

Excellence in Postgraduate Education:

Manufacturing, Materials and Design

30 April 2015



A Journey to Excellence in Postgraduate Education



This report was produced by Cranfield University in partnership with the National Centre for Universities and Business

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Presentations from the day can be found at:

www.cranfield.ac.uk/about/events/listings/event-details/excellence-in-postgraduate-education-2015.html

Report Editors: Dr Susan Impey, Manufacturing Technology and Materials, Programme Director
Dr Fiona Charnley, Design Programme Director

Photographer: Christian Trampenau

Roadmap Design: Greg Boulton

Report Design: Catherine Rippin

Thanks to National Centre for Universities and Business for sponsoring the event



Join the Linked-in group for continued discussion called "Excellence in Postgraduate Education: Manufacturing, Materials and Design"

Excellence in Postgraduate Education: Manufacturing, Materials and Design

Supporting organisations

University of Cincinnati
Coventry University
Loughborough University Design School
Institute of Engineering Designers
National Centre for Universities and Business
National Union of Students





A Journey to Excellence in Postgraduate Education

Event organisers:

Dr Susan Impey, Programme Director
Manufacturing Technology and Materials,
Dr Fiona Charnley, Design Programme Director

A Journey to Excellence in Postgraduate Education

Postgraduate education should be distinctive, inspirational and innovative with many diverse and different strands. Identifying what excellence in postgraduate education looks like and how excellence can be achieved in postgraduate teaching, learning and the student experience is strategically important and under increasing funding pressure.

At an independent forum last year (May 2014) the future of postgraduate education in manufacturing, materials and design, was discussed by a range of representatives from the Higher Education Academy, Engineering and Design Accreditation Bodies, Engineering Professors Council, National Centre for Universities and Business, Manufacturing, Materials and Design Industries and a wide range of UK Universities. Best practice was shared and the attributes for achieving excellence in postgraduate teaching and learning were debated. Three main action points for which a revolutionary improvement in postgraduate education could be based were proposed:

1. **The development of a manufacturing, materials and design postgraduate education roadmap that links to those of technology and business**
2. **A clear taxonomy of postgraduate education across sectors**
3. **Research into all aspects of postgraduate teaching, learning and overall experience in collaboration with industry; specifically answering the questions:**
 - How can the gap between industry needs and postgraduate education be tightened?
 - How can postgraduate teaching, delivery and assessment better reflect the requirements of future careers?
 - How can postgraduate education provide the required flexibility to adapt to changes in industry needs and student lifestyles?
 - How can advances in digital technology be harnessed within postgraduate education?

This second symposium brought together a community of experts across the fields of manufacturing, materials and design postgraduate education to add further clarity to essential attributes and propose routes to achieving excellence in postgraduate education.

Short presentations and discussion during the day considered existing perspectives from UK and US Universities, business and industry employers and the postgraduate student body with insight from a HEFCE funded postgraduate study project. The 44 participants were invited to consider what makes a top quality postgraduate education from three perspectives; the University, the Postgraduate learner and the Employer. A roadmapping activity (action 1) was facilitated in which participants were encouraged to add to and further define attributes from the previous workshop and prioritise them in a shared vision of a journey to excellence in postgraduate education in manufacturing, materials and design. The resulting data was subsequently visually represented as a 'roadmap' which can be found towards the end of this report.

The discussions, findings and outcomes from the event have been captured in this report and will be of value to a range of professionals, across higher education institutions, who are involved in the delivery of postgraduate taught courses. This includes policy managers, education managers, academics that plan and teach postgraduate courses, recruitment and marketing colleagues, international advisors and support staff. The findings will also be of benefit to researchers and practitioners interested in improving the student experience of postgraduate (PG) students.

Speakers



Chair: Tracey Bailey
Academic Professional Development Lead



Lynette Ryals

Lynette Ryals is Pro-Vice-Chancellor, Education at Cranfield University. Her responsibilities include learner experience and education quality for award-bearing and non-award-bearing executive and professional courses, as well as the education aspects of research degrees. Lynette gave a UK University perspective for a top postgraduate experience outlining challenges linked to the emerging postgraduate/post experience education landscape for the future.



