London South Bank University

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Nathu Puri Institute for Engineering and Enterprise

2019 Annual Report

Enabling Enterprising Engineers


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Executive summary

The Nathu Puri Institute (NPI) for Engineering and Enterprise at London South Bank University (LSBU) is focused on embedding enterprise into engineering education and industrial practice. This is achieved through pursuing an integrated set of research, education and knowledge exchange activities in order to generate new knowledge and corresponding impact as well as the delivery of teaching activities. The institute has continued to build up momentum since Professor Simon Philbin joined LSBU to lead the NPI in 2018.

The institute's research work has been proceeding very well and has resulted in several papers presented at international conferences as well as new articles published in international journals. Thomas Empson's research focuses on understanding engineers' contribution to the creative process within sustainable production solutions. He has presented his work at various conferences, including the International Conference on Engineering and Product Design Education held at the University of Strathclyde and the Futurebuild Conference in London. Paul Mansell's research focuses on understanding the measurement of infrastructure projects' success against the sustainable development goals. Paul has presented his work at various conferences across Europe, including the Project Management Congress held at TU Delft in the Netherlands. He also gave a presentation at the Institution of Civil Engineering in Cape Town, South Africa.

Pavan Kumar Sala has been making good progress on his doctoral research. He has completed his initial literature review focused on understanding how high-tech entrepreneurs successfully pivot as part of the entrepreneurial journey and will soon be embarking on the empirical stage of his research. Clarissa Rocha joined the NPI team in September 2019 for six months as a visiting researcher from the Pontifical Catholic University of Paraná in Brazil to undertake research on open innovation and Industry 4.0. Prof. Philbin has also been conducting further research with several international collaborators on emerging technologies and in particular on green energy and sustainability applications as well as preliminary research on engineering education.

Educational activities have included delivery of the Technology Evaluation and Commercialisation module and the Technical, Research and Professional Skills module by Prof. Philbin. These modules substantially underpin the provision of enterprise education and professional skills for level 7 Masters' students at LSBU, which includes postgraduate MSc and final year undergraduate MEng students. Student feedback obtained for both modules has been highly positive and has underscored the practical relevance of gaining professional and enterprise skills and knowledge alongside the traditional technical aspects of an engineering education.

The NPI team has developed with the IET (Institution of Engineering and Technology) an innovative new online course called 'Entrepreneurial Skills for Engineers', which is available via the IET Academy. The successful completion of this project delivered in partnership with the IET represents a significant step forward by the NPI in the provision of enterprise education for engineers and followed on from several months of intensive work on the project. The course has been designed in particular to appeal to graduate engineers and those working in industrial companies.

A range of knowledge exchange activities have been pursued over the year, including Thomas Empson's role as the facilitator for The Great Competition organised by the Design Museum. Prof. Philbin commenced his duties as the President of the American Society for Engineering Management (ASEM) and attended the society's International Annual Conference in Philadelphia. More recently, Prof. Philbin was invited by the Chinese Academy of Engineering as a foreign expert at the International Forum on Engineering Management held in Jinan, China. Prof. Philbin, Paul Mansell and Thomas Empson delivered a successful seminar on 'The Power of Partnerships' at the 2019 LSBU Staff Conference. Also, Thomas Empson and Pavan Kumar Sala both gave poster presentations at the 2019 LSBU Doctoral Research Conference.

During 2019, a new strategic plan for the institute was developed and agreed with the School of Engineering and the plan has been guiding the operations of the institute over the last year. Performance of the institute is monitored across an integrated set of key performance indicators, which are tracked quarterly as part of a balanced scorecard. In regard to social media presence, the NPI launched a new website in 2019 that provides enhanced information on the work of the team.

Looking forward, the NPI is in an excellent position to continue the various academic activities in the area of engineering and enterprise as part of pursuing its strategic agenda. NPI will continue to engage with collaborative partners both across the UK and internationally, which highlights the global reach of the institute. The current projects and activities can act as an ideal platform to build further initiatives with partners and stakeholders in order to continue generating impact across the knowledge, industrial and societal dimensions of engineering and enterprise.

