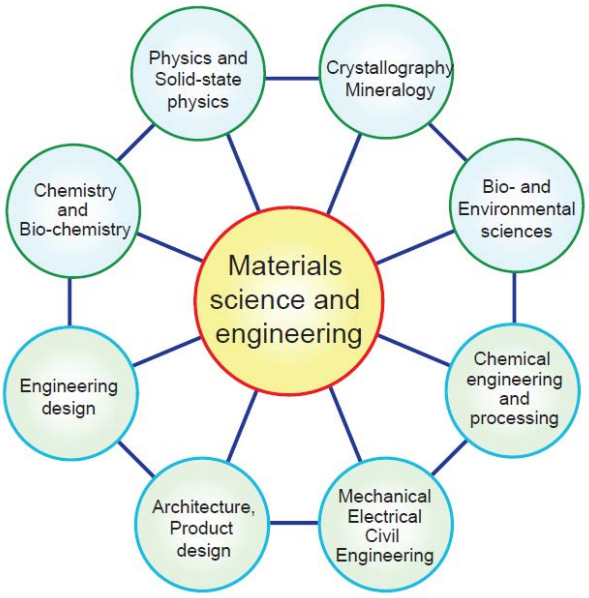
6TH INTERNATIONAL MATERIALS EDUCATION SYMPOSIUM



April 10-11, 2014

Clare College

UNIVERSITY OF CAMBRIDGE

The Symposium is coordinated by Granta Design

GRANTA
MATERIAL INSPIRATION

It is supported by the advisory committee, ASEE Materials Division, ASM International, Cambridge University (Department of Engineering and Department of Materials Science and Metallurgy), SEFI, and FEMS

FEMS

SEFI
European Society for Engineering Education
Europäische Gesellschaft für Ingenieur-Ausbildung
Société Européenne pour la Formation des Ingénieurs

UNIVERSITY OF CAMBRIDGE

ASM INTERNATIONAL
The Materials Information Society

6th International Materials Education Symposium

Clare College
University of Cambridge, UK

April 10-11, 2014

Information Booklet

Section 1:

Participants

Attendee list

(Correct at April 3, 2014)

	Name	Institution	Country	Speaker	Poster	Attending
1	Mr Simon Andrews	Falmouth University	UK		Y	Symposium
2	Ms Jo Anslow	Granta Design	UK			Full Event
3	Mr Victor Arnoux	Granta Design	UK		Y	Symposium
4	Prof Mike Ashby	University of Cambridge	UK	Y		Full Event
5	Dr Giovanni Badini	Granta Design	UK		Y	Full Event
6	Miss Mette Bak-Andersen	Copenhagen School of Design & Technology	Denmark			Symposium
7	Mr Nick Ball	Granta Design	UK			Full Event
8	Mr Lars Bark	Mälardalen University	Sweden			Full Event
9	Dr Alain Bataille	Université d'Artois	France		Y	Advanced Course & Symposium
10	Prof Matteo Bravi	Idromin S.r.l.	Italy			Full Event
11	Prof Yves Brechet	CEA	France	Y		Symposium
12	Dr Oana Bretcanu	Newcastle University	UK			Symposium
13	Prof Bruno Buchmayr	Montanuniversität Leoben	Austria		Y	Full Event
14	Mr Mattias Calmunger	Linköping University	Sweden		Y	Symposium
15	Dr Nihed Chaâbane	Institut National des Sciences et Techniques Nucléaires	France		Y	Symposium
16	Dr Beth Cope	Granta Design	UK			Symposium
17	Dr Patrick Coulter	Granta Design	UK			Symposium
18	Dr Jonathan Cullen	University of Cambridge	UK	Y		Symposium
19	Ms Rebecca De Rafael	Granta Design	UK		Y	Full Event
20	Dr Frederik de Wit	The Hague University of Applied Sciences	The Netherlands			Full Event
21	Ms Gema Diaz	Granta Design	UK			Symposium
22	Prof Rian Dippenaar	University of Wollongong	Australia			Symposium
23	Prof Annett Dorner-Reisel	University of Applied Sciences Schmalkalden	Germany			Advanced Course & Symposium
24	Dr Kari Dufva	Mikkeli University of Applied Sciences	Finland			Full Event
25	Dr David Embury	McMaster University	Canada	Y		Symposium
26	Mr Mats Eriksson	University West	Sweden		Y	Symposium
27	Ms Janna Fabris	UBC Composites Research Network	Canada	Y		Symposium
28	Mr Udo Fekken	Hanzehogeschool Groningen	The Netherlands			Symposium
29	Prof Lucia Fernández	Universitat Politecnica de Catalunya	Spain			Full Event
30	Dr Didac Ferrer	Universitat Politècnica de Catalunya	Spain	Y		Symposium
31	Ms Magda Figuerola	Granta Design	UK		Y	Full Event
32	Dr Claes Fredriksson	Granta Design	UK		Y	Full Event

33	Ms Abbie Fung	Granta Design	UK			Full Event
34	Dr Fernando Gimeno	Centro Universitario de la Defensa de San Javier	Spain		Y	Symposium
35	Prof Stephané Godet	Universite Libre de Bruxelles	Belgium			Symposium
36	Prof Peter Goodhew	University of Liverpool	UK	Y		Symposium
37	Dr Alec Goodyear	The Open University	UK			Symposium
38	Mr Stéphane Gorsse	ICMCB-CNRS	France			Symposium
39	Dr Ion-Cosmin Gruescu	University of Lille 1	France	Y	Y	Symposium
40	Dr Peter Hammersberg	Chalmers University of Technology	Sweden			Full Event
41	Mr Tony Hayward	Birmingham City University	UK			Symposium
42	Prof John Ion	Malmö University	Sweden			Symposium
43	Mr Jaime Juan Muñoz	Barcelona Tech	Spain		Y	Symposium
44	Dr Ron Kander	Philadelphia University	USA	Y		Full Event
45	Prof Maria Kocsis Baan	University of Miskolc	Hungary		Y	Symposium
46	Dr Yoke Chin Lai	VIA University College	Denmark			Symposium
47	Ms Rachel Lawler	Materials World Magazine	UK			Symposium
48	Mr Henrik Lekryd	Mälardalen University	Sweden			Full Event
49	Mrs Laura Leyland	Birmingham City University	UK			Symposium
50	Mrs Xinxin Li	University of Science and Technology Beijing	China	Y	Y	Full Event
51	Mr Li Liu	University of Science and Technology Beijing	China			Full Event
52	Mr Christian Lystager	KEA	Denmark			Full Event
53	Dr Ian Mabbett	Swansea University	UK	Y		Symposium
54	Miss Mette Marko	Copenhagen school of Design and Technology	Denmark			Symposium
55	Ms Hannah Melia	Granta Design	UK		Y	Full Event
56	Mr John Metcalf	Sheffield Hallam University	UK		Y	Advanced Course & Symposium
57	Prof Mark Miodownik	UCL	UK	Y		Symposium
58	Dr Patricia Muñoz de Escalona	University of Strathclyde	UK			Full Event
59	Prof Martinho Oliveira	Universidade de Aveiro	Portugal		Y	Symposium
60	Prof Raymond Oliver	Northumbria University	UK		Y	Symposium
61	Dr Javier Orozco Messana	UPV	Spain	Y		Symposium
62	Dr Ana Pereira	Granta Design	UK		Y	Full Event
63	Mrs Lili Persson	VIA University College	Denmark			Symposium
64	Dr Liliana Pires	Universidade de Aveiro	Portugal			Symposium
65	Prof Dmitry Podgorny	National University of Science and Technology "MISIS"	Russia			Full Event