John McCardle

John McCardle is Associate Dean (for Teaching) at the Loughborough Design School where he lectures in Product Design Technology, electronics and computing. He has chaired a number of postgraduate taught (PGT) accreditation panels for the Institution of Engineering Designers. John warned against complacency; as spoken PGT taught masters programmes are offered throughout the world, the UK needs educational offerings that are distinctive and of value.



Jay Lee

Jay Lee is an Ohio Eminent Scholar and is a Distinguished Professor of the University of Cincinnati. Jay is also Founding Director of National Science Foundation (NSF) Multi-Campus Industry/University Cooperative Research Centre on Intelligent Maintenance Systems (IMS) with the Universities of Cincinnati, Michigan, Missouri and Texas-Austin. Jay advised "Learn to push learning capabilities, not knowledge (as industry can change)".



Rosa Fernandez

Rosa Fernandez is Research Director for the National Centre for Universities & Business. Her team provides analysis and intelligence to inform collaboration decisions in the UK, with bespoke analysis and reports commissioned for and by NCUB members and funders. Rosa demonstrated that in early careers more diverse destinations widen opportunities for external labour market progression and illustrate the flexibility of postgraduates.



Adam Wright

Adam Wright is a Research and Policy Officer with the National Union of Students (NUS), and is their lead advisor on postgraduate education. Adam is a strong supporter of widening access to postgraduate study and urged all to recognise inclusive teaching and learning as a path to excellence. Excellence in higher education depends on partnership and collaboration with postgraduate students not markets and competition.



Phillip Lewis

Phillip Lewis is Associate Head of Department for Mechanical, Automotive and Manufacturing at Coventry University. He is the 'Key Link' for Coventry University collaborating on the Kingston University led HEFCE funded Postgraduate Experience Project (PEP). He reported that almost all PG students expect more independent study and a more personalised study experience than at UG and that the main driving force for PG study is for employment.



A Journey to Excellence in Postgraduate Education Roadmapping

Facilitator: Andy Shaw
National Centre Manager

The most frequently cited benefit of the approach of roadmapping is communication. The process of roadmap development brings together the various key stakeholders and perspectives, building consensus. Once a roadmap has been developed it can be more widely disseminated, acting as reference point for ongoing dialogue and action¹. Roadmaps can take many forms, although generally the focus is a graphical representation¹. A flexible approach was taken to the roadmap since this can be readily adapted to suit a wide range of contexts.

The aim of the roadmapping activity was to map the key components required on a journey towards excellence in postgraduate in education in manufacturing, materials and design for universities, employers and students together. To accomplish this it was necessary to identify key requirements for current and future excellence in postgraduate education from the perspective of Universities, employers and students.

Lynette Ryals set the scene sharing the Cranfield University view that three perspectives or areas are important in an education strategy relevant for a top 10 postgraduate learner experience. The University or organisation responsible for education needs a focus on the education quality and relevance, an outstanding experience is required for the postgraduate learner and performance and career enhancing outcomes are important for the employer. These themes were used as guidelines for the roadmapping activity.

Theme: Quality of the	Questions
Education process	What elements go to make up the best quality postgraduate education?
Postgraduate experience	By the end of a programme what makes for best quality postgraduate experience?
Postgraduates after the education process	What are the key characteristics of top quality postgraduates at the end of the process?

Table 1: Questions and issues explored during discussions and workshop activity

Small groups explored and articulated essential components for excellence in postgraduate process, output and experience in more detail, using a common template, to develop a 'first-cut' roadmap for review and discussion. Participants were asked to identify what was possible now in a high quality postgraduate scenario, in the near term, 2-4 years and beyond 5 years. Each participant reviewed the three areas and was asked to identify their top 5 priority issues for each of the three areas. The 'roadmap' presented on pages 10 and 11 is a visual representation of the ideas generated during the workshop.

1. Technology roadmapping; facilitating collaborative research strategy. R Phaal and D Probert, Institute for Manufacturing, Cambridge. 10 Dec 2009
2. Excellence in Postgraduate Education: Manufacturing, Materials and Design, Meeting Report. Cranfield University. 8 May 2014



Education Process: Quality Postgraduate Education Elements



Quality and innovation of teaching, quality of teachers and learner and relevance to employers and organisations were identified as important attributes of an excellent postgraduate education process.

