and communicate the benefits of the product because people care about what it does, not what it is” [D].

In 2018, Syngenta proposed the theme of ‘protect our planet’ and all sponsors encouraged ideas to address environmental sustainability. The final introduced the innovation of inviting 7 entrepreneurial past participants to augment the judging panel and network with the winning teams [4,5]. After the final, the Head of Technology Identification and Evaluation for Crop Protection at Syngenta, said: “Collaboration between industry and universities is key to achieving a strong knowledge-driven economy. For the past eight years we have hosted a YES workshop to tackle specific challenges in order to showcase innovate ideas and to stimulate blue-sky thinking amongst potential future entrepreneurs to enable them to foresee potential opportunities. Once again there were some great ideas pitched so the future remains bright!” [G].

In 2019, the overarching theme was ‘science and engineering empowering sustainability’ [6]. The final was expanded to include a showcase of how past participants careers had developed because of taking part in YES [7]. For example, the founder of Seedball explained how she had, in 2013, created the social enterprise to enhance biodiversity. She shared how their product is now stocked by over 150 retailers, both in the UK and across mainland Europe, and how all their profits support global nature reserves. She concluded that “Environment YES gave us the confidence and knowledge to really go for it – we couldn’t recommend the training highly enough” [H]. The value of YES to the industry partners was summarised by one of the scheme’s partners, Potter Clarkson, “Every year, our employees are asked about IP as a

career from a number of YES participants and it is heartening to see those people again a few years later when they join the profession (even with competitor firms). When we review CVs, being a YES alumni really does make the candidate stand out and is highly valued by industry” [F].

Finally, since taking part in YES, one participant has started up four companies in Green Technology and Agriculture before launching a social enterprise in Malaysia to inspire schoolchildren within science and engineering with over 40,000 children taking part in 2019 [I]. He argued that: “My most important takeaway from YES was confidence. I believe this is something that people need to develop more than anything else. Other things you can learn but confidence needs to be built” [I].

5. Sources to corroborate the impact

- A. BBSRC YES 20th anniversary brochure
- B. YES case study – [Kinewell energy](#)
- C. YES case study – [Biologist](#)
- D. YES case study – [Fotenix](#)
- E. Impact statement from Director Academic Liaison at GSK
- F. Impact statement from Partner at Potter Clarkson
- G. YES press release 2018
- H. YES case study – [Seedball](#)
- I. YES case study – [Association of Science and Technology](#)