Design Education –
Growing our Future

Editors: Erik Bohemia, William Ion, Ahmed Kovacevic, John Lawlor, Mark McGrath, Chris McMahon, Brian Parkinson, Ger Reilly, Michael Ring, Robert Simpson and David Tormey
Dedication

We dedicate the E&PDE13 proceedings to Professor Chris McMahon and Professor William Ion.

Chris and Bill have played important role since joining PDE
- Product Design Education conference of IED and EDE
- Engineering Design education conference of SEED (now DESIG)
into the event which was held in Glasgow 1999 and which since 2000 is known as E&PDE. Over the years, both Bill and Chris have provided crucial leadership and helped in developing the conference from the meeting of relatively small number of academics in the truly international and multidisciplinary conference that covers broad range of subjects in engineering and product design education.

We will miss subtle but focused scientific and organizational steering of the conference by both of them. However, the legacy of their contribution will be preserved through continuation of exploring issues related to design education by conducting future E&PDE conferences.

On behalf of the Design Education Special Interest Group (DESIG) of the Design Society, and the Institution of Engineering Designers (IED)

Judith Grace, Brian Parkinson, Erik Bohemia and Ahmed Kovacevic
Design Education –
Growing our Future

Erik Bohemia
Loughborough University, Design Education Society
Special Interest Group, Design Society

William Ion
Strathclyde University, Design Education
Special Interest Group, Design Society

Ahmed Kovacevic
City University, Design Education Society
Special Interest Group, Design Society

John Lawlor
Dublin Institute of Technology

Mark McGrath
Dublin Institute of Technology

Chris McMahon
University of Bristol, Design Education Society
Special Interest Group, Design Society

Brian Parkinson
Institution of Engineering Designers

Ger Reilly
Dublin Institute of Technology

Michael Ring
Dublin Institute of Technology

Robert Simpson
Dublin Institute of Technology

David Tormey
Institute of Technology, Sligo
# Table of Contents

**Foreword**

**Design Society**

**Institution of Engineering Designers**

## Chapter 1 – Design Methodology

2   Introducing Mechanism Design to Product Design Students  
*John Brennan, Michael Ring and Michael O’Hehir*

8   Product Evolution Diagram; A Systematic Approach used in Evolutionary Product Development  
*Huub Ehlhardt*

14  Improved Design Methodology Practice: Successful Matching of Tasks and Employees  
*Malte Sebastian Hinsch, Jan Erik Heller and Jörg Feldhusen*

20  Visualizing Early Product Decisions and Sticking to them... or Not  
*Aske Korsgaard Hejlesen and Christian Tollestrup*

26  The Potential of Low Cost Topology Optimization  
*Anna-Lena Beger, Alex Brezing and Jörg Feldhusen*

32  Enhancing Product Architecture Application in Education and Industrial Practice  
*Claudia Dittmann, Malte Hinsch, Ino Schliefer, Johannes Van Der Beek and Jörg Feldhusen*

38  An Out-of-School Design Learning Intervention for Second Level Students  
*Emma Creighton and Gary Granville*
Chapter 2 – Best Practice in Design Education

46  The Importance of Common Sense: Ergonomics in Design Education
     Philippa Davies and Dr Guy Bingham

52  Perspectives in Competencies-Based Education: A Curricular
     Experience to form a New Industrial Design Profile
     Luis Mejia and Maria Clara Betancourt

58  How To Teach Design For Manufacturability at Micro Scale Tasks
     Volker Schulze, Frederik Zanger and Philipp Hoppen

64  Tools for Assessing Student Learning in Mechanical Design Courses
     Dónal Holland, Conor J Walsh and Gareth J Bennett

70  Exploring the Influence of Self-Confidence in Product Sketching
     Pepijn van Passel and Wouter Eggink

76  Broadening Assessment Criteria and Student Awareness
     Julian Lindley and Richard Adams

82  Who Wins from Academic Consulting?
     Anders Berglund and Phillip Tretten

88  Reflection in Design Practice – Quality Assurance of Practical
     Training in Product Design Education
     Bente Skjelbred and Arild Berg

Chapter 3 – Creativity

96  The Innovation Paradox: Starting from what is ‘Known’ to Facilitate
     the Discovery of the ‘Unknown’
     Karel Vandenhende

102 Morphological Analysis of C-K’s C-Constructs on Design Group Creativity
     Wim Zeiler

108 Narrative in Design Development
     Peter R N Childs, Ying Zhao and Joanna Grigg

114 Designing Training Plans in Creativity Techniques for Companies
     Marita Canina, Laura Anselmi and Elisabetta Coccioni