Technology enhanced learning was prioritised by participants as an essential element in a quality and innovative education process. Cutting edge content, different teaching styles and methods also purposeful, structured and paced engagement were identified as important. In addition, building room for failure and designing high-pressure experiences into the education process was thought to be necessary.

Ensuring high quality of the teachers, facilitators and academics was raised as an issue; they too need to learn to educate, to be assessed appropriately and for outstanding teaching to be recognised. Participants prioritised lecturers as facilitators of learning and the need for pioneering staff as essential. Additionally staff need time and space to innovate and innovative teaching should be reflected in a staff reward model.

“More guide on the side’, less ‘sage on the stage”

Lynette Ryals

John McCardle used the phrase ‘education without boundaries’ to capture working in inter and cross-disciplinary ways. The increasing complexity of products, services, and experiences has replaced the idea of the lone creative genius with the reality of the enthusiastic interdisciplinary collaborator. The best design thinkers don’t simply work alongside other disciplines; many of them have significant experience in more than one.

Adam Wright drew attention to inequalities in the current education process. He emphasised that the structure of learning is often authoritarian rather than democratic and that learning spaces tend to reproduce existing inequalities. Adam suggested that an education system is needed that values the diversity of students, utilising their many different capabilities, expectations, and aspirations; viewing diversity as a core part of an education that allows us to learn from each other. This means that students are empowered as co-producers in developing an exceptional education system not as passive consumers. Participants identified mixing FT and PT for the benefit of both, blurring boundaries of taught and research degrees and quality based on individuals as contributions to inclusivity.

Measuring quality in inclusive learning spaces is a challenge. Just because students are satisfied, engaged and happy doesn’t mean they are learning. Education is a collaborative process so the assessment of quality must also be collaborative, perceptual and contextualised. Students could co-design feedback and assessment to support their own progress. Aligning module learning to the overarching course in design and operation and integrating learning and assessment across modules were highlighted as important for the near future. Embracing diversity and flexibility in courses is key to the future of postgraduate education. This will enable us to strike the correct balance between meeting needs of industry now and upskilling for future economy and society.

Lynette outlined a number of challenges linked to the emerging postgraduate / post experience education landscape for the future. More effective use of assessment to enhance learning as opposed to assessing the learning was suggested. Looking to the future, there is a likelihood that multi-location learning may be more commonplace and/or education may be independent of location. Referring to ‘lecture rooms’ is unhelpful and a flexible “learning space” is desirable.

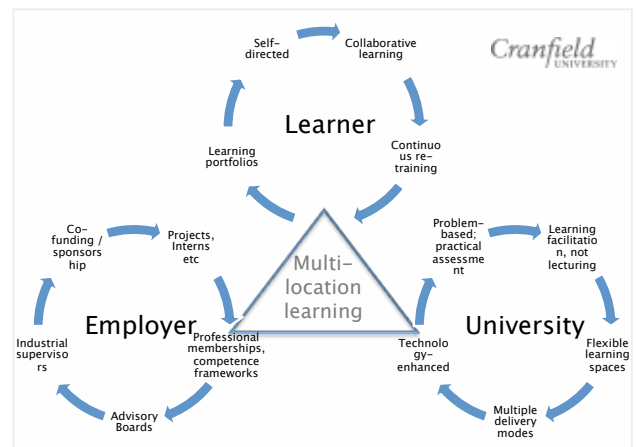


Figure 1: Key requirements for current and future excellence in postgraduate education from the perspective of universities, employers and postgraduate learners -Lynette Ryals

Partnerships were identified as essential to inclusivity and contributing to quality. In the near future and within the education process, peer to peer learning and appreciation and using alumni to partner and mentor current learners was noted to be of benefit. Additionally PGT masters research could contribute to the wider research discussion. The NUS raised the partnership agenda in education with a manifesto to define what partnership could mean. Other NUS commitments to improvements are radical interventions in teaching and learning and quality higher education for the next generation of students.

