

---

## Editorial

---

### Laura Galloway\* and William Keogh

School of Management and Languages,  
Heriot-Watt University,  
Edinburgh EH14 4AS, Scotland  
Fax: +44-931-451-8286  
Fax: +44-0181-451-8288  
E-mail: l.galloway@hw.ac.uk  
E-mail: w.keogh@hw.ac.uk  
\*Corresponding author

**Biographical notes:** Laura Galloway is a Lecturer at Heriot-Watt University, Edinburgh. Her research interests include entrepreneurship education, minority entrepreneurship and e-commerce and she has been a co-author on Scotland's Global Entrepreneurship Monitor.

Professor William Keogh is the Enterprise Co-ordinator at Heriot-Watt University, Edinburgh. He has been leading teaching and research activities in the area of Science and Technology, seeking to widen access to enterprise teaching across the University. Prior to joining Heriot-Watt, he held the Chair in Entrepreneurship at the Robert Gordon University in Aberdeen (1997–2000), where he was also Deputy Director of Research for Aberdeen Business School. His main research interest lies in the use of knowledge in innovative, entrepreneurial technology-based small firms. He is currently a member of the Editorial Boards of five journals, including the *International Small Business Journal (ISBJ)*, *Small Business and Enterprise Development* and the *Journal of Strategic Change*. He is also an external examiner for entrepreneurship at a number of universities and a Director of the Institute for Small Business and Entrepreneurship (ISBE).

---

## 1 Introduction

This special edition seeks to provide information and knowledge for and about entrepreneurship and enterprise for those invested and involved in the teaching and learning of engineering. Throughout the modern world there is a focus, often at government level, on stimulating and encouraging enterprise amongst those qualified in the Science, Engineering and Technology (SET) disciplines, in the belief that it is professionals within these knowledge-intensive industries that are most likely to create the highest value innovations and competitive advances of the future. Moreover, the SET professions themselves are aware of the value of enterprise within the context of the modern knowledge economy, not least the engineering professions: indeed in their recommendations regarding the acquisition of Chartered Engineer status, and within the context of continued professional development, the various Institutes of Engineering are beginning to specify not just management training or education experience, but

specifically, that involving enterprise, for example, in the UK, the UK-SPEC Regulations for Registration developed by the Engineering Council (UK) include that students of engineering should receive professional competencies that include enterprise to achieve credit as a Chartered Engineer. The rationale here is that through enterprise the engineering industries can stay competitive in the context of a global knowledge economy. Enterprise can be applied in a variety of ways. For example, enterprise is applied within the context of entrepreneurship in the form of new firm creation, and potentially, new industry creation. Alternatively, enterprise is applied also within the context of intrapreneurship, often in the form of innovation within organisations, large or small

This special issue begins with two papers that investigate the current environment for engineers who start firms. Firstly, Schaul Chorev and Alistair R. Anderson describe the changing nature of entrepreneurship through three generations of technology and engineering specialists in the context of the evolution of the Israeli economy. This paper explores the changes that have occurred as a result of socio-economic and population changes in Israel for engineers who start firms. They find that motivations for starting-up, aims and objectives of the firms started, and the strategic direction of new firms are all affected by socio-economic circumstances of the time, and through this they inform the wider debate on entrepreneurial potential. For the most modern incarnation of the Israeli engineer entrepreneur, learning is an ongoing career and firm requirement, thus there is implied a role for educational institutions and industry institutes in the facilitation of this learning. In the next paper, Sarah Cooper explores the electronics and software industries specifically, and notes that while many tertiary (and other) entrepreneurship programmes are judged on the basis of volume of firms created directly after graduation, this is in fact entirely inappropriate. She finds, particularly in the electronics and software industries explored, that career trajectories of entrepreneurs in these fields tend to include substantial periods of employment in industry first. In fact, this paper argues that workplace-based learning is highly important in terms of providing 'well-conceived and sustainable ventures' in these industries. This impression is reiterated in the paper by Laura Galloway, Maggie Anderson and Wendy Brown, who present analysis of students of engineering in three universities in Scotland, and find that compared with students of other disciplines, engineering students tend to claim to aim to start firms relatively later in their careers. There are a variety of reasons for this, not least that engineering students in most countries are obliged to experience further training over a period of years post-graduation before they gain Chartered Engineer status. During this period, as corroborated by Sarah Cooper in the previous paper, valuable education and experience of the profession is gained, and this in turn contributes to the viability and quality of future ventures. Galloway, Anderson and Brown also note that students appear to be aware of the value of enterprise education within the context of the engineering industries where intrapreneurship is as valuable a commodity as potential for entrepreneurship. They find in this paper that students claim that the education received during entrepreneurship modules is as likely to be of benefit within paid employment as it is within the self-employment/business ownership context.