VIII  EPDE 2013
120 Merging Creative Design and CAD Learning Activities in a Product Design Programme
*Pearl O’Rourke, Colm O’Kane, Leslie Smith and Michael Ring*

126 Analysis of Students Opinion about a Creative Design Experience by Means of Virtual Synchronous Teams
*Elena Mulet, Nathalie Escamilla, Vicente Chulvi, Carlos Garcia-Garcia, Francisco Felip and Julia Galán*

132 Systematic Training Manual Designed Within Digital Design to increase the Level of Creativity in a Shorter Time
*Jamshid Emami and Shaghayegh Chitsaz*

**Chapter 4 – Reflections on Design Teaching**

140 Engineering Design Education: Skin Deep or is there a Need for Body?
*Brian Parkinson and Kevin Edwards*

146 How Else Might We Learn to do Design? Alternative Visions for Future Development of Skills for the Profession
*Chris Dowlen*

152 Exploring the Design of Mousetraps
*Gunnar H. Gundersen*

158 Reflections on the use of Case Studies in the Teaching of Engineering Design
*Steve Lambert and Oscar Nespoli*

164 Models of Resilient Adaptive Practice
*Stephen Trathen and Soumitri Varadarajan*

170 An Integrated Approach for the Teaching of Mechanics and Electronics in a Design Context
*Guy Bingham, Darren Southee and Tom Page*

**Chapter 5 – Experimental Studies in Design Methods**

178 Comparison of Design Approaches between Engineers and Industrial Designers
*Seda Yilmaz, Shanna R Daly, Colleen Seifert and Rich Gonzalez*
Empirical Analysis of Product Design with Different Times and Interruption levels
Raymond Djaloeis, Martin Frenz, Sönke Duckwitz, Malte Hinsch, Jörg Feldhusen and Christopher M Schlick

The Use of Systematic and Heuristic Methods in the Basic Design Cycle: A Comparative Survey of Students Method Usage
Oscar Person, Jaap Daalhuizen and Valentin Gattol

Forming a Method Mindset: The Role of Knowledge and Preference in Facilitating Heuristic Method Usage in Design
Jaap Daalhuizen, Oscar Person and Valentin Gattol

Analysing Visual Strategies of Novice and Experienced Designers by Eye Tracking Application
Quentin Lohmeyer, Mirko Meboldt and Sven Matthiesen

Chapter 6 – Design Education in Industry

“It's Part-Time - but not as we know it!” - An Evaluation of a Flexible Learning MEng
Tania Humphries-Smith and Christopher Benjamin

Combining Rich User Interaction with the Personas Technique in a Student User Experience Design Project
Jan Corremans and Achiel Standaert

Collaboration Mechanisms for University-Industry Projects
Andrew J Wodehouse and Kepa Mendibil

Cooperation between Novice Designers (Students) and Professional in Building Industry
Wim Zeiler

Practice-Oriented Engineering Design Education – An Institutional Comparison
Markus Voss and Hans Lautner

The Role of the Design Coach - A Novel Approach to achieving 360° Collaboration between Industry and Higher Education
Lee E J Styger and Ian Ellis
Chapter 7 – Innovation in Teaching

260 Towards an Internationalised Product Design Curriculum
Jennifer Loy and Donald Welch

266 Advanced Teaching in Design
Nicola Crea

272 Design Learning Through Iterative Folding of Non-Paper Materials
David Morgan

277 Systems Thinking and Connecting the Silos of Design Education
Hyuna Park and Eric Benson

282 Humanistic Perspectives on Design Education: Tools for Reflection
Marieke Sonneveld

288 Geometry as a Tool for Visual Organisation and Proportion in Designing Aesthetic and Attractive Products
Alejandra Velásquez

Chapter 8 – Projects

296 Cooperation-Focused Education in Mechatronic Engineering Design Projects
Sebastian Schmidt, Quentin Lohmeyer, Stefan Krebs, Sören Hohmann and Sven Matthiesen

302 Issues in Organisation and Management of Multidisciplinary Group Design Projects
Ken Keating, Claire Brougham, Graham Gavin and Ger Reilly
A Case Study on a Conceptual Design of Solar Thermal Collectors using a Collaborative Framework of Engineering Design and Product Design Tools
George Loumakis, Bruce Wood, Fred Birse, Stas Burek, Ahmed Kovacevic and Sham Rane