Professor Simon P. Philbin,
Director of the Nathu Puri Institute for Engineering and Enterprise, London South Bank University

Historical background of the institute

The NPI was originally established by LSBU in 2011 following a generous donation by the Puri Foundation in order to embed enterprise in engineering education and industrial practice. This was based on the premise that although engineers still require a solid technical foundation for their education and practice, they also require access to a wider set of enterprise and professional related knowledge and skills in order to be successful. The original intent for the institute that remains valid was summarised succinctly by Professor Nathu Puri at the institute's launch event: "Knowledge should be available to future engineers and engineering students so that more of them can break the glass ceiling and become entrepreneurs and our business leaders. Current demands are for engineers with a much wider knowledge base, hence this initiative today". The institute was also set up according to the original vision of the founder, Emeritus Professor Rao Bhamidimarri.

In this context, enterprise includes innovation, entrepreneurship and intrapreneurship as well as broader professional related skills and knowledge. This is because being enterprising is not limited to new venture creation but also includes the ability to understand how to develop an idea into a new product or a new business area within an existing company. It also refers to understanding how to commercialise research and technology towards new product development as well as the management of technology and engineering projects. Since its creation, the NPI team has undertaken a series of projects and initiatives in regard to advancing this strategic agenda and generating the required outcomes and wider impact.

Members of the institute

The institute currently has the following members:

- Professor Simon P. Philbin, Institute Director
- Thomas Empson, Research Fellow and Doctoral Researcher
- Paul Mansell, Doctoral Researcher
- Pavan Kumar Sala, Doctoral Researcher
- Clarissa Rocha, Visiting Researcher
- Sunita Selvarajan, Project Administrator
- Professor Shushma Patel, Affiliated Academic Staff
- Dr Safia Barikzai, Affiliated Academic Staff

The institute is part of the School of Engineering at LSBU. In regard to governance, the Director of the NPI reports to the Dean of the School of Engineering (Professor Asa Barber).

Strategic objectives of the institute

The institute has the following strategic objectives:

1. To build the reputation and academic standing of the NPI and LSBU.
2. To deliver the current doctoral research projects and generate the required academic outputs, such as journal publications and conference papers.
3. To deliver suitable educational activities for the School of Engineering at LSBU.
4. To undertake knowledge exchange activities with institute stakeholders.
5. To submit proposals and secure grant funding for new NPI research projects.
6. To secure more strategic and longer-term funding for the NPI.
7. To maintain institute supporting infrastructure, such as the website and balanced scorecard.
8. To build a strategic relationship with the Puri Foundation.

The institute conducts an integrated programme of activities across engineering and enterprise. This includes research, education and knowledge exchange activities.

Institute research themes

The institute pursues research across four integrated research themes.

1. Enterprise for engineers – Understanding how enterprise, creativity and project management help engineers to leverage technical capabilities as well as support sustainable engineering solutions.
2. Entrepreneurship for engineers – Understanding how engineers can be more entrepreneurial and improve our understanding of tech entrepreneurship.
3. Technology development and innovation – Understanding the impact of emerging technologies as well as how innovation impacts engineers and engineering organisations.
4. Engineering education – Understanding how enterprise can be embedded more effectively as part of engineering education programmes.

Research projects

Creative engineering for a sustainable future

Thomas Empson has been undertaking his doctoral research towards creative engineering for a sustainable future. In 2019, humanity extracted around 1.75 planets worth of natural resources and since the 1970's we have continued to extract more planetary resources than Earth can replenish, resulting in an impending ecological and climate crisis. The costs of our extractive economy jeopardises the long-term stability of a healthy planet and the prosperity of future generations. Solutions able to address global grand challenges are unfortunately not happening at the scale and pace needed to reverse climate change and regenerate the ecological overspend. However, within this reality, driven by science developments and real world degradation, what constitutes something as creative must be redefined, judged and measured accordingly.

Thomas' work proposes a system level perspective framework to measure the contextual pressures facing engineers and businesses today. This framework has been applied to measure the level of contextual creativity of case study projects against social, environmental and economic impact. Thomas uses a triangulation mixed method approach to firstly understand the 'purpose' of a case study engineering firm, secondly to quantify the contributions of engineers in creative solutions toward sustainable development, and thirdly qualify engineers' contributions against the influence of the organisations' purpose towards creative ventures.