66	Prof Srinivasa Ranganathan	Indian Institute of Science	India	Y		Advanced Course & Symposium
67	Prof Vasco Rato	ISCTE-University Institute of Lisbon	Portugal			Full Event
68	Prof Timothy Raymond	Bucknell University	USA		Y	Symposium
69	Prof Philippe Revel	UTC	France		Y	Symposium
70	Prof Steffen Ritter	Reutlingen University	Germany			Symposium
71	Dr John Robertson-Begg	University of Derby	UK	Y		Symposium
72	Mrs Nuria Salan	UPC-BarcelonaTECH	Spain	Y		Symposium
73	Prof Richard Schilling	Reutlingen University	Germany			Symposium
74	Prof Jordi Segalas	Universitat Politècnica de Catalunya	Spain			Symposium
75	Mr Mikael Segersäll	Linköping University	Sweden		Y	Symposium
76	Dr Hugh Shercliff	University of Cambridge	UK			Full Event
77	Dr Islam Shyha	Northumbria University	UK			Full Event
78	Dr Arlindo Silva	Instituto Superior Técnico	Portugal		Y	Symposium
79	Prof Jian Song	Hochschule Ostwestfalen-Lippe	Germany		Y	Symposium
80	Mr Jon Stenz	KEA	Denmark			Full Event
81	Miss Elena Tejado	UPM	Spain		Y	Symposium
82	Prof Erik Tempelman	TU Delft	The Netherlands	Y		Symposium
83	Mrs Louise Turner	Open University	UK			Symposium
84	Dr Olga Ushakova	National University of Science and Technology "MISIS"	Russia			Full Event
85	Dr Tatiana Vakhitova	Granta Design	UK		Y	Full Event
86	Mr Marcel van Varik	INHOLLAND University of Applied Sciences	The Netherlands		Y	Advanced Course & Symposium
87	Prof Frederic Veer	TU Delft	The Netherlands	Y		Symposium
88	Mr Teppo Vienamo	Aalto University	Finland			Symposium
89	Dr Mircea Voda	University of Lille 1	France		Y	Symposium
90	Prof John Wang	National University of Singapore	USA			Symposium
91	Dr Ben Wang	Georgia Tech Manufacturing Institute	USA			Symposium
92	Mr Steve Warde	Granta Design	UK			Full Event
93	Ms Katherine Whalen	TU Delft	The Netherlands	Y		Symposium
94	Mr Nicholas Woodfine	Southampton Solent University	UK			Symposium
95	Dr Shoufeng Yang	University of Southampton	UK			Full Event
96	Dr Chuck Zhang	Georgia Tech Manufacturing Institute	USA			Symposium
97	Mr Zhiyi Zhao	University of Science and Technology Beijing	China			Full Event

Section 2:

Agenda

At-A-Glance Agenda & Locations

TIME	*EVENT*	*VENUE*
***TUESDAY**: INTRODUCTORY SHORT COURSE*		
9:30 am	Registration & Refreshments	**Cambridge University Engineering Department (CUED)**
10:30 am	Course Starts	
12:30 pm	Lunch	
3:00 pm	Coffee & Refreshments	
5:30 pm	Course closes	
Evening	Free evening	*(see **maps** for dinner venues in Cambridge)*
***WEDNESDAY**: ADVANCED SHORT COURSE*		
8:45 am	Registration & Refreshments	**Cambridge University Engineering Department (CUED)**
9:00 am	Course Starts	
10:45 am	Coffee & Refreshments	
1:00 pm	Lunch	
3:30 pm	Coffee & Refreshments	
4:30pm	Course closes	
4:30 – 5:30pm	CES EduPack Development Team Meeting	
6:30 pm	Presenters gather for punting/Free evening	**Meeting Point – by Clare College Bridge** *If you have not signed up to arrive by punt please meet us at Magdalene College at 7pm*
7:00 pm	Presenters Dinner/Free evening	**Magdalene College, Cambridge, CB3 0AG**
***THURSDAY**: SYMPOSIUM, DAY ONE*		
8:00 am	Registration, Refreshments and Poster setup	**Clare College**, The Gillespie Centre, *Garden Room*
8:45 am	Symposium Day One Starts	**Clare College**, The Gillespie Centre, *Riley Auditorium*
9:55-10:30 am	Poster Teasers	
10:30-11:25 am	Poster Session & Refreshments	**Clare College**, The Gillespie Centre, *Garden Room and Elton-Bowring Room*
12:30-2:15 pm	Lunch and Poster Session	
3:35-4:15 pm	Afternoon Tea & Poster Session	
5:30 pm	Symposium Day One Closes	**Clare College**, The Gillespie Centre, *Riley Auditorium*
7:00 pm	Symposium Dinner/Free Evening	**Clare College**, The Great Hall
***FRIDAY**: SYMPOSIUM, DAY TWO*		
8:15 am	Registration, Refreshments	**Clare College**, The Gillespie Centre, *Garden Room*
9:00 am	Symposium Day Two Starts	**Clare College**, The Gillespie Centre, *Riley Auditorium*
9:55-10:45 am	Poster Session & Refreshments	
12:30-2:00 pm	Lunch and Poster Session	**Clare College**, The Gillespie Centre, *Garden Room and Elton-Bowring Room*
3:20-4:00 pm	Afternoon Tea & Poster Session	
5:15 pm	Symposium Day Two Closes	**Clare College**, The Gillespie Centre, *Riley Auditorium*
SATURDAY		
10:30am	Walking Tour of Cambridge	**Meet in front of the Guildhall**

Please see **Section 5** for maps and more details on venues.

Symposium Day One: Thursday April 10, 2014

LOCATION: GILLESPIE CENTRE, CLARE COLLEGE, CAMBRIDGE UNIVERSITY

8.00 am	Registration, Coffee, and Poster setup
8.45 am	Welcome Address
	SESSION 1: MATERIALS AND SUSTAINABILITY Session Chair: **Prof. Peter Goodhew**, University of Liverpool and Derby, UK
9.00 am	Session Introduction
9.05 am	**Prof. Yves Bréchet** – Grenoble-INP & Atomic Energy and Alternative Energies Commission, France *Sustainability and nuclear energy: materials issues*
9.30 am	**Prof. Mike Ashby** – Engineering, University of Cambridge, UK *Materials in a Systems-dominated, Resource-constrained world*
9.55 am	**Poster Teasers** Poster Presenters invited to give a one minute presentation about their poster
10.30 am	Coffee and Introductions **Poster Session**
11.25 am	**Dr. Jonathan Cullen** – Engineering, University of Cambridge, UK *Sustainable materials: with both eyes open*
11.50 am	**Dr. Didac Ferrer** – Sustainability Science and Technology, Universitat Politècnica de Catalunya *Is this technology more sustainable?*
12.15 pm	Session discussion led by the session chair
12.30 pm	Lunch **Poster Session continued** (starts 1.00 pm)
	SESSION 2: MATERIALS AND DESIGN Session Chair: **Dr. Hugh Shercliff**, University of Cambridge, UK
2.15 pm	Session Introduction
2.20 pm	**Prof. Mark Miodownik** – Director, Institute of Making, University College London, UK *Experiments promoting multidisciplinary materials research*
2.45 pm	**Dr. Frederic Veer** – Materials Science, Delft University of Technology, Netherlands *Using CES EduPack to look at materials which can be developed for future needs*
3.10 pm	**Dr. Erik Tempelman** – Industrial Design Engineering, Delft University of Technology, Netherlands *Manufacturing and Design – towards a new educational paradigm*
3.35 pm	Coffee/Afternoon Tea **Poster Session continued**
4.15 pm	**Prof. Peter Goodhew** – Universities of Liverpool and Derby, UK *Updating the textbook*
4.40 pm	**Prof. Srinivasa Ranganathan** – Department of Materials Engineering, Indian Institute of Science, Bangalore, India *The Coming of Archaeological Materials Science*
5.05 pm	Session and day discussion led by the session chairs
5.25 pm	Concluding remarks
5.30 pm	Close