A Journey to Excellence in Postgraduate Education

Relevance to employers and organisations was highly ranked. Close working with industry, industrial input and teaching staff with industrial experience were all identified as important by participants. Thus a crucial partner in the PG education process and a key stakeholder is industry or employing organisations. In the near future industry sponsored programmes and cross university/cross industrial sector programmes were prioritised. For the future, co-creating courses between universities and business was recognised as important. A national level industrial advisory board was also suggested.

The view of employers is that excellence is about combining specialism with a good sense of non academic ways of working. Rosa Fernandez showed examples from the NCUB state of the relationship (2014) report to illustrate a range of successful ways of working in partnership for universities, postgraduate students and business through joint course development, consultancy and placements. It was recognised that for significant benefits reward systems need adapting and sufficient staff resource is needed.

“Cooperative Education facilitates learning and earning”

Jay Lee

Jay Lee outlined the very successful Cooperative Education (Co-op) in the US, founded at the University of Cincinnati, which is based on a German-system of apprenticeship engineering. Co-op is the practice of alternating students' studies with paid relevant professional work. During a 5 year degree, 1.5 years are spent in industry. International Co-op Programs are also currently offered to learn a second language and gain international experience through an overseas co-op assignment.

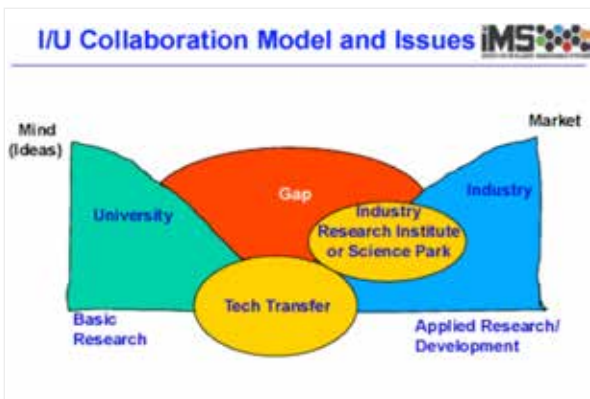


Figure 2: Industry/University Co-op research fills the considerable gap that can exist between basic research and applied research and or between ideas and a product to market. The centres must be self sustaining within 10 years. Jay Lee

For the providers of education, there is concern that financial income streams might be prioritised over education pedagogy. It is generally recognised that it is exceptionally expensive to study in the UK. European universities are offering course fees at 1/6th of those in the UK. Examples were given of UK Universities where the numbers of international PG are reducing as the PG students chase lower fees to study outside of the UK. There could be a number of varied responses. Attention was drawn to a comment from Professor Michael E Porter of the Harvard Business School, “Don't compete with IKEA by offering cheap Scandinavian flat-pack furniture”.

As UK spoken taught masters programmes are offered throughout the world, it is important to ensure the UK offering is distinct and of value. Good doctoral training centres that are multi institutional provide ways of seeing things and are often industry linked.

“Compete by being unique; Be distinctive but also diverse”

John McCardle



An Outstanding Postgraduate Experience



In an outstanding postgraduate experience each individual learner gains advocacy, satisfaction (exceeding expectations) and enjoyment. How is this ensured?

Jay Lee highlighted that in Japanese and Chinese the word education is two words; teach and nurture. To nurture postgraduate researchers in the NSF/IMS centre there is a focus on core values (A to E) are namely: attitude, breadth, curiosity, diligence and execution. During the period of study in industry the work can often be alone, however the experience and knowledge is shared when PGs return to the University. All personnel and postgraduates are encouraged to value themselves using 'ASK'; based on who you are (Attitude), what you can do (Skills) and what you know (Knowledge).

What does this mean for postgraduate students as they develop knowledge, skills and individual values. Do employers view them as real 'commodities', as marketable items? Do learners need to see immediate dividends in terms of finance, or career prospects?

"Students think of themselves as valuable, desirable and want employers to invest in them"

John McCardle

Participants prioritised a journey that unfolds itself as the programme proceeds as important to the student experience. Philip Lewis reported on the collaborative Postgraduate Experience Project (PEP) which looks to widen participation in postgraduate education. Of 1200 students surveyed across 11 institutions in the UK, almost all students expect MSc study to be more independent, that the PG study will both widen and specialise their knowledge and experience more personalised study than at UG. The relevance of the programme for today, future, industry, and life was thought significant and with such multifaceted requirements, the teaching should be transformational and needs to enhance the PG employment prospects (Figure 3).