Capturing SDG impact for infrastructure projects

Paul Mansell has been undertaking his doctoral research to address the following question: Does existing infrastructure project measurement capture SDG (sustainable development goal) impact? The PhD research is structured in five phases, the first three of which have been completed. Phase 1 was the literature research – separated between contextual themes and the underlying theories. The first group includes sustainability, sustainable development, SDGs, defining project success, and SDG measurement on infrastructure projects. The second group includes the underlying theories, which are the theory of change, logic frame, triple bottom line, and creating shared value. Phase 2 was an exploratory investigation to test hypotheses using a survey of 350 engineers, followed by initial analysis of data and the subsequent data capture from 40 interviews with infrastructure organisations' CEOs and corporate Heads of Sustainability.

Phase 3 involved development of the theoretical model and from early desk-top testing, a proposed methodology for use in practice. The research project has now commenced Phase 4, which involves case studies with leading projects (including a 'mega' project) to test the model and methodology with partners across the project-programme-portfolio and organisational boundaries. Phase 5 will be delivered through partners (primarily the Environment Agency) in order to apply the model and methodology to the Agency's portfolio of projects. The impact of this work will be that the Agency will have a credible approach to prioritise which SDG targets and indicators they will measure performance against for projects across the portfolio.

High-tech entrepreneurs and pivoting

Pavan Kumar Sala has been undertaking his doctoral research on understanding how high-tech entrepreneurs successfully pivot as part of the entrepreneurial journey. The research study is focused on the practice of high-tech entrepreneurs in order to understand how pivoting (i.e. changing direction) has impacted the entrepreneurial journey. The research is considering the types of pivots available to a high-tech entrepreneur and the possible factors that can trigger the high-tech enterprise to pivot. Furthermore, the research is focused on identifying the impact of technology in pivoting through using the technology S-curve model.

A mixed methods approach involving quantitative and qualitative data analysis is being employed to derive an empirical solution for the pivots, the factors that trigger pivoting and the impact of the technology in pivoting. Once the empirical solution has been obtained, the research study will address the knowledge gap in the extant literature and develop insights that will benefit practicing entrepreneurs in the high tech sector. Finally, the research will focus on developing a predictive model, which a high-tech entrepreneur can use to decide whether or not to pivot and which type of pivot to adopt as part of the entrepreneurial journey.

Open innovation and Industry 4.0

Clarissa Rocha is a visiting researcher based at the NPI from September 2018 to February 2019. Clarissa is from the Business Administration Program at the Pontifical Catholic University of Paraná (PUCPR) and her research is under the supervision of Prof. Carlos Quandt and Prof. Fernando Deschamps both from PUCPR and in collaboration with Prof. Simon Philbin. The research aims to analyse how R&D collaborations contribute to business innovation in Brazilian and European industrial firms in the context of Industry 4.0 and through utilising the open innovation theoretical concept in manufacturing.

The research uses qualitative empirical evidence from non-participant observations of the digital technological structures of each industrial case and interviews with managers of Brazilian and UK large manufacturers directly involved in digital projects, as well as inputs from technical experts on digital transformation from the UK. This research project is important for organisations that need to further evolve through adoption of disruptive technologies, such as those associated with Industry 4.0. The findings will enable manufacturers to understand the antecedent factors in preparing for the change towards digitalisation. Furthermore, to consider the relevance of engaging with external partners as a source to facilitate and even accelerate operationalization of digital initiatives and therefore become more competitive.

Research on emerging technologies

Prof. Philbin has been undertaking various strands of research on emerging technologies with several international collaborators. This work is based on the application of an engineering management perspective in order to improve our understanding of the challenges and opportunities for a range of emerging technologies. He has investigated with a Canadian researcher the technology and economic factors that impact adoption of electric vehicles through comparing them against hybrids, gasoline and diesel vehicles. The findings show that the complexity of electrical power supply, infrastructure requirements and full life cycle concerns lead to the position that electric vehicles have a clear place in the future but that ongoing improvements are required to support greater levels of adoption.