Evening

Formal Symposium Dinner: Clare College, Old Court, Drinks Reception at 7:00pm.

Symposium Day Two: Friday April 11, 2014

LOCATION: GILLESPIE CENTRE, CLARE COLLEGE, CAMBRIDGE UNIVERSITY

8.15 am	Registration, coffee, and poster setup
	SESSION 3: MATERIAL SYSTEMS Session Chair: **Prof. Bill Clyne**, University of Cambridge, UK
9.00 am	Session Introduction
9.05 am	**Dr. Ronald Kander** – Executive Dean, Kanbar College of Design, Engineering and Commerce, Philadelphia University, USA *Teaching Systems Thinking: Why, What & How*
9.30 am	**Janna Fabris** – Department of Materials Engineering, The University of British Columbia, Canada *Composite Process Design – The need for a systematic and structured approach*
9.55 am	Coffee and Introductions **Poster Session**
10.45 am	**Prof. David Embury** – McMaster University, Canada *The Automobile as a catalyst for the development of Materials*
11.10 am	**Dr John Robertson-Begg** – School of Engineering and Technology, University of Derby, UK *Reframing petrol heads – encouraging motorsport students to think about sustainability*
11.35 pm	**Dr. Xinxin Li** – University of Science and Technology Beijing, China *Virtual Internship for Iron and Steel Making*
12.00 pm	Session discussion led by the session chair
12.30 pm	Lunch **Poster Session continued** (starts 1.00 pm)
	SESSION 4: SPARKING INTEREST: INNOVATION IN MATERIALS TEACHING Session Chair: **Dr. Noel Rutter**, University of Cambridge, UK
2.00 pm	Session Introduction
2.05 pm	**Dr. Javier Orozco Messana** – Universitat Politècnica de València, Spain *Teaching Sustainability for Materials in Architecture*
2.30 pm	**Dr. Ion Cosmin Gruescu** – Mechanical Engineering, University of Lille 1 – Sciences and Technology, France *Eco-design tools and materials selection used in innovative industrial design*
2.55 pm	**Katherine Whalen** - Industrial Design Engineering, Delft University of Technology, Netherlands *Exploring Sustainable Design and Material Criticality through a Game-based Approach*
3.20 pm	**Poster Session continued** Coffee/Afternoon Tea
4.00 pm	**Dr. Núria Salán** – RIMA-GIDMAT (Materials Science and Technology Community of Practice), Spain *Active Methodologies: Making Materials Science & Technology Attractive in Engineering Studies*
4.25 pm	**Dr. Ian Mabbet** – Baglan Bay Innovation & Knowledge Centre, UK *Raising awareness of materials education to expand the undergraduate talent pool*
4.50 pm	**Prof. John Wang** – Materials Science & Engineering, National University of Singapore, *Introduction to the 1st Asian Materials Education Symposium*
4.55 pm	Session and day discussion led by the session chairs
5.10 pm	Concluding remarks
5.15 pm	Close

2015 Symposium – next year's event is tentatively scheduled for April 9-10.

Please use the evaluation forms to let us know of your interest, and whether these dates are suitable.

Section 3:

Presentation Abstracts

Day One: Thursday April 10, 2014

Day One, 9:05am

Sustainability and Nuclear Energy: Materials Issues

Y. Brechet
Grenoble-INP & Atomic Energy and Alternative Energies Commission, France

In a context of global warming, producing electricity via nuclear power is a major asset to limit greenhouse gases. However, sustainability of such energy production remains an issue. Sustainability can be understood in terms of fuel resources as well as in terms of waste management. Standard nuclear reactor using Uranium and thermal neutrons are facing limitations in terms of uranium resources. Fast breeders and thorium cycle are possible solutions for this problem. Both of them present materials selection problems, both for the cooling fluid, and for structural materials. The issue of waste management also requires a sustainable development. Relying on engineered solutions as in Sweden, or on geological confinement, as in France, will also raise materials selection issues.

Day One, 9:30am

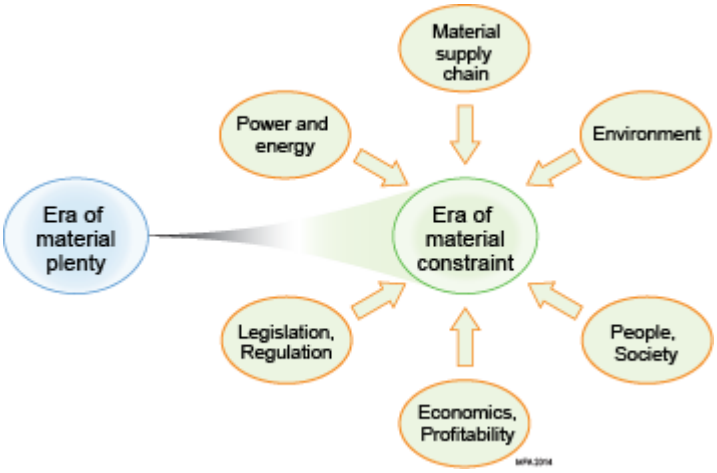
Materials in a Systems-dominated, Resource-constrained world

M. Ashby
University of Cambridge, UK

What will our students be doing 10 years from now? Teaching and research, like us? A few. Far more will be employed in materials-dependent industries; many of these will assume managerial roles charged with managing materials-related risk.

Over much of the last century material supply was not (with occasional exceptions) a major issue. Trade tended to be national rather than global. Material prices, in real terms, were static or falling. There was relatively little control over the way materials were used or what happened to them at the end of product life. Corporate priorities focussed on profitability and financial returns to shareholders.

Today the picture looks rather different. The increasing complexity of products creates a dependence on a larger number of elements, some comparatively rare. These are sourced globally and used to make products that are traded on a global scale. Manufacturing nations increasingly compete for exclusive rights to minerals resources world-wide in order to safeguard their industrial capacity. New and expanding legislation controls many aspects of manufacturer responsibility, product design, material usage and material disposal. The public, stakeholders and government increasingly judge corporate success not just in financial terms but in terms of stewardship of the environment and welfare of its workforce and that of the local economy of the communities in which it operates. Corporations respond by issuing Sustainability Reports detailing their attention to Corporate Social Responsibility (CSR).