A central part of the PG experience is diversity of many individuals at different career stages and life experiences. To be inclusive with such a heterogeneous group, all playing by the same rules, is a significant experience. Crucial to this was felt to be cultural understanding and international integration.

The highest prioritized characteristics identified as important for a quality postgraduate experience are opportunities to establish good 'value frameworks' to demonstrate professionalism, organisational planning, team work, and independent study. Participants also prioritised opportunities for problem solving experience to support critical thinking.

Student perception of MSc value

A PGT will develop/improve...

94.1% employment prospects	87.6% confidence in tackling unfamiliar problems
95.8% research skills	87.5% reflection on own professional development needs
92.2% better preparation for future employment	87.2% communication skills
90.8% transferable skills	78.4% employer networking opportunities
90.6% research paper writing skills	75.6% research networking opportunities
90.5% confidence about independent learning	62.6% confidence in self-presentation
89% practical experience in the subject area	

hcfce PEP

Figure 3: A summary of the perceptions of the value of the MSc is given. Employment is the driving force for PG study while 75% perceive that employers value a PG qualification more than UG (while 18% are unsure). Phillip Lewis

Group projects, individual projects and industry engagement were highlighted as opportunities to demonstrate and experience active thinking and adaptability to diverse situations was desired.

In the near future it was felt that the 'whole' PG academic and social experience should be enriched (both at the course/ institutional level). Participants prioritized equipping individuals to function not only in the disciplines for which they were trained, but also in broader social roles as important. Acquiring the 'softer skills' such as commercial and interpersonal skills (the latter relates to social etiquette and conduct at work) is of benefit. Indeed the whole PG experience should permit readiness for employment, and include reality checks for performing in the work place.

Harnessing the experiences of alumni was thought to be significant. To engage alumni in learning and teaching reviews may develop a sense of responsibility in a PG shared experience. Using fellow PG and alumni to broadening networks and friendships was noted, other opportunities incorporate ambassadors and stewardship. The experiences of the alumni could be used to develop a 'more flexible/adaptive learning programme'; capable of dealing with change.

A significant consideration (to incorporate in the longer term) was to incorporate experiences and skill development such that the learner feels well prepared for the future and for employment success. This may be that the education acquired is applicable to a range of employers, and flexible with knowledge bases. Skills for solving problems that don't yet exist and skills to enable lifelong learning such as self motivation were recognised as important (in the long term). Significant too is feeling that what has been learned will grow with the PG in the future. The use of models, tools and strategies that have longevity of learning were important.

Post Education Process: Key Characteristics of Quality postgraduates



Critical to the employer and prospective employee are better employment prospects, higher salaries and better organisational performance. The explicit benefits for companies in recruiting postgraduates were emphasised by Rosa Fernandez. She highlighted the significant gap between occupational sectors and subjects being studied at postgraduate level since most universities think in disciplines whilst employers think in sectors. Postgraduate students however think of careers and employment.

“No longer jobs for life. Those entering the workforce now are expected to retrain 8 times during their working life”. Lynette Ryals

For the NSF postgraduates following their period of study in the US there is a personnel transfer model over three years from the University into a company (often a spin out company). In the first year 80% of the salary is financed by the University and 20% by the employer. For years two and three, 80% is funded by the employer.

Jay Lee suggests that a 21st century workforce needs vision to identify new technological opportunities, to innovate new products and services and the capability to integrate diverse knowledge and resources. A breadth of experience in the conception, design, manufacturing, and servicing of products is important as well as an ability to use experience to extend the frontiers of knowledge in the advancement of technology. Additionally experience with a diversity of cultures is also recommended as a prerequisite for the workforce.

For employers and organisations communication skills are among the most important skills for engineers. Confidence in their field of study, to speak, debate, challenge peer group and lead new work in their workplace was felt important by participants. It was recognised that to be able to teach, train and show others and pass on skills to help others to learn was useful. Team working skills are a must as well as an ability to expand the boundary of business opportunities in global market.