Prof. Philbin has investigated with a researcher from China the sustainable development of carbon capture and storage (CCS) technologies. CCS technology offers much promise in regard to the capture of major levels of waste carbon dioxide produced from the burning of fossil fuels for electricity generation and from industrial processes. Crucial to the development of CCS technology is the need for improved decision-making tools to underpin sustainable investment and associated policy initiatives for CCS technology and infrastructure. This research has been focused on the techno-economic analysis of CCS, which included analysis of CCS technologies and related investment, identification of CCS policy determinants, economic modelling of CCS using levelized cost of electricity (LCOE) for power generation via combined cycle gas turbine (CCGT), and analysis of CCS pilot scale projects.

More recently, Prof. Philbin has been collaborating with a research team from Chang'an University in China and other international collaborators in the area of sustainable engineering. This has already resulted in a new journal publication on the development of a revenue sharing method for application to public-private-partnerships to support provision of major infrastructure and enable the corresponding delivery of services.

Research on engineering education

Prof. Philbin has conducted a preliminary research study with collaborators from East Carolina University (USA) and West Virginia University (USA) in the area of engineering education, skills and industry alignment. The research had two objectives. The first was to provide a comparative analysis of studies and reports from the UK and USA that focused on engineering education, skills development and industry alignment. The second was to identify trends and key areas to be developed in the context of the Engineering Management Body of Knowledge (EMBoK).

The research was based on the review of 23 reports issued by professional societies from the UK and USA. Findings included new insights on the nature of engineering education and how professional and enterprise related skills can be integrated on engineering degree programmes. The research also highlighted the role of industry in supporting engineering education as well as the need for engineering education to be up-to-date in technological terms.

Education initiatives

New online course – Entrepreneurial Skills for Engineers
The NPI team has successfully delivered the new online course 'Entrepreneurial Skills for Engineers', which was developed in partnership with the Institution of Engineering and Technology (IET) and launched in August 2019. The course team included Prof. Simon Philbin, Thomas Empson, Robin Jones (Division of Mechanical Engineering and Design), Paul Mansell, Pavan Kumar Sala, Mausam Gaurav and Sunita Selvarajan. The course provides the skills and knowledge that engineers can use as part of the entrepreneurial journey to develop innovative ideas through to new products and businesses. The course is especially relevant for graduate engineers from industry but can also serve as the basis for providing a thorough overview of enterprise and related areas for engineering students.

The course has the following units:
1. Introduction
2. Ideation and creativity
3. Leveraging research and development
4. Product design
5. Entrepreneurial finance
6. Capturing market needs
7. Managing innovation projects
8. Leading the team
9. Strategic business development
10. Driving continuous improvement into your business

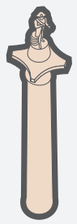
The new course has also been made available on modules within the School of Engineering at no cost to either LSBU or the engineering students, thereby creating additional value from this educational initiative. The course has to date been made available on the Innovation and Enterprise undergraduate module that has students from across the School of Engineering and as the main learning component on the HND in Electrical Engineering module - Engineering Applications (Work Based) in the Division of Electrical and Electronic Engineering.

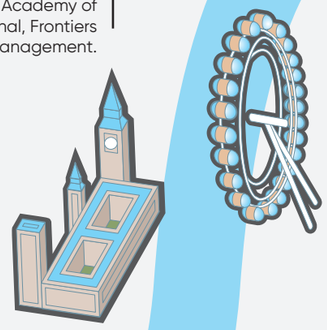
The project to develop the online course was managed by Sunita Selvarajan.

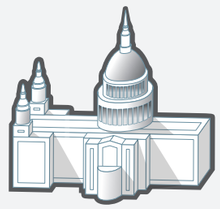
Technology Evaluation and Commercialisation Masters' Level Module
In the first half of 2019, Prof. Simon Philbin delivered the Masters' level Technology Evaluation and Commercialisation (TEC) module for the School of Engineering. The module involves use of the TEC Algorithm that was originally developed at North Carolina State University in USA. The TEC module allows Masters' level students to be guided towards identifying an emerging technology idea that is evaluated for its commercial potential. The module represents a highly experiential learning experience. This approach allows the students to prepare the commercialisation strategy and write the business plan for a potential high-tech start-up company.