Thus a significant role of the Materials Engineer is now likely to be dominated by issues such as:

- Adapting to, and complying with environmental and other material-related legislation
- Managing the material supply chain, particularly where "critical" materials are involved
- Contingency planning to cope with material constraints and price volatility
- Helping the company to adapt to a circular materials economy

In short, it is probable that many of our students will be involved with materials risk-management.

To what extent should our materials teaching respond to these changes? This talk explores some of the issues and provides some ideas and schematics to help explain them to students. My hope that this will stimulate a discussion and sharing of views on how to adapt our teaching to include these global issues.

Day One, 11:25am

Sustainable Steel: With Both Eyes Open

J. Cullen
University of Cambridge, UK

Our society is addicted to steel. Global demand for steel has risen to more than 1.5 billion tonnes a year, or 250kg per person per year, and is predicted to at least double by 2050. The steel industry generates nearly a 10% of the world' s energy related carbon dioxide emissions, and meeting a 50% cut emissions by 2050, against a doubling in demand, will require a 75% reduction in emissions for every tonne of steel produced. Process efficiency improvements are unable to deliver such a large cut in emissions. However, if steel can be used more efficiently, thus delivering the same services with less steel, then the targeted emissions reduction becomes possible.

This talk reflects on a 5-year journey with the steel industry to present demand reduction as a credible option for reducing emissions. It will describe how using cross-industry engagement, evidence based arguments, clear messages and a good deal of persuasion, we were able to help slowly shift opinions and present the idea of demand reduction as a viable option.

Day One, 11:50am

Sustainability Science and Technology

D. Ferrer, J. Segalàs, M. F. Ashby
Universitat Politècnica de Catalunya, Spain

Teaching sustainability to engineering students is critical and needs structured methodologies in order to evaluate how sustainable are technological solutions and what sustainability articulations are taken in account. The first author coordinates the subject Sustainable Design, a 5 ECTS subject within the Master degree in Sustainability Science and Technology run at UPC Barcelona Tech University. The subject uses constructive and community oriented learning for sustainable design. It is organized around three axes: Strategies, Tools and Projects. First, students are introduced to sustainable design strategies principles, like Eco-design, Cradle to Cradle, Biomimicry, Design for sustainable Behaviour, Social Design and Product Service Systems. Second, students have to learn sustainable design tools, and in that purpose they use CES EduPack 2013 using the new sustainability database that integrates social and environmental awareness into various aspect of engineering, science, or design. It is based in the 5 steps approach: Prime objective and scale; Stakeholders analysis; Fact-finding; Integration and Reflection on alternatives. Finally, students apply the approach to a contextualized project taking into consideration the sustainable strategies available.

During the academic year 2012-13 a pilot using this methodology was carried out in the subject. Students' learning was evaluated using an individual learning portfolio, a project evaluating rubric and a Students' Evaluation of Education Quality questionnaire. After taking the subject students appreciated the methodology as a holistic and practical approach to exploring sustainability. They commented that it gives guidance and focus while tackling the complexity of the task. They thought the CES EduPack Level 3 Sustainability database helped to save time and find relevant information. They greatly appreciated the continuous feed-back from the teachers after each phase. This paper presents a new teaching method and a supporting tool to be used in a systematic manner in engineering, design and materials courses. The first trials with teachers who were familiar with sustainability concepts reveal it to be useful, as it brings focus, guidance and concrete tools to the students and instructors.

In autumn 2013, new pilot experiences are being carried out at two different levels: First year Bachelor students and Master Final Thesis. The suitability of the methodology is going to be studied and the outcomes will be also introduced the spring symposium.

Day One, 2:20pm

Experiments promoting multidisciplinary materials research

M. Miodownik
University College London, UK

In March 2013 we opened the Institute of Making, a place dedicated to promoting the study of materials and making with University College London. The institute is a multidisciplinary research club for those interested in the made world: from makers of molecules to makers of buildings, synthetic skin to spacecraft, soup to diamonds, socks to cities. We believe that materiality is central to all disciplines and activities, and our role is to be a central node in the university where discipline specialists can meet and collaborate. We recognise that a university is more than a just community of scholars, and staff of all kinds are both interested in research and can contribute to it. Thus membership is free to anyone in the university from students to professors, and from cleaners to finance directors. The institute contains a workshop, materials library, a full set of tools from mechanical to electronic, from textile and digital, from playful to exact. We run seminars, master-classes, research sand pits, but most importantly allow our members full use of the space to conduct their own research projects. Since opening more than thousand members have joined from all parts of the university from architecture to materials science, from anthropology to chemistry, from archaeology to medicine. In this talk I discuss the research and the community that has grown up in this new experimental space, and reflect on our successes and our failures.

Day One, 2:45pm

Using CES EduPack to look at materials which can be developed for future needs

F. Veer
Delft University of Technology, Netherlands

The strong point about CES EduPack is the abundance of data about existing materials. Where existing materials do not meet the needs of the engineer in part or completely new materials can be designed.

The synthesizer tool introduced in CES EduPack 2013 allows the user to look at possible materials for innovative structures.

At Delft University architectural engineering department a course on structural design with glass was started in 2013. This course is given to both architectural engineering and civil engineering students as an elective in the master programme. At the end of the course a workshop is introduced where students look at the problems with structural materials. Analyse the problem in terms of what performance the material should have in terms of material index and in terms of material shape and processing route.

CES EduPack is used to analyse the problem, find which materials have suitable properties and thus find a route to design a material or composite that would function better. The synthesiser tool is one of the tools used for this. The eco tool is used to analyse the environmental impact of the designed material/composite.

The results of two workshops are described and the advantages of using CES EduPack to stimulate thinking about future materials is discussed. Suggestions for further development are given.

Day One, 3:10pm

Manufacturing and Design – towards a new educational paradigm

E. Tempelman[1], H. Shercliff[2], B. Ninaber van Eyben[1]
[1]Delft University of Technology, Netherlands, [2]University of Cambridge, UK

The study of manufacturing processes presents an excellent opportunity to (re-) acquaint students with many key concepts from the field of materials science, yet at the same time it presents numerous practical aspects of its own. One consequence is that while some elements of design for manufacture can be traced back to material properties and principal limitations, others can only be understood in terms of the technological state-of-the-art. However, existing approaches for teaching about manufacturing and design do not adequately reflect this dual nature of the topic. Similarly, these approaches generally do not make explicit that essentially, 'any design can be manufactured', and that the real question should be 'at what cost, and with which quality' if useful choices for manufacturing processes are to be made. Also, they tend to be encyclopaedic, not equipping the student for life-long-learning, and do not (yet) adequately reflect sustainability considerations.

Taking these considerations as their starting points, the authors present a novel approach towards teaching and learning about manufacturing and design. Key to this approach is rigorous selection to include only the most important processes and process variants, the main theoretical underpinnings, and the essential practical considerations. In this, we consulted a broad range of literature sources and interviewed numerous manufacturing experts and design professionals. The results are now available in textbook format. It guides the student towards understanding the main processes as well as helps in building up insight about less common ones. Also, it systematically addresses sustainability, giving specific attention to recycling operations as 'reverse manufacturing'. It is hoped that this approach may complement or even come to replace the existing teaching and learning paradigm.

Day One, 4:15pm

Updating the Textbook

P. Goodhew
Universities of Liverpool and Derby, UK

Many topics in materials and engineering might be considered factual and the role of the conventional book is largely to transmit and explain technical concepts. This remit has been extended over the past couple of decades by the addition of on-line material to support, illustrate, amplify or formatively assess the subject matter.