Mechatronic Design for Students: Model based on Industrial Engineering Techniques
Carlos Alberto González-Almaguer, Jose Manriquez, Sergio Trelles, Luis D. Reyes, Xochitl Neria, Armando Acevedo, Jose M. Avila, Joaquim Lloveras and Oscar Rioja

Integrated Projects: Positioning Design as the Underlying Ingredient towards Integrating Subject Areas within an Undergraduate Programme - A Case Study
Sangarapillai Sivaloganathan and Tamer Shahin

Valuation of Questions in Presentations of Group Projects
Joaquim Lloveras

A Student's Interdisciplinary Product Development Project in Engineering Design Education
Carsten Haack, Ernst Lüthi and Volker Janssen

Towards a Design Model for Student Graduation Projects – A Case Study
Sangarapillai Sivaloganathan and Tamer Shahin

Integrating Formula Student into Design Education – Bridging the Gap between Theory and Practice
Fabio Dohr and Michael Vielhaber

Students Practising Realistic Design Process by Collaboration of Different Disciplines
Bernard Huggins, Sara Linda, Sham Rane, Adam Walley and Chris Dougan

Evolving an Innovative Design Education Environment: The Formula DIT Story
Donal McHale, Mark McGrath, Gerry Woods, Bill Reddington and Derek McEvoy

Compose or Decompose - Resource Allocation in Engineering Design Projects
Anders Berglund

EPDE 2013
Chapter 9 – Styling/Form

370 Expressing Product Character: Teaching Design Students How to Exploit Form’s Parameters
Silvia D Ferraris and Roberta Gorno

376 Visual Elements of Products - An Educational Experience on “Resetting and Reshaping a Product”
Silvia Deborah Ferraris and Venere Ferraro

382 Explaining the Design & Styling of Future Products
Wouter Eggink and Angèle Reinders

388 Inspirational Categories for Product Design: A Study within the Conjoint Trends Analysis Method
Angela Cadavid Lopez and Jorge Maya Castro

Chapter 10 – Knowledge

396 Enhancing Knowledge Acquisition
Alan R Crisp, James Dale and Phillipa Marsh

402 Eu-Optimus – A Case Study of a Novel Systems-Approach Pedagogy in Technology Education
Ciara Ahern and Mark McGrath

408 Towards Documentation Support for Educational Design Thinking Projects
Thomas Beyhl, Gregor Berg and Holger Giese

414 Retrospective Study on Teaching Engineering Design and Product Development
Timo Lehtonen, Tero Juuti, Kaisu Rättyä and Mikko Vanhatalo

420 Designers' Knowledge in Plastics
Kaare Eriksen

Chapter 11 – Inclusive Design

428 Designing the Difference in an Inclusive Way
Rita Assoreira Almendra

EPDE 2013 XIII
Mood Boards for their own Formative Years help Students Design Better for Elderly People
Arthur O Eger and Huub Mulhof

Disability + Relevant Design: A Portfolio of Approaches
Sheila M. Schneider, Deana McDonagh and Joyce Thomas

Community Design Challenge, Products Striving from Concept
Bernard Timmins, Siobhan Long and Noel McQuaid

Chapter 12 – Reflection on Creativity

Are we all Designers?
Paul A Rodgers, Ashley Hall, Euan Winton, Ellie Land and Marco Aurisicchio

Back to Craft
Elina Karanastasi, Matthijs Moelee, Xenia Papariantafyllou, Marintina Kardarakou, Angeliki Terezaki, Strata Alexopoulou, Athina Papadopoulou and Maria Nikolakaki

Creating the Creative
Amos Scully

The Making of a Journey - Identifying New Design Approaches in Contemporary Art
Vibeke Sjøvoll and Tore Gulden

Chapter 13 – Technology in Design Education

Exploring Featherweight Industry PLM Solutions for Academic Use
Jeff Barrie and Geraint Owen

Individual Study of 3D Modelling Software using Interactive Video
Knut Aasland

Asking Why as Well and How: Strengthening the Technical Proficiency of New Designers
Phillipa Marsh and Leslie Arthur
498  Sketchtube; Integrating Digital Media in the Education of Design Skills
  *Maaike Mulder-Nijkamp and Wouter Eggink*

504  Designing Experienceable Systems by using Microcontroller Based Platforms
  *Guido De Grande, Chris Baelus, Dries De Roeck and Lukas Van Campenhout*

**Chapter 14 – Design Education and Business**

512  Bridee – Bridging Design and Entrepreneurship in Education
  *Chris Baelus, Guido De Grande and Alexis Jacoby*

518  Collaboration between Industrial Design Students and Industry: Sharing Knowledge and Intellectual Property
  *Stijn Verwulgen, Frank Goethijn and Vanessa Vankerckhoven*