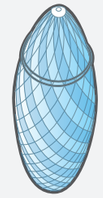
The module was identified at a meeting of the external examiners in the School of Engineering as being an exemplar for how postgraduate teaching should be delivered. Furthermore, Prof. Philbin presented on his work leading the TEC module as part of a seminar at the 2019 International Entrepreneurship Educators Conference held at Oxford Brookes University. Student feedback on the module has been highly favourable with some students commenting that they actively intend to use the skills and knowledge gained through undertaking the module as part of launching a new commercial venture, thereby highlighting the enterprise focus of this module.

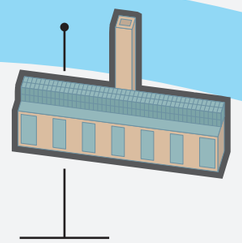
Our highlights for 2019

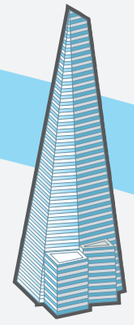


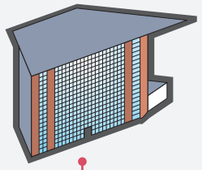












LSBU

April 2019 – Paul Mansell delivered a workshop at the Institution of Civil Engineers (ICE) in London on measuring impact at the project level on the UN SDGs.

February 2019 – Thomas Empson gave a presentation on contextualising creative practices in sustainable development for engineers and designers at the Futurebuild Conference in London.

March 2019 – The new NPI Website was launched, which was coordinated by Sunita Selvarajan.

May 2019 – Paul Mansell passed the RES3 panel review for his doctoral research project on capturing SDG impact for infrastructure projects.

May 2019 – Prof. Philbin completed delivery of the Technology Evaluation and Commercialisation (TEC) Masters' Level module in the School of Engineering.

May 2019 – Thomas Empson was the project facilitator for The Great Competition by the Design Museum in London.

June 2019 – Thomas Empson and Pavan Kumar Sala both gave poster presentations at the LSBU Doctoral Research Conference.

June 2019 – Prof. Philbin, Thomas Empson and Paul Mansell delivered a seminar on 'The Power of Partnerships' at the LSBU Staff Conference.

July 2019 – Prof. Philbin co-authored an article on the adoption of electric vehicles that was published in the Chinese Academy of Engineering's journal, Frontiers of Engineering Management.

August 2019 – The NPI Team delivered and launched the new online course, 'Entrepreneurial Skills for Engineers' with the IET. The project was coordinated by Sunita Selvarajan.

September 2019 – Pavan Kumar Sala passed the RES3 panel review for his doctoral research project on high-tech entrepreneurs and pivoting.

September 2019 – Prof. Philbin gave a seminar at the 2019 International Entrepreneurship Educations Conference (IEEC) held at Oxford Brookes University.

September 2019 – Clarissa Rocha (Visiting Researcher from PUCPR in Brazil) joined the NPI for 6 months to conduct research on open innovation and Industry 4.0.

October 2019 – Prof. Philbin commenced his term as the President of the American Society for Engineering Management (ASEM).

November 2019 – Thomas Empson passed the RES4B panel review for his doctoral research project on creative engineering for a sustainable future.

November 2019 – Prof. Philbin co-authored an article on public-private-partnerships for infrastructure applications that was published in the international journal, Sustainability.

December 2019 – Prof. Philbin completed delivery of the Technical, Research and Professional Skills (TRAPS) module for MSc and MEng students in the School of Engineering.

December 2019 – Pavan Kumar Sala and Clarissa Rocha completed their tutorial support for undergraduate students on the Innovation and Enterprise module in the School of Engineering.

December 2019 – Prof. Philbin visited Jinan in China as an invited foreign expert to attend the Chinese Academy of Engineering's International Forum on Engineering Management (IFEM).