However there is a different type of text in which subjective opinion plays a greater role. This is of course commonplace in arts, humanities, and social science, but I believe that there are a number of topics in modern engineering in which attitudes and approaches are amenable to discussion and debate. These might include management topics, ethical issues, engineering education and even current "hot" topics such as sustainability and climate change. Any printed version of a book which includes such topics is immediately frozen at a point in time with a particular set of attitudes, approaches and examples.

I have therefore identified a need for a "commentable" book. Ideally this would be an original text, produced in the conventional way by one or two authors, published on line preferably as an Open Educational Resource (OER) under a Creative Commons licence. The reader would be able to add a comment to any paragraph to provide an alternative point of view or an additional example. Since I believe that a paper book still has value (it's hard to wave a web page at a seminar or read it on a West Coast mainline train!) the on-line version would be linked to a print-on-demand facility.

All the constituent elements of this concept exist – free on-line texts exist; you can comment on the writing of another in googledocs; there are many print-on-demand suppliers – but they do not appear to have been combined in the way I suggest. I have therefore set up a proof-of-concept project to take my existing text "Teaching Engineering" update it as far as I am able, and then publish it as a commentable text. I expect by April 2014 to have made substantial progress on this project and propose to report on the success or otherwise of this experiment.

Day One, 4:40pm

The Coming of Archaeological Materials Science

S. Ranganathan
Indian Institute of Science, India

Conventional materials science characterizaion has been mainly concerned with the investigation of spatial microstructures in three dimensions. This has been expanded with the explosive development of nanoscopy in recent years so that characterization extends down to the atomic level. The tomographic atom probe is a powerful example.

Cyril Stanley Smith laid the foundations of archaeometry by looking at microstructures of specimens from ancient times. This added the time dimensions to our investigations. In the last decade archaeological materials science has become fully established. We will draw examples from our work on wrought iron, wootz steel and high tin bronzes to illustrate the crossing of disciplines so that the materiality of culture can be appreciated.

In addition as ancient materials include natural materials, dyes, pigments and textiles, molecular characterization has become important. The full power of crossing into cultural domains across time in billions of years and space to picometers will be brought out

Day Two: Friday April 11, 2014

Day Two, 9:05am

Teaching Systems Thinking: Why, What & How

R. Kander
Philadelphia University, USA

A system is an interconnected set of elements that is coherently organized in a way that achieves a specific function or purpose. Examples of systems all around us range from complex manmade systems like our automobiles and computers, to biological ecosystems like our bodies and our planet, to complex service systems like universities, hospitals and governments.

In today's world, it is important to teach systems thinking because the challenges we face are becoming more and more complex with time, and more difficult to understand and predict using traditional tools and techniques.

There are two prevailing theories on why humans have so much trouble dealing with complex, highly interconnected systems. One theory is that people are idiots. (This may indeed be true, but it is not a very useful theory and not one I will address in this presentation!) The second theory is that we don't have very good tools to visualize, model and simulate the behavior of complex, highly interdependent systems. More importantly, we also don't have good ways to communicate understandings and insights about complex systems to one another and to key decision makers.

This second theory is the one addressed by a new course at Philadelphia University that is designed to impart "systems thinking" skills to students from a wide range of professional majors from the design, engineering and business disciplines. Students who successfully complete this course are able to explain the major attributes of a system, define the spatial and temporal boundaries of a system, map the interrelationships between variables within dynamic systems, and apply systems thinking tools to recommend solutions to complex real world problems.

The course is taught using VensimPLE, a systems dynamics software package from Ventana Systems (http://www.vensim.com). This is freeware that can be downloaded from the web for educational use, so no student purchase is required. The course also uses a book authored by Donella H. Meadows entitled "Thinking in Systems: A Primer" (Chelsea Green Publishing, 2008).

Day Two, 9:30am

Composite Process Design – The need for a systematic and structured approach

J. Fabris, A. Poursartip
The University of British Columbia, Canada

Managing manufacturing is critical to the success of innovation and technology transformation. Enhancing manufacturing process knowledge is key to remaining competitive; however current engineering design methods inadequately address manufacturing affordability. New methods are required to cope with inherent uncertainty and risk associated with complex engineering system development. The ability to minimize the number of costly mistakes and false starts and replace wasteful 'trial and error' approaches that are often used to bring new products to market would have a tremendous impact on addressing affordability and risk.

The utilization of advanced composites is an excellent example of how the insertion of a promising new technology is threatened by manufacturing risk and uncertainty. Currently all major aerospace OEMs have made significant investments in composite structures; however the current status of composites process design is largely empirical and is based on experience or 'know-how' rather than a scientific basis or 'know-why'. Early adopters of composites process analysis are beginning to recognize the need to transition this knowledge to wisdom. It is apparent that a paradigm shift in current academic research and university teaching practices is required to not only generate fundamental knowledge but to educate, students and practicing engineers alike, of better practices with respect to the utilization of knowledge in design.

Efforts by the Composites Research Network (CRN) to establish a framework that attempts to capture knowledge that is correct, open, usable and useful, link 'know-how' with 'know-why' and commoditize this knowledge in 'knowledge in practice documents' (KPDs) will be presented. The need to formalize a scientific and systematic design strategy for composites manufacturing, based upon a similar approach originally proposed by Ashby to address material and process selection in mechanical design, will be highlighted.

Day Two, 10:45am

The Automobile as a catalyst for the development of Materials

D. Embury
McMaster University, Canada

The conventional view of automobiles from an Ecological viewpoint is that they contribute significantly to climate change, consume fuel resources, and hasten the depletion of raw materials. Nonetheless they are a significant part of the world's manufacturing economy and social aspirations. Thus it is appropriate to examine the role of the automobile in terms of the development and economical utilization of materials and its influence on manufacturing methods. This presentation will outline how the automobile has contributed to the development of materials in terms of the combinations of properties needed to meet a design need. In addition it will examine how the need to fabricate components in an efficient and economical manner has contributed to new approaches to manufacturing leading to more ecological and sustainable uses of materials. Finally it will examine the automobile as an agent to enhance the development of combined structural and functional materials.

Day Two, 11:10am

Reframing petrol heads – encouraging motorsport students to think about sustainability

J. Robertson-Begg
University of Derby, UK

Motorsport students are sometimes seen as people who want to get maximum performance with little regard to the effect their passion has on sustainability and the environment.

A core module delivered in the final year of a three year undergraduate motorsport course is "Advanced Engineering Materials and Applications". This module is also an option on the final year of a manufacturing and production engineering degree that is studied by mainly part time students employed by local industry. An assignment in the 2012/2013 academic year required the cohort to consider sustainable solutions for car body panels.

This paper discusses and evaluates the submissions of the motorsport students in terms of sustainability outcomes and compares these with the submissions of mainly part time students on the manufacturing and production degree.

Students made extensive use of CES EduPack in their work. They were able to use the software to explore sustainability using appropriate materials indices and some used a synthesizer tool to model their own novel materials.

Both groups of students were able to justify their materials selection and confirm these by carrying out simple eco-audits. The manufacturing and production students though showed much more awareness of issues around the processes of actually making the panels and their environmental impact.