524  Design for the Bop and Top Markets: Strategies used by the Design Students
  *Santosh Jagtap, Andreas Larsson, Viktor Hiort of Ornäs, Elin Olander, Anders Warell and Pramod Khadilkar*

530  Articulating Excellence in the context of Design and Employability
  *Dan Trowsdale and Becky Clark*

536  The Efficacy of a CDIO based Integrated Curriculum as Preparation for Professional Practice in Product Design and Development
  *John Paul Hermon*

**Chapter 15 – Design Cultures**

544  Challenges in the Welfare Sector – Some Educational Perspectives
  *Martina M Keitsch and Jóhannes B Sigurjónsson*

550  Creative Camaraderie: Promoting a Shared Design Culture for Staff and Students
  *Jennifer Loy and Simon Ancher*

556  Socio-Cultural Dimensions to Sharpen Designer’s Cultural Eyeglasses
  *Annemiek Van Boeijen*
Chapter 16 – Multidisciplinarity

576 Navigating the In-Between Spaces- Growing Designers of the Future using an Interdisciplinary Approach
*Ray Ekins, Bernard Timmins, Fiona Timmins, Pearl O’Rourke, Eugene Coyle and Siobhan Long*

581 Missing Miscommunications in Interdisciplinary Design Practice
*Vanna Savina Torrisi and Ashley Hall*

587 Managing Multidisciplinarity – Growing Future Creators
*Anders Håkansson and Bengt Holmqvist*

593 Interdisciplinarity is a Key to Enhance the Product Development Process – How Students Deal with it and How they Evolve with it
*Paul Gerber, Sönke Krebber, Ingmar Langer, Sinja Röbig, Susanne Sprenger and André Stocker*

599 Universal Dilettantes and Blinkered Specialists: Historic Models and Future Potential of Interdisciplinary Design Education
*David Oswald*

Chapter 17 – Rapid Prototyping

606 Beyond Static: Ideation using Interactive Prototyping Toolkits
*Dries De Roeck, Bart Stoffels, Achiel Standaert and Stijn Verwulgen*

611 Additive Manufacturing in Product Design Education: Out with the Old and in with the New?
*Peter Ford and Lionel Dean*

617 Impart ‘Design for Production’ Knowledge by Application of Functional Prototyping
*Bastian Leutenecker, Quentin Lohmeyer and Mirko Meboldt*

XVI  EPDE 2013
Integration of Evaluation and Simulation Methods for Virtual Prototypes
François Christophe, Faisal Mokammel, Eric Coatanea and Mohamed Bakhouya

Fablabs in Design Education
Manon Mostert-Van Der Sar, Ingrid Mulder, Leo Remijn and Peter Troxler

Tangible Ideation: How Digital Fabrication Acts as a Catalyst in the Early Steps of Product Development
Roozbeh Valamanesh and Dosun Shin

Chapter 18 – Best Education in Practice

Transitioning Product Education to Product Service Education
Linda Ryan, David Tormey and Perry Share

Applying Experience Reports in Design Education: Challenges and Ideas
Gert Pasman and Natalia Romero Herrera

Curriculum Differentiation for Masters in Product Development
Alexis Jacoby and Chris Baelus

Supplying the Demand: Aligning Product Design Curricula and the Professional Practice of Design
Martyn David Evans and Jon Spruce

Spaces Supporting Creative Design Work
David Cannon and Tuuli Utriainen

Zoocentric Design: Pigs, Products, Prototypes and Performances
Seaton Baxter and Fraser Bruce

Design to Connect: An Online Database Providing Inspiration for Design Education and Practice
Tore Bleuzé, Jan Detand and Patrick Debaets
Chapter 19 – Emotion/Senses

686 Experience Design Tool: Encouraging Designers to Consider Different Design and Emotion Strategies
Mary Maclachlan and Bruce Wood

692 The Interaction of Product Noise and Form Design in Evoking Users’ Responses
Abu Hanifa Ab Hamid, Shahriman Zainal Abidin and Mohamad Hariri Abdullah

698 Enhancing Product Sensory Experience: Cultural Tools for Design Education
Sara Colombo, Roberto Gorno and Sara Bergamaschi

704 Designing Burial Monuments to Increase Emotional Awareness in Product Design
Einar Stoltenberg and Arild Berg

710 Modelling of Memories through Design
Tore Gulden

716 The Characteristics of Form in Relation to Product Emotion
Mohd Syafiq Jamaludin, Muhammad Fadli Zulkapli and Shahriman Zainal Abidin