December 2019 – Thomas Empson presented on his doctoral research studies at the Society for Research into Higher Education (SRHE), Newer and Early Career Researchers Conference in Newport, Wales.

Technical, Research and Professional Skills Masters' Level Module
More recently Prof. Philbin has been leading on the delivery of the Masters' level Technical, Research and Professional Skills (TRAPS) module for the School of Engineering. This module is taught to Master's level degree students (i.e. MSc and MEng) and it provides training for the skills that are necessary for successful completion of the research dissertation in the near future and for professional development in the long-term future. The students are required to prepare a feasibility study report for their proposed Master's research project and also present a summary of the report as part of meeting the requirements for the module assessment.

The module provides a thorough grounding on research methods, data analysis and associated aspects concerning the research process. It also provides students with an introduction to other areas, such as how to conduct a literature review, critical analysis, ethics and professionalism, project management, technical report writing and presentation skills. Feedback obtained from students has highlighted that the majority rated the module as 'excellent', with many favourable comments in regard to the value of the technical material provided as well as the real-world applications selected for the tutorial exercises.

Innovation and Enterprise Undergraduate Module
The NPI team has been supporting delivery of the Innovation and Enterprise module, which is an undergraduate elective module in the School of Engineering that is led by Dr Safia Barikzai. In this regard, Pavan Kumar Sala and Clarissa Rocha have served as tutors on the module. Prof. Simon Philbin provided a guest lecture for the module on 'Insights from Managing Collaborative Research Projects'. Also, Thomas Empson, Pavan Kumar Sala and Clarissa Rocha gave presentations on their doctoral research projects as part of a research panel session for the module. These contributions have helped the undergraduate students on the module to gain an improved understanding of engineering and enterprise, including both the supporting theory as well as industrial applications.

Knowledge exchange

The Great Competition by the Design Museum
Thomas Empson had a leading role in The Great Competition as the Project Facilitator of this UK wide competition delivered by the Design Museum and funded by the Royal Commission for the Exhibition of 1851. As part of his role, Thomas helped to write the competition brief, developed an outreach lecture on sustainable manufacturing and was responsible for production as well as assisting in the recruitment of several hundred students from across the country to take part in the competition. The project required Thomas to visit universities across the UK to give a presentation on the competition and the importance of sustainable design. This included presenting at LSBU as well as visiting Ravensbourne University, Brunel University, Warwick University, Teesside University, Falmouth University, University of Hertfordshire, London College of Communication and Leeds University. Thomas presented at the launch of the Great Competition and at the final award ceremony, both held at the Design Museum in London. This initiative was a fantastic success in engaging cross-disciplinary student teams to design sustainable design solutions.

Courtesy of Paul Wyatt (paulwyatt.co.uk)

Leadership Role with the American Society for Engineering Management

Prof. Simon Philbin commenced his duties as the President of the American Society for Engineering Management (ASEM) in October 2019. Prof. Philbin was previously elected to serve ASEM as the Secretary (2017/18), President-Elect (2018/19), President (2019/20) and Past-President (2020/21). This followed on from serving the society as its International Director and he has been a member of the board of directors since 2014. His current responsibilities include providing overall leadership for ASEM, which has its origins in the United States but also has international members and sections, and is focused on advancing the discipline of engineering management. The society has a remit to develop the tools, techniques and knowledge to help with the management of people and projects in technology driven organisations.

Other academic activities of the institute

In his capacity as President of ASEM, Prof. Philbin was an invited guest of the Chinese Academy of Engineering (CAE) at the International Forum on Engineering Management (IFEM), which was held in December 2019 in Jinan, China. As part of the visit, Prof. Philbin was involved in a number of activities and meetings that were held alongside the conference. This involved visiting local facilities that showcased technological innovation in the Jinan area, including riding on a hydrogen fuel cell powered bus fitted with mobile 5G wireless technology (with an interview of Prof. Philbin that featured on China Central Television), visiting the National Supercomputing Centre in Jinan and the major research facilities of Qilu Pharmaceutical Co. Ltd. located in Jinan. Prof. Philbin spoke at a high level event with the Governor of Shandong Province along with other representatives from local government and industrial organisations. He also held discussions with key contacts from the Engineering Management Division of the CAE in support of the partnership with ASEM.