The work shows that different groups engineering students can become aware of sustainability but that their previous background and study can influence their holistic thinking abilities.

It is pleasing to note that one of the motorsport students went to work for a renowned motor manufacturer in a job role with specific responsibilities for making interior fittings more sustainable.

Day Two, 11:35pm

Virtual Internship for Iron and Steel Making

X. Li, Z. Zhao
University of Science and Technology Beijing, China

China makes the largest contribution to the global iron and steel output. But it has always been a challenge for engineering students majored in materials, metallurgy and mining to undertake on-the-spot internships at the industry due to economy and safety reasons. Building an integrated steel production platform based on computer simulation technologies may make it possible for students to take virtual internship on campus which is a great complementation for the industry experience. In this paper, we will take internship practice for material students as an example, to present the plan of USTB to build the virtual platform, which gives a more holistic and integrated educational experience to the students. The platform is about to start its construction end of 2013. It will take around 2 years for the whole platform to be ready for use. After being founded, it may accept 2 classes with maximum 60 engineering students or industry trainees to take virtual internship at the same time. The virtual internship may help the university to save huge money and energy for students' field internship. Furthermore, it can also provide a way for the university to help the steel industry to train new employees and undertake joint scientific research with the steel industry.

Day Two, 2:05pm

Teaching Sustainability for Materials in Architecture

J. Orozco Messana
Universitat Politècnica de València, Spain

The use of materials in architecture is lacking a systematic approach allowing the adequate comparison of performance from well-established criteria and international standards. This situation is complex when teaching.

Teaching sustainability in architecture requires a thorough analysis on the concepts of the ecology of contemporary construction, and the relevance for the final user. This effort involves identifying standards, databases and user profiles for defining requirement attributes of our existing anthropogenic stock of buildings while formulating design strategies that contribute to reuse and recycling of building materials and components. After considering all relevant information a Life Cycle Analysis (LCA) approach is introduced for the correct evaluation of materials in the sustainable building.

Materials are compared and ranked from the building systems perspective, through the previously defined LCA approach. The impact of hybrid materials is also explored as an alternative strategy for the architectural use of materials today. At the final stage the relevance of materials in the overall evaluation is performed through charts obtained with the CES Selector 2014.

Day Two, 2:30pm

Eco-design tools and materials selection used in innovative industrial design

I. *C. Gruescu, M. Voda*
University of Lille 1, France

Based on both applied science and art, the industrial design is a creative answer allowing to improve the functionality, aesthetics and usability of products. Consequently, the designer is simultaneously an artiste, a technician, an ergonomist and an inventor. His first task is to impregnate himself with the product, with its technical characteristics and with the consumer needs.

The materials choice and eco-design tools such the life cycle assessment (LCA), allow to the designer to create environmentally friendly and with longer lifetime products.

Taking in account the need of a rigorous approach, based on the coupling between LCA and materials choice, we decided to work with the mechanical engineering students from the Lille 1 University (France) and Politehnica University (Romania) on an innovative design procedure which facilitates the materials choice and allows a simultaneous development of the student's curiosity and technical creativity. Several aspects of this approach are presented hereafter.

The studied product are a Stirling engine and a refrigerator, two products apparently with different complexity: typical for Mechanical Design and one with mechatronic implications. Given that the greening of electronics parts does not necessarily depend only of the product designer, it is shown that both products can be treated in the same manner from the design methodology point of view.

Strictly with respect to the design and to materials choice procedure, the used software is Autodesk Inventor, and the Eco Materials Advisor module associated with it.

The product design is realized by integrating its functional parameters and by performing researches concerning the existing norms, the adapted machining processes or technologies. The materials choice allows the further evaluation of the environmental footprint of the entire manufacturing process, by emphasizing the energy reduction costs. This procedure helps in making better choices in numerous engineering applications and confirm the importance of integrating the environmental footprint criterions in the design of the product.

Day Two. 2:55pm

Exploring Sustainable Design and Material Criticality through a Game-based Approach

K. A. Whalen
Delft University of Technology, Netherlands

Material criticality is often overlooked as a key aspect of sustainable development, partly because that dimension of materials is seldom addressed in design and engineering educational programs. A major challenge in teaching about material criticality is its complex, cross-disciplinary nature. This presentation addresses that challenge by drawing on insight gained from creating and testing a specially developed serious game called In the Loop: The Critical Raw Materials Game, an educational tool that has proven to increase materials awareness among university-level students of product development.

Building on industry case studies and academic research, In the Loop approaches material criticality from a product design perspective and serves as a catalyst for discussion about systems thinking. Because there is no singular, simple solution to dealing with challenges posed by critical materials, the game gives students an opportunity to confront and explore the many facets of material criticality, including those involving product design, engineering, research, supply chains, economics, and business strategy. In the Loop also helps students to make the link between material elements and products (which is necessarily the first step in discussions of material criticality) and to appreciate the criticality of materials from the perspectives of geography, economy, and society. Moreover, by raising questions about the challenges and opportunities associated with scarce resources, the game highlights the value of using design to keep materials in a life cycle that is looped, rather than linear.

Day Two, 4:00pm

Active Methodologies: Making Materials Science & Technology Attractive in Engineering Studies

N. Salán, E. Rupérez, S. Illescas, Y. Torres, J. Llumà, J. Jorba, D. Rodríguez
RIMA-GIDMAT (Materials Science and Technology Community of Practice), Spain

The Bologna Process (BP) and the European Higher Education Area (EHEA) have motivated universities to consider new academic curricula and new actors in the teaching-learning process, where the focus is on the student itself, as an active protagonist of his/her own learning process, on contents and skills. Information and Communication Technologies (ICTs) have provided more flexible teaching activities where text, images, simulations, and videos can be linked for the improvement of the student engagement, participation and comprehension. In the Materials Science & Technology (MS&T)

In this field, ICTs have helped to visualize processes and concepts, as well as to manage big databases oriented to the selection, the design and the process of engineered materials and devices (CES EduPack™). On the other hand, active methodologies can help to make MS&T more attractive for students and trying to get better learning results.

We propose a selection of active methodologies that can be included in "conventional" sessions or could be considered as an alternative to usual lab activities.

Pre & post quiz: This is a questionnaire of 3-4 short questions that are given to the students before a lecture. After the lecture, the same questionnaire is given to the students to answer the questions at the back of the paper.

Aronson's puzzle (jig-jag): It consists of firstly dividing the contents of a theme or activity in 3 or 4 parts, and secondly, each part is given to a group of students to work on it separately. Later, all groups are brought together, which allows the activity to be completed in full. This activity can be adapted with CES EduPack.

Role Playing: activity where students, in groups of 5, play the role of a Junior Materials Engineering Consultant Company that should give professional and accurate advice to the different requests and requirements of a client (role played by the teacher). This activity can be adapted with CES EduPack.

Day Two, 4:25pm

Raising Awareness of Materials Education to Expand the Undergraduate Talent Pool

I. *Mabbet*
Baglan Bay Innovation & Knowledge Centre, UK

One significant challenge in materials education is ensuring ample talented feedstock apply for undergraduate courses in the first place. In many cases KS2 to post-16 materials curricula content is taught with limited experience of the applications and employability within the field.

To address this, lecturing and research colleagues in Swansea initiated an outreach and public engagement programme; Materials Live! This project delivers introduction to materials science and engineering lectures and workshops at all levels, incorporating materials students delivering content at schools and colleges, science festivals or at University facilities, incorporating lab and pilot production line tours.