Henrik Berglund and Karl Wennberg contribute a paper on creativity amongst Masters students of entrepreneurship and enterprise in Sweden. They compare the creative potential and outputs of students participating on well-established entrepreneurship programmes in a business school and an engineering school, and find

that while both score highly in terms of factors affecting creativity, the specific creative indicators most representative of engineering students vary from those of business students, that is, creativity is developed and expressed differently. Beglund and Wennberg's paper goes on to discuss the implications of their investigation for those involved in entrepreneurship education for engineering students. These include a higher focus on the potential for commercialisation and markets, whereupon engineers take into account commercial potential while developing knowledge and technique within engineering.

The following two papers explore case studies in entrepreneurship education for engineering students within higher education. The first, by Peter van der Sijde and Annemarie Ridder provides a detailed account of the design, outcomes and value of the Minor Entrepreneurship programme at the University of Twente in The Netherlands. The University of Twente has as a focus, commercialisation and entrepreneurship via any of its degrees, and the Minor Entrepreneurship programme was targeted specifically at engineering students, and involved project work for real firms requiring entrepreneurial solutions. van der Sijde and Ridder find in their paper that this type of entrepreneurship education provision works best for engineers where themes to be dealt with by students are concrete (i.e. not abstract) and complex, where student groups are relatively small, and where partner firms are fully invested in the project in terms of supporting the student groups. Profiling a different model of providing entrepreneurship education for engineering students, William Keogh and Laura Galloway describe the situation at Heriot-Watt University, an institution known traditionally for its engineering programmes, but not particularly entrepreneurship education. The main issues upon establishing the provision of enterprise and entrepreneurship within existing engineering programmes involved lack of specialist knowledge amongst engineering faculty staff, as well as lack of curriculum time. These have been addressed over several years by recruiting entrepreneurship education specialists and embedding entrepreneurship teaching in engineering degree programmes. Horizontal integration is achieved by tailoring and marrying entrepreneurship classes to specific core subject activities, and vertical integration is achieved by progression of enterprise studies in line with core vocational studies, all the way through the undergraduate programme to either the Bachelors or Masters engineering qualifications. This model of enterprise/core subject integration has been highly successful in engineering and is being developed elsewhere within the SET disciplines at Heriot-Watt as a result.

The final paper in this special edition on enterprise by Mark Hannan, Claire Leitch and Shirley-Anne Hazlett provides a comprehensive review of the subject of entrepreneurship education and specifically that affecting students of SET disciplines. It focuses on the cognitive approach to entrepreneurship education and generates the myriad implications for educators developing entrepreneurship courses. In particular, this paper highlights the need for SET lecturers to be fully aware and invested in the aims of entrepreneurship education, and that these aims must be in alignment with expected outcomes. Measurement of the success of entrepreneurship education must take account of the aims and outcomes and this paper promotes the idea of evaluation. Like the first two papers in this special issue, Hannan, Leitch and Hazlett propose also that measurable outcomes include skills development for application in any employment status context, rather than just the number of business start-ups achieved within a given period. In this way, the final authors conclude with the same sentiments as the first authors in this edition, in that enterprise is not necessarily about creating entrepreneurs, especially

in the context of the engineering profession. It is through the application of enterprise skills, either entrepreneurially or intrapreneurially, that the engineering industries will maintain competitiveness and contribute most effectively within the modern, global economy.

### **Acknowledgements**

We wish to thank Dr. Stephen Kelly of the University of Strathclyde and Dr. Paul Gardiner of Heriot-Watt University for their assistance.