Prof. Philbin has been involved in various other academic activities. This includes serving as an external examiner for the Department of Engineering Management and Systems Engineering at Missouri University of Science and Technology, USA and for the Centre for Advanced Studies in Engineering at the University of Engineering and Technology, Taxila, Pakistan.

Prof. Philbin has continued to serve as the Associate Editor (Program and Project Management) for the Engineering Management Journal (EMJ) and as a Member of the Editorial Board for the Journal of Research Administration (JRA). Prof. Philbin also served as an Advisor on the JRA Author Fellowship Program through providing guidance to researchers based at different universities in USA.

Building on the Legacy of the Global Engineering Congress at the Institution of Civil Engineers

The NPI team through Paul Mansell's doctoral research studies has continued to build on the legacy of the 2018 Global Engineering Congress (GEC) at the Institution of Civil Engineers (ICE) in London in regard to the adoption of the United Nation's Sustainable Development Goals (SDGs). As part of this legacy work, Paul has given a series of workshops at ICE in order to continue engagement with key stakeholder organizations. This work further builds on the NPI Symposium on Innovation in Engineering Education that was part of the congress. The Symposium provided opportunity to discuss emerging issues and options to support innovation in engineering education, in the context of the GEC that focused on how the engineering industry can respond to the SDGs. The event was chaired by Prof. Simon Philbin and included presentations by Prof. Shushma Patel, Thomas Empson and others. Also, Paul Mansell gave a Keynote Presentation as part of the main GEC event.

Conclusions and forward view

The NPI has made excellent progress over the last year across the areas of research, education and knowledge exchange focused on engineering and enterprise. The doctoral research projects are making an impact in areas such as sustainable engineering and project management. These projects are now ready to generate significant impact in regard to understanding optimal routes for sustainable development by industrial enterprises and the current case study work that is being undertaken should enable further opportunities for impact with UK industrial companies. The research on high-tech entrepreneurs and pivoting is gaining momentum and the findings from this research are expected to be informative and valuable to high-tech entrepreneurs, thereby helping to improve the survival rates for technology startup companies.

Research on open innovation and Industry 4.0 through the new UK/Brazil collaborative research project has been generating results through the interviews of representatives from various UK industrial companies as part of the case study research. This research has engaged a number of major manufacturing companies, including those from the automotive and other high-tech sectors. The findings from this research are expected to generate valuable insights that can be used by industrial companies to enhance the pathway towards digitalisation.

Research towards improving our understanding of the characteristics of emerging technologies and in particular green energy related technologies has been undertaken and this has resulted in several journal publications. This research is underpinning a significant level of international collaboration. A short study has also been conducted on engineering education and alignment with industry needs and this has yielded new insights in this area.

The NPI team has made significant progress in regard to the delivery of educational programmes targeted to improve the provision of enterprise and professional skills for engineers. This includes delivery of the Technology Evaluation and Commercialisation module as well as Technical, Research and Professional Skills module both at the Masters' level as well as the support provided on the Innovation and Enterprise undergraduate module. A further key development was the successful roll-out of the 'Entrepreneurial Skills for Engineers' online course that is available through the IET.

The educational activities across the postgraduate, undergraduate and open online provision levels have allowed the NPI to generate significant impact that is closely aligned with the original remit of the NPI. Master's level students graduating from LSBU are being equipped with an enhanced set of enterprise and professional skills related knowledge. This will help enable the graduating students to be enterprising in their chosen careers and support their long-term career development. The provision of the online course with IET has also provided an open route for engineers from different areas and stages of their careers to gain enhanced enterprise skills and knowledge.

Members of the institute have been involved in various knowledge exchange activities. This includes Thomas Empson's role in the Great Competition with the Design Museum, Paul Mansell's ongoing collaborative work with the Institution of Civil Engineers and other partners as well as Prof. Philbin's role as the President of the American Society for Engineering Management. Indeed, members of the NPI have been engaging with a broad range of collaborative partners both within the UK and globally.