Participants prioritised professionalism as a significant characteristic for a PG. This includes being able to work independently at pace, to be responsible for self learning and be self directed. To plan and meet deadlines, keeping quality and scope of the work is important. Also relevant is the ability to continue self learning and self development following the PG education into the future.

A wide variety of skills desirable for the emerging PG were outlined by participants. Analytical thinking skills were highly valued; skills in critical thinking, being able to navigate through knowledge and innovation, general broad sector skills and also a quality green belt were felt useful.

Real world application and experience in context was highlighted as a priority by participants. Problem formulation skills and the ability to lead a significant technology based problem solving exercise with others were noted. The key issue was to be able to contribute to the business quickly 'hit the ground running' and understand the context of job quickly.

In the near future the most significant characteristic identified for the PG was resilience. Skills in adaptability and change management and to be outward looking were valued. The ability to learn how to learn was also recognised as highly desirable (Figure 4). It was desired that a PG demonstrate professional ethics. These might include the capability of navigating the regulatory legislation field in their topic, to recognise environmental impact of decisions and include regulatory and legislation knowledge such that the business or organisation is informed.

The ability to innovate was recognised as a long-term priority. Also noted were skills in intellectual property mapping for new research opportunities and for business models (and value proposition thinking). The ability to be resilient and adaptable during significant and pivotal major changes was desired.

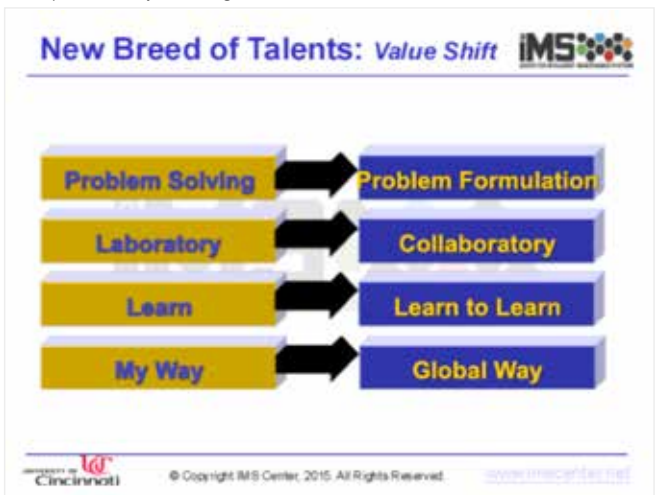


Figure 4: The requirements for a value shift in postgraduate talents aiding collaborative working. Jay Lee



Roadmap

Education Process

What elements go to make up the best quality postgraduate education?



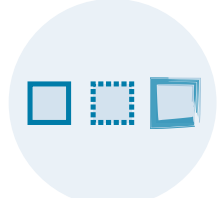
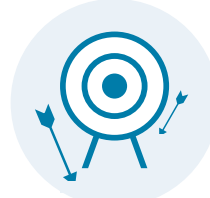
Industry Input / Working with Industry

Technology Enhanced Learning



Pioneering Staff

Build in Failure



Different Teaching Styles and Methods

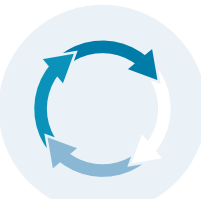
Postgraduate Experience

By the end of the programme what makes for best quality postgraduate experience?



Good Problem Solving Foundations

Professionalism, organisational planning, team work, independent capability



A journey that unfolds as the programme proceeds

International Integration Cultural Understanding



Active thinking - adaptability to diverse situations

After Education Process

What are the key characteristics of top quality postgraduates at the end of the process?



Real World Application

Analytical Thinking Skills



Professionalism

Problem Solving



Confident in Their Field of Study

Present

Closing comments

Rather than driving innovation and diversity in teaching and learning, responses to the market have made universities focus on short-term financial interests and increased marketing. It is argued that the obsession with marketisation has de-valued our education, and the role of students and academics in it, while at the same increasing the financial cost to students and influencing staff wages, pensions and job security.