Chapter 20 – Learning

724 Teaching Design Theory: Scaffolding for Experiential Learning
Viktor Hiort Af Ornäs and Martina Keitsch

730 Creative Design Teaching-Learning Methods: A Reflection from the Professors
Maria Clara Betancourt

735 Student Preferences on Tactile Versus Digital Learning: Implications for Conceptual Design
Gül E Kremer, Conrad Tucker and Kathy Jackson

740 A Model for Transforming Engineering Education through Group Learning
Shannon Chance, Gavin Duffy, Brian Bowe, Mike Murphy and Tony Duggan

XVIII EPDE 2013
Chapter 21 – Reflection

760 A Reflection Model for Sensing and Development of Experience
Bente Dahl Thomsen and Marianna Chraudin

766 Wheel of Design – Reflective Alignment of Design Skills with Aspirations
Karen Bull, Alan Barrett and Jane Osmond

772 Introducing Nature Analogies at the Framing Stage of Design Projects
Mithra Zahedi and Manon Guité

778 Bridging the Discrepancy between Reflective Practice and Systematic Form Generation Approaches
Maral Babapour and Ulrike Rahe

Chapter 22 – Sustainability

786 Encouraging Sustainable Urban Access: An Exploratory Student Approach to Design of Product Service Systems
Alexandros Nikitas, Ulrike Rahe and Toni-Matti Karjalainen

792 Supporting Sustainability Thinking in Postgraduate Design Education
Clare Brass

798 Upcycling: Re-Use and Recreate Functional Interior Space Using Waste Materials
Nawwar Shukriah Ali, Nuur Farhana Khairuddin and Shahriman Zainal Abidin

804 Effectiveness of Ecodesign Methods in Assisting SMEs towards Market Success
Munire Hilal Bugali and Melehat Nil Gulari
Chapter 23 – Reflection on Design Cultures

812 Ethnography and Design, Understanding Everyday User-Product Relationships
   Clare Green

818 Exploring the Effectiveness of Design Education in Iran using Protocol Analysis
   Ameneh Sadat Seyyedi Komjani, Maryam Mizan, Fater Saadat Niaki and Morteza Pourmohamadi

824 Industrial Design 2.0: A Renaissance
   Ian De Vere

830 Design Education; At The Cross Roads of Different Disciplines
   Robert Tully

Chapter 24 – Learning Spaces

838 Out of the Lecture and into the Studio: A New Take on Teaching Design History
   Bryan Howell and Kimberly Christensen

844 Make Space, Make Place, Make Sense
   Bas Leurs, Jasper Schelling and Ingrid Mulder

850 Task Furniture in Education: Design, Science and Industry Creating Solutions to Support 21st Century Learning
   Alex Milton, Caoimhe Mc Mahon and Simon Dennehy

856 Facilitating Problem-Based Learning in Teams with Scrum
   Nis Ovesen

862 Learning Spaces and Social Climate in Architectural Education: Design Studio vs. Traditional Classroom
   Hernan Casakin and Nitza Davidovitch

868 Impact of a Change of Environment on Autonomy and Design Exploration
   Gareth Loudon, Steve Gill and Paul Wilgeroth

XX EPDE 2013
Foreword

DESIGN EDUCATION – GROWING OUR FUTURE

The 15th International Conference on Engineering and Design Education (E&PDE) was held at Dublin Institute of Technology (DIT) on 5th and 6th September 2013.

The conference was hosted by the School of Manufacturing and Design Engineering in the College of Engineering and Built Environment, Bolton Street, Dublin (Ireland) in close collaboration with the Design Education Special Interest Group (DESIG) of the Design Society, and the Institution of Engineering Designers (IED).

The E&PDE conference was initiated in 1999 in the United Kingdom and was consolidated as an international conference in 2004; alternately taking place in the UK and abroad. Its objective is to facilitate the bringing together of people from within education and industry who are interested in sharing expertise on the implementation and analysis of contemporary and developing methodologies in engineering and design education. It provides educators and researchers from product development, engineering and industrial design, together with industry and government representatives, with a platform for discussion on topical educational issues in design education and its future direction.