Materials Live! utilises the 100% satisfaction score at NSS achieved by Swansea materials and highlights extensive links to employers such as Tata, BASF, NSG, ESA and Rolls Royce. Case studies include SPECIFIC-IKC, an industry and academic consortium led by Swansea University to scale up production of coated building materials that generate, store or release renewable energy and the Rolls Royce UTC. Materials is promoted as applied study of chemistry, physics and mathematics to underpin all engineering disciplines and contribute to advanced manufacturing.

The aim is to increase numbers of applications to materials degrees, raise awareness of excellent employability within the field and focus on encouraging more female uptake. In the first seven months the project visited 1269 school children, hosted visits from over 310 and had a footfall at STEM events and science festivals in excess of 65000. This resulted in a 1/3 more students attending Swansea materials UCAS open days and ¼ more students enrolled in 1st year materials degrees. It's anticipated that this will grow further as more young people are engaged and younger pupils that have been reached approach application age. Expansion of the project includes targeted technical partnerships with A level groups and CPD activities for teachers and careers advisors.

Day Two. 4:50pm

Introduction to the 1st Asian Materials Education Symposium

J. Wang
National University of Singapore, Singapore

Find out what's happening in Singapore on December 11-12, 2014

www.materials-education.com/2014/singapore/

Section 4:

Poster Abstracts

Posters

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3	Dr. Annett Dorner-Reisel	University of Applied Sciences Schmalkalden, Germany	Teaching practical properties of biological based materials by using CES EduPack database
4	Dr. Arlindo Silva	Dept. Mechanical Engineering, University of Lisbon, Instituto Superior Tecnico , Portugal	Mechanical engineers' typical misconceptions in materials science, and how to correct them
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Poster Abstracts

Poster 1

Case Study in Ecodesign Education

Alain Bataille
Université d'Artois, France

Hereby the different steps of an ecodesign education project are presented. The case study was a table. Some mechanical specifications were given, i.e. strength, toughness, maximum strain. The students had to determine the stress state of each part of the table. Then they calculated performance indexes according to a minimization of mass and/or embodied energy. Using those performance indexes they selected five different materials. Meanwhile they investigated the related manufacturing processes. They defined some limits of the study and they described life cycle scenarios. Eventually they compared the different materials in terms of environmental impacts aggregated in energy and in carbon footprint. They distinguished the relative importance of the different sequences of the life cycle of the designed object.

Poster 2

Resources to Support Bio-Engineering Teaching and Research

Ana G. Pereira-Medrano, Jorge M. Sobral and Sarah Egan
Granta Design, UK

The field of bio engineering, biomedical engineering and similar biomaterials courses are of great academic interest, especially in the USA and Europe. Already holding advanced databases currently used in the biomedical sector, such as the human biological materials and materials for medical devices, we have compiled a complete set of resources to support bio engineering teaching and research at Universities.

Starting with CES EduPack for undergraduate teaching, the new Bio Engineering edition provides a set of teaching resources has been updated and developed: a completely overhauled database as the foundation, and supportive medical and non-medical case studies. This new editions comprises of two levels:

1) Level 2 for introductory-level courses for biomaterials, which has data on relevant biomaterials for bio engineering applications. This level will help to develop the understanding of natural and naturally-derived materials versus man-made engineering materials. Starts to explore factors important in medical device design. biomimicry, and use of biomaterials as sustainable alternative.

2) Level 3, for advanced-level courses, which comes with an advanced materials database enabling material selection for medical devices. Providing nearly 4,000 materials, this level provides a comprehensive database for advanced teaching and projects in the field of bioengineering.

The poster also provides an overview of our research resources, currently used in the medical devices industry. These include CES Medical Selector™, which is built on the same principles as the software in CES EduPack™. Instead of the extensive teaching resources available in CES EduPack, this provides specialist tools, extensive materials property data, and advanced graphical analysis for industry and research centers. Additionally, there are 2 online libraries of information: the Human Biological Materials Database and ASM Medical Materials Database. Both are ideally suited for in-depth research of biomechanical properties of tissues, in the case of the first one, and screen, analyze, and source candidate materials and coatings for device applications and associated compatible drugs, in the latter one.

Poster 3

Teaching practical properties of biological based materials by using CES EduPack data base

Annett Dorner-Reisel[1], Roman Lieberwirth[1], Stefan Svoboda[1], Tao Wang[2]
[1]University of Applied Sciences Schmalkalden, Germany
[2]Nanjing University of Aeronautics, Peoples Republic of China

In recent times, the interest of students in biological based materials is increasing strongly. It is known, that naturally grown raw materials offer a substantial resource, which is only used by a small fraction at the moment. However, the request as well as the market for "green products" is enormous. Biomaterials, biological based materials development, environmental friendly and integral materials selection seems to touch inherent human needs. This tendency should be further skilled by systematic materials selection and materials development based on tools of the CES EduPack.

Three examples of biological based materials (wool, chitin, chitosan) are given in this poster presentation during the 6th International Materials Education Symposium in Cambridge 2014. The aim is to place emphasis on natural resources and their properties based potentials (materials driven approach), as well as to teach the structure of these materials (science driven approach). Based on these backgrounds, the students are guided to further develop these two natural materials. Some characterisation methods will be explained. Also special advantages of most natural load carrying elements, such as their strong hierarchic structure will be emphasised.

Poster 4

Mechanical engineers' typical misconceptions in materials science, and how to correct them

Arlindo Silva
University of Lisbon, Portugal

At Instituto Superior Tecnico (IST), the University of Lisbon, students of mechanical engineering take two courses related to materials: materials science (MS) and materials in engineering (ME). While the former dwells on the usual fundamental principles of materials, the latter focuses on materials selection and the role of materials in engineering design. When students reach ME course they bring with them certain misconceptions about materials science matters that have to be corrected if they are to fully grasp the main topics of the course. Using hardness, strength, stiffness and toughness interchangeably to mean the same thing is one of these misconceptions. Another misconception is the effect that thermal treatments have on the mechanical properties of steels: what are the properties affected and why. The CES EduPack is a very powerful tool in helping to correct these misconceptions. The built-in database helps in showing examples of the effect of thermal treatments and the science notes help in distinguishing between strength and stiffness, for example. Also, plotting properties like Young's modulus against yield strength helps in explaining why materials with the same composition but different thermal treatments can have properties with a range of variation while other properties remain almost constant. The implications of this fundamental knowledge can then be used in mechanical design and materials selection by the students. The presentation will show how this has been done in class.

Poster 5

Poster: Computer-based Support in the Teaching of Product Development

Claes Fredriksson[1] and Mats Eriksson[2]
[1]Granta Design, UK and [2]University West, Sweden

Product Development is a prime topic for many engineering courses and educational programs. The Product Development Process is implemented by companies in many different ways, depending on *e.g*. costumer requirements. However, a number of common elements exist and are covered by teaching at Universities. In our poster, we point out and describe several key elements of a Product Development process that can be facilitated and taught using, for example, a standard edition of the widely used CES EduPack software. These are:

- **Specification of product function and requirements**, using the limit stage parameters as guidelines for properties to consider.
- **Selection of concepts**, where material properties, such as strength or cost for concepts can be estimated using the software.
- **Optimization of properties for the final design**, is a core EduPack functionality, finding the best metal alloy or grade of polymer.
- **Manufacturing selection and costing**, can be performed using links between materials and process data or the tree function, in combination with built-in cost models.
- **Evaluation of properties of the final product for marketing**, which could consist of finding out the carbon footprint using an Eco Audit, or declaration of embedded energy or recyclability using Eco property attributes in data records.