As we look forward, the NPI is in a good position to build on the successes of 2019 through continued delivery of the research and education activities as well as through exchanging knowledge with partners and stakeholders. It is envisaged that the outcomes of the current portfolio of research projects will help deliver benefits for stakeholder organisations and industrial companies, which will demonstrate the impact potential for the research work. This will be accompanied by the pursuit of new project opportunities that will further broaden and deepen the research portfolio of the NPI. The NPI is also able to consider the development of more strategic level collaborations with partners as well as possible international programmes with suitable partners. In conclusion, the NPI team have generated significant academic outputs over the course of 2019, as evidenced by the various developments that are detailed in this report. The team is now poised to continue along this trajectory and become further established as an international 'centre for excellence' focused on engineering and enterprise.

Publications and conference presentations in 2019

1. **Journal paper** – Philbin, S.P., Hsueh-Ming Wang, S. (2019) Perspectives on the Techno-Economic Analysis of Carbon Capture and Storage, *Journal of Technology Management and Innovation,* Vol. 14, No. 3, pp. 3–17.

2. **Journal paper** – Kennedy, D, Philbin, SP (2019) Techno-Economic Analysis of the Adoption of Electric Vehicles, *Frontiers of Engineering Management,* Vol. 6, No. 4, pp. 538-550.

3. **Journal paper** – Du, Y., Fang, J., Ke, Y., Philbin, S.P., Zhang, J. (2019) Developing a Revenue Sharing Method for an Operational Transfer-Operate-Transfer Project, *Sustainability,* Vol. 11, No. 22, pp. 6436.

4. **Journal paper** – Mansell, P., Philbin, S.P., Broyd, T., Nicholson, I. (2019) Assessing the Impact of Infrastructure Projects on Global Sustainable Development Goals, *Proceedings of the Institution of Civil Engineers: Engineering Sustainability,* doi.org/10.1680/jensu.19.00044.

5. **Conference paper** – Empson, T., Chance, S., Patel, S. (2019) A Critical Analysis of 'Creativity' in Sustainable Production and Design, *21st International Conference on Engineering and Product Design Education,* University of Strathclyde.

6. **Conference paper** – Mansell, P., Philbin, S.P., Konstantinou, E. (2019) 'Call to Arms': Using the Creating Shared Value Business Governance Paradigm to Deliver Projects' Business-Society Impact Against the UN SDG 2030 Targets. *Proceedings of the EURAM (European Academy of Management) 2019 Conference,* Lisbon, Portugal [the conference paper was selected as one of four top papers for further consideration in the Project Management Journal].

7. **Conference paper** – Mansell, P., Philbin, S.P., Plodowski, A. (2019) Why project management is critical to achieving the SDGs and how this can be achieved, *Proceedings of the Delft TU Project Management Congress 2019,* Delft, The Netherlands.

8. **Conference paper** – Mansell, P., Philbin, S.P., Broyd, T. (2019) Infrastructure Projects' Impact on Sustainable Development – Case Study of a Water-Utility Company, *Proceedings of the International Conference on Organization, Technology and Management in Construction (OTMC),* Zagreb, Croatia.

9. **Conference paper** – Philbin, S.P., Kauffmann, P., Wyrick, D. (2019) Engineering Education, Skills and Industry Alignment – Comparative Analysis of the UK and USA, *Proceedings of the 40th American Society for Engineering Management (ASEM) International Annual Conference,* Philadelphia (PA), USA.

10. **Conference presentation** – Philbin, S.P. (2019) Enterprise Education for Engineers with the Technology Evaluation and Commercialisation Framework, 14th International Entrepreneurship Educators Conference (IEEC), Oxford Brookes University.

11. **Conference presentation** – Empson, T., Patel S., Chance, S. (2019) A critical analysis of the contextual pressures sustainable development presents HE researchers and evaluators, Society for Research into Higher Education (SRHE) Newer and Early Career Researchers Conference, Newport, Wales.

12. **Conference presentation** – Empson, T. (2019) Contextualising creative practices in sustainable development for engineers and designers, Futurebuild Conference, London.

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