Conference theme
As the host institution for E&PDE 2013 we gave much consideration to the main theme of the conference and decided it would be appropriate to focus on the importance of design education in the context of the current economic situation in Ireland and in Europe. We developed the theme of: Design Education – Growing Our Future in the knowledge that in recent years the Irish government has placed significant emphasis on the development of Ireland as a knowledge economy. As educators, we are convinced that design and creativity in engineering and product design education will be the key driver in this strategic goal. The European Commission clearly sees the power and potential of design as a driver for growth and competitiveness and has set up the European Design Innovation Initiative (EDII) in 2011 to:

- raise the awareness of design as a driver of innovation in Europe
- enhance its role as a key discipline to bring ideas to market

transforming them into user-friendly and appealing products, processes or services by enterprises and public services in the EU.
The European Commission will promote wider use of industrial design as well as other non-technological innovations for developing high value products, increasing productivity and improving resource efficiency. Design and Innovation enables a virtuous cycle of competitiveness which improves productivity, boosts demand, reduces cost, provides increased revenue and a ready source of reinvestment.

The future is in the hands of the students we educate. The educational experiences of these aspiring professionals in our universities and institutions will largely define their subsequent efforts to create a new and vibrant vision for the Europe and the World. If we are to commence on an upward trajectory there is no better time for a wide ranging discussion on how engineering design education can lead to the development of a brighter, stronger and more stable future. Innovative design, initiated and nurtured within the education process, can contribute greatly to economic recovery and growth. This central theme of Design Education-Growing our Future provides the thinking behind the principle objectives of the conference, namely:

- Provide a broad forum for designers of all disciplines and vocations
- Explore how design education may best promote and encourage sustainable growth
- Seek innovative solutions to a better world through ‘best practices’ in engineering design
- Encourage innovation through industrial collaboration
- Embed the methodology of design in our curricula
- Discuss how design education may best be used to influence economic recovery and growth
- Explore the broadening and expanding of student experience through international exchange
- Discuss the role designers may play in influencing our economic and political future

**Conference programme**

Thirty countries will be represented at the Conference this year. 271 contributions were received which explored the full depth and diversity of the conference theme. After reviewing abstracts, full paper submissions and subsequent revisions 139 contributions were selected to be included in the proceedings, of which 23 will be poster presentations at the conference. The accepted papers allowed the committee to build a conference programme with a number of major streams including; Design Methodology, Sustainability, Creativity, Design Education and Business, Design Education in Industry, Best Practice in Design Education. As such, the programme covers the issues and meets the needs that arose when the conference theme was defined.
Our keynote speaker Professor Dr Larry Leifer, Stanford University is a Professor of Mechanical Engineering Design and founding Director of the Center for Design Research (CDR) at Stanford University. Once a design student himself at Stanford University, he has instigated many design initiatives at Stanford including the Smart-Product Design Program, Stanford-VA Rehabilitation Engineering Center, Stanford Learning Laboratory, and most recently the Center for Design Research (CDR).

**Conference host**

E&PDE 2013 is hosted by the School of Manufacturing & Design Engineering in Dublin Institute of Technology (DIT). The School has a strong and vibrant design ethos and offers Honours Degree Programmes in Product Design, Manufacturing & Design Engineering and Medical Device Innovation.

DIT is currently based on six campus sites in the city centre but within five years will relocate all its activities to a new education and research campus at Grangegorman. The new campus will be a unique innovation hub for the Dublin region, with education, research and health facilities co-located with industry, business incubation and community enterprise, and with European centres for international universities. It is expected DIT will have the first student cohort in the new campus in September 2014.

In preparation for the new campus, the Institute was reorganised in 2009, aligning programme provision into four new Colleges; Arts & Tourism, Business, Engineering & Built Environment and Sciences & Health.

Hosting E&PDE 2013 will provide a platform to showcase the design programmes in the school and to provide the opportunity for DIT to become a more relevant and visible stakeholder to the educational, academic and industrial domains both nationally and internationally.

**Acknowledgements**

This 2013 edition of the E&PDE conference was made possible through the commitment and efforts of many people. I would like to thank Chris McMahon, Ahmed Kovacevic, William Ion, Judith Grace, Brian Parkinson and Erik Bohemia for their excellent leadership in organizing this conference and their dedication to the common cause: guaranteeing a conference series of growing quality and impact. I am grateful for having had the opportunity to work with Alison Parker from the Institution of Engineering Designers, the work of organising the conference would have been much more onerous without the practical support, hands-on experience and in-depth knowledge which Alison provided. To Nadine a big thank you for your administrative work particularly the onerous task of proof reading the author contributions.

EPDE 2013
I would sincerely like to thank all the members of the International Academic Review Board. They succeeded in the timely review of a vast number of papers, while retaining a true professional and academic stance on the intrinsic value and qualities of all papers submitted.