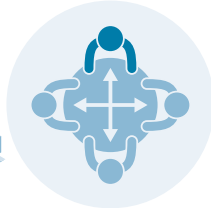
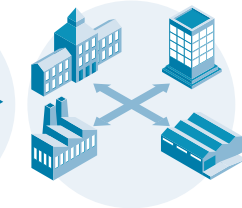
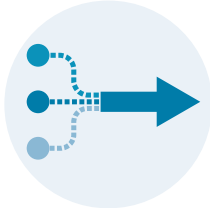
Megan Dunn, NUS Vice president (Higher Education) says "We know that good quality, forward-thinking education doesn't come from universities competing against one another to develop good teaching and learning in secret; it comes from students and academics working together and providing innovative forms of pedagogy, based on challenge and collaboration".



A Journey to Excellence in Postgraduate Education

Aligning Module Learning

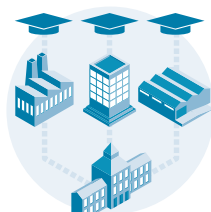
Lecturers as Facilitators of Learning



Cross University/Industrial Sector Programmes

Aquiring the 'Softer Skills'

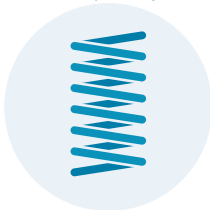
Harness experience of Alumni



Equipping individuals to function in broader social roles

Resilience and Adapability

Professional Ethics

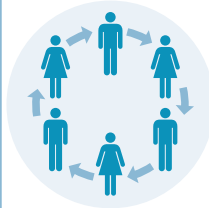


Learning to Learn

Near Future (2 - 4 Years)

The partnership should be fully inclusive and not just academics and postgraduate students since employers and business must be firmly on board. Industry Advisory Boards or Learning watchdog – industry guides were highlighted as a key component for university/industry collaboration. Industrialists were the lowest number of participants at this event. All were encouraged to bring in more business representatives to the debate and any future events. This partnership community must include all stakeholders.

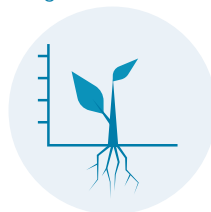
Universities and Business Co-Creating Courses



Peer to Peer Learning

National Level Industrial Advisory Board

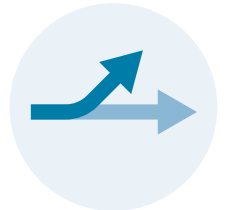
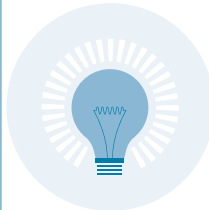
What they learn will grow with them



Flexibility of knowledge bases

Longevity of learning - models, tools and strategies

New Research Opportunities



Ability to Innovate

"Pivot" Major Change

Future (5+ Years)

Jay spoke of the importance of speed, critical in a University for 2020. The speed of making good mistakes to increase value of industry research with lower risk than without the Industry/ University collaboration; speed of knowledge discovery and dissemination, speed of learning and talent development and speed of innovation and value creation. There is increasing importance in embracing technology as a medium through which engagement and participation is facilitated.

NEXT STEPS

Passionate and committed individuals are part of a motivated community which aspires to collectively journey towards excellence in postgraduate education. Enthusiastic presentations and discussions highlighted many ideas for future improvement. Aspirations and debate are important and further research is required to move towards an effective, flexible and valuable postgraduate learning experience. However the challenge for us all is what we do as a result of the discussions and findings.

The Excellence in Postgraduate Education: Manufacturing, Materials and Design event highlighted areas for enhancing quality in postgraduate education. The community need to get involved putting ideas into practice, embracing technology and share the learning:

- undertake inclusive practice in teaching and learning
- develop partnerships and collaborative projects
- cross educational boundaries

Next 'Excellence in post graduate education - Manufacturing, Materials and Design' event will be on the 28th of April 2016

Cranfield University

For further information please contact:

Dr Susan Impey or Dr Fiona Charnley

T: +44 (0) 1234 750111

E: s.a.impey@cranfield.ac.uk, f.j.charnley@cranfield.ac.uk

www.cranfield.ac.uk