I am really indebted to Azeeta Seery and Donna Brogan from the Irish Tourist Board (Fáilte Ireland) who were a great help in printing conference flyers, funding our participation in the Antwerp Conference and providing conference bags. The Director & Dean of the College of Engineering & Built Environment was generous in providing funding to refurbish the conference area while Tom Corrigan, Dean of Craft Education & Training made a significant contribution by opening doors of opportunity to progress the necessary infrastructural improvements.

Naturally, I would like to express my gratitude to all colleagues from the School of Manufacturing & Design Engineering – especially Ger Reilly, Mark McGrath, William Bergin, Robert Simpson and David Tormey from IT Sligo.

On behalf of the conference programme committee;

John Lawlor
Head
School of Manufacturing & Design Engineering
Dublin Institute of Technology
Bolton Street
Dublin 1
Ireland
Conference Programme Committee

Erik Bohemia  Design Education Special Interest Group (DESIG)
Judith Grace  Institution of Engineering Designers
William Ion  Design Education Special Interest Group (DESIG)
Ahmed Kovacevic  Design Education Special Interest Group (DESIG)
John Lawlor  Dublin Institute of Technology
Chris McMahon  Design Society and (DESIG)
Brian Parkinson  Institution of Engineering Designers
Ger Reilly  Dublin Institute of Technology

Local Organisation Committee at Dublin Institute of Technology

William Bergin
John Lawlor
Mark McGrath
Michael Ring
Ger Reilly
Robert Simpson

International Academic Review Board

Sebastian Adolphy  Fraunhofer Institute for Production Systems
Aliresa Ajdari  University of Tehran
Ermanno Aparo  Polytechnic Institute of Viana do Castelo
Bjørn Baggerud  NTNU
Anders Berglund  Royal Institute of Technology, KTH
Hilde Osteraas Berntsen  NTNU
Richard Bibb  Loughborough University
Guy Bingham  Loughborough University
Erik Bohemia  Loughborough University
Casper Boks  NTNU
Lyndon Buck  Buckinghamshire New University
Hernan Casakin  Ariel University Center of Samaria
Peter Childs  Imperial College London
Derek Covill  University of Brighton
Leon Cruikshank  Lancaster University
Steve Culley  University of Bath
Guido De Grande  Artesis University
Ian de Vere  Swinburne University of Technology
Chris Dowlen  London South Bank University
Joze Duhovnik  University of Ljubljana
Kevin Edwards  Aston University
Arthur Eger  University of Twente
Wouter Eggink  University of Twente

EPDE 2013  XXV
International Academic Review Board cont.
Kaare Eriksen Aalborg University
Michael Evatt IED
Bob Eves Bournemouth University
Nusa Fain University of Strathclyde
Ana Filomena Curralo Polytechnic Institute de Viana do Castelo
Peter Ford De Montfort University
Geert Frateur Artesis University College Antwerp
Nigel Patrick Garland Bournemouth University
Detlef Gerhard Vienna University of Technology
Michele Germani Università Politecnica delle Marche
Carolina Gill Ohio State University
Deshinder Singh Gill University of Brighton
Mey Goh Loughborough University
Hilary Grierson University of Strathclyde
Tore Gulden Oslo og Akershus University College of Applied Sciences
Malte Hinsch Institute for Engineering Design
Peter Hogarth DESIG
Bengt Yngve Homqvist Lulea University of Technology
Bryan Howell Brigham Young University
Tania Humphries-Smith Bournemouth University
William Ion University of Strathclyde
Doris James Icesi University
Toni-Matti Karjalainen Aalto University
Tim Katz University of Brighton
Ahmed Kovacevic City University London
Steve Lambert University of Waterloo
Lau Langeveld Delft University of Technology
John Lawlor Dublin Institute of Technology
Tatjana Leblanc University of Montreal
Colin Ledsome IED
Timo Lehtonen Tampere University of Technology
Andre Liem NTNU
Debra Lilly Loughborough University
Blaine Lilly Ohio State University
Udo Lindemann TU Munich
Julian Lindley University of Hertfordshire
Derek Little University of Strathclyde
Joaquim Lloveras Technical University of Catalonia (UPC)
Jennifer Loy Griffith University
Mark McGrath Dublin Institute of Technology
Alison McKay University of Leeds
Dennis McKeag University of Ulster
Chris McMahon University of Bristol

XXVI                 EPDE 2013
Luis Mejia
Carlos Alberto Montana
Hoyos
Richard Morris
Aede Hatib Musta’amal
Eddie Norman
David Oswald
Brian Parkinson
Gert Pasman
Neven Pavkovic
Architecture, Croatia
Viviana Polo
Luis Pons Puiggros
Alun John Price
Keith Robert Pullen
Lucia Rampino
Mamata N Rao
Ger Reilly
Michael Ring
Sergio Rizzuti
Paul Rodgers
Dosun Shin
Robert Simpson
Liliana Soares
Darren Southee
Brian Stone
Megan Strickfaden
Ian Stroud
Lee Styger
David Tormey
Svetlana Usenyuk
Stijn Verwulgen
Michael Vielhaber
Markus Voss
Craig Whittet
Andrew J. Wodehouse
Bruce MacLeod Wood
Seda Yilmaz
Wim Zeiler
Icesi University
University of Canberra
University of Brighton
Universiti Teknologi Malaysia
Loughborough Design School
HTW Berlin University of Applied Science
IED
Delft University of Technology
Faculty of Mechanical Engineering and Naval Architecture, Croatia
Universidad de San Buenaventura
University Hospital of Vall de Hebron, Health Institute of Catalonia
Edith Cowan University
City University
Politecnico de Milano
National Institute of Design, India
Dublin Institute of Technology
Dublin Institute of Technology
University of Calabria
Northumbria University
Arizona State University
Dublin Institute of Technology
Polytechnic Institute of Viana do Castelo
Loughborough University
The Ohio State University
University of Alberta
EPFL
Sydney Business School
Dublin Institute of Technology
Aalto University
Artesis Hogeschool Antwerpen
Saarland University
DHBW Baden-Wuerttemberg Cooperative State University
Glasgow School of Art
University of Strathclyde
Glasgow Caledonian University
Iowa State University
TU Eindhoven
The Design Society is an international non-governmental, non-profit making organisation whose members share a common interest in design. It strives to contribute to a broad and established understanding of all aspects of design, and to promote the use of results and knowledge for the good of humanity. The Design Society was founded in 2000, taking on the previous activities and responsibilities of the Workshop Design Konstruktion (WDK) Society, especially the organisation of the International Conference on Engineering Design (ICED) series of conferences, which had been running since 1981. Since 2000 the Society has organised ICED conferences in Stockholm, Melbourne, Paris, Stanford and Copenhagen, with the 2013 event planned for Seoul. It has also expanded with members from forty countries and with further very popular events such as the Engineering and Product Design Education conferences and the International Conference on Design Creativity among many other activities. The Society is very active in publishing papers and proceedings on design topics, and it has a developing portfolio of other design resources available to members including a repository of theses and collaborative agreements with a number of design research journals. The Design Society concentrates on activities that transcend national boundaries, and, where possible, will seek to complement national activities. The objects of the Society are to promote the development and promulgation of understanding of all aspects of design across all disciplines by

- creating and evolving a formal body of knowledge about design;
- actively supporting and improving design research, practice, management and education;
- promoting co-operation between those in research, practice, management and education;
- promoting publications and their dissemination;
- organising international and national conferences and workshops;
- establishing Special Interest Groups and other specialist activities;
- co-operating with other bodies with complementary areas of interest.

The Design Society is a charitable body, registered in Scotland, number SC 031694. Registered Company Number: SC401016

The Design Society is open to new members. www.designsociety.org

XXVIII
Established in 1945, Incorporated by Royal Charter in 2012, the Institution of Engineering Designers is the only organisation in the UK to represent those working in the many fields of engineering and product design.

Our members enjoy a range of benefits, including advice on professional codes of conduct, a job board, regular newsletters to keep members up to date with relevant developments and events and a helpful legal advice line. We host regular events which offer our members the chance to network with other professionals and members receive the Institution’s bi monthly journal – Engineering Designer.

We are committed to encouraging CPD for all our members, and support ongoing training and skills development.

We are licensed by the Engineering Council to assess candidates wishing to join the EC’s Register of Professional Engineers and Technicians and we also accredit academic and training courses, both for membership of the Institution and registration with the EC. Those members who achieve the appropriate academic and competence standards receive Chartered Engineer, Incorporated Engineer or Engineering Technician status.

We are also a licensed body of the Society for the Environment and are able to register suitably qualified and competent members as Chartered Environmentalists (CEnv).

We welcome members from any organisation that has a design function and employs design engineers and we have many academic teaching staff in membership. The first step to becoming a member is to register as an Affiliate, you can find out more about becoming a member of the IED at http://www.ied.org.uk