The findings can be useful for different directions within product development, for example *Design for X* (DfX) used to represent different design focuses. In particular, X could stand for Manufacturability, Value or Environment in our approach. The methodology described has been tested in a group of third year undergraduate students of mechanical engineering at University West, Sweden in a sustainability design project. This is described more closely in a separate poster.

Poster 6

GRADMAT – Materials Engineering to integrate Education-Society-Technology

Daphiny Pottmaier, Paulo Bodnar, Janaina Batista
Universidade Federal de Santa Catarina, Brazil

In order to sustain an ever increasing economical development, Brazil faces an important challenge of forming high level engineers and scientists. This mission was taken by the Universidade Federal de Santa Catarina with for example the creation in 2000 of a co-operative course in Materials Engineering. With this innovative model of teaching engineering, it has trained a creative work force by interchanging academic periods (9 terms) with internships (6 terms) a course duration of 5 years (15 terms). During academic terms students have from 9 to 22.5 hours per week of classes, while work terms is a fixed 40 hours. Internships places are performed 78 % in the industry and 22 % in research institutions, related to metals, ceramics, polymers, management, others. Thus, it is a materials engineering course very versatile as to form both scientists and engineers in a wide range of subject areas. Another fundamental contribution is the integration of Education-Society-Technology, where professors-workers-students have important and interconnected roles for the transformation of information into knowledge. And they become fellows in the construction of knowledge about and for the world, which is basically constituted of materials.

Poster 7

The MaterialsWeek: a global learning experience for materials engineering students

Elena Tejado and J Y Pastor
Universidad Politécnica de Madrid, Spain

Modern educational approaches strongly emphasize active learning based on projects and problems, underlining the idea that learning may occur at every location and time [1]: in the classroom, on a fieldtrip, in a museum, at home, in the streets of a city, on Wikipedia, etc. Learning may happen within one of these spaces, but also across them. In this respect, science fairs are a way to overlap those learning spaces into one, encouraging young people to become involved in and excited by science and technology, acquiring communication skills and the opportunity to interact with other students interested in science. Nevertheless, those activities are not usual at University level, where traditional way of learning is still extended.

With the goal of overcome this situation, the Materials for the Future Cluster of the Moncloa Campus of International Excellence (a joint venture between the Complutense and the Technical Universities of Madrid) hold the first edition of the MaterialsWeek, an event composed of lectures, presentation of research areas and enterprises, workshops on materials, courses, open days, talent shows…mainly addressed to students, companies, researchers and professors in the field of Materials Science and Engineering. Of special interest was the Materials Gymkhana Competition, a game-based learning environment where students played well-known games adapted to the world of materials: materiapolis, trivimaterial… Surprising results were achieved with this global experience.

[1]: N. Balacheff, S. Ludvigsen, T. de Jong, S. Barnes (Eds.), Technology Enhanced Learning: Principles and Products, Springer, Heidelberg, Germany (2009), pp. 233–249

Poster 8

Visualization of Materials Knowledge on Concepts

Elisabeth Kahlmeyer, Magda Figuerola, Hannah Melia
Granta Design, UK

We are surrounded by thousands of inputs in our daily life, from adverts on the street to millions of internet entries. It has become more important to stand out and use visualization tools, not just to advertise but to create and support an understanding of a subject.

Most people agree that:

- a picture says a thousand words
- students learn in different ways
- students learn best when they are engaged with the subject.

Therefore, images and charts that illustrate materials knowledge and concepts are a useful tool for materials educators. This approach aims to transfer knowledge in an efficient way and to promote materials knowledge to the next generation and catch their attention.

In this poster we want to show examples and possible applications of presenting materials knowledge and concepts in a visual way.

Poster 9

Teaching Materials Science and Technology to Military Air Force Students

Fernando Gimeno, J L Meseguer
Centro Universitario de la defensa, Spain

How to teach Science and Technology of Materials to students who reconcile their engineering studies with becoming an Air Force pilot, and to make the experience interesting at the same time?

At the University Center of Defence in the General Air Academy in Spain, we are developing specific contents focused on the materials, industrial processes and applications used in the aircraft industry.

The main goal is to provide the students with technical information and knowledge to train them as Air Force Officers and pilots. As an integral part of this training the students take the Industrial Organization Engineering Degree, which includes a Materials Technology course.

The training program extends over two semesters, the first semester emphasizes the Introduction to Materials Science and Technology, centering the examples to aeronautical use materials and alloys. The second semester is dedicated to technology, industrial manufacturing processes of the aeronautical industry and strength of materials.

We take advantage of the excellent location of our students at the University Center of Defence, inside an airbase, to complement the lectures with visits to the maintenance, NDT and inspection of aircraft in hangars.

The students express their interest and satisfaction with the approach to the subject, which links theoretical learning of a new branch of science with practical knowledge closely related to their future career.

Poster 10

Neutron and Synchrotron Light Sources: The Role of Large Scale Facilities in Education

Giovanni Badini Confalonieri
Granta Design, UK

Neutron and Synchrotron light sources are commonly associated with industrial and academic advanced research activities. However, large scale facilities are increasingly interacting with Universities to support and be part of postgraduate and undergraduate teaching. In this work, the role of large scale facilities in science and technology is briefly reviewed, together with indications on how these facilities fit into Engineering and Science programs.

Poster 11

Materials and eco-design. A novel pedagogical approach in the mechanical engineering curriculum at the University of Lille 1 – Sciences and Technology

Ion Cosmin Gruescu[1], Mircea Voda[2], Jean Luc Menet[3],
[1]University of Lille 1. France, [2]University "Politehnica" Timisoara, Romania,
[3]University de Valenciennes et du Hainaut Cambrésis, France

The actual preoccupations of industry are related to the numerous steps which a product must follow during its entire lifecycle, since the materials production until the disposal. Realizing environmentally friendly products involves the environment integration in their design and during all the lifecycle, whether these stages are placed in the upstream (raw materials extraction and transformation) or downstream (recycling, landfill, energetic valorisation, etc.).

Looking for the best compromise, the designer selects and combines several solutions related to the materials choice, production, packaging and logistics, use of product or end of life. Everything is decided during the design, and the future evolutions, considered from the technical, economical and lawful points of view, are factors contributing to the development of eco-design abilities for students integrating the technical sector in the Bachelor's and Master's technical degrees.

A vocational Bachelor degree of 550 hours educational program was recently introduced at the Technical Institute "A" of the Lille 1 University. The pedagogical content was structured in order to offer a global vision of the product design process of a product and of its lifecycle:

- by ensuring the continuity of the technological education in mechanics and by integrating innovative technologies
- by sensitising the students to the environmental management
- by emphasizing the connections between materials, processes and environment

These items were reached by:

a) offering directly to companies the possibility to teach. E.g., the KSB company, a pumps manufacturer, teaches the eco-design approach in the same manner that it was integrated by the company to develop their eco-designed game of pumps

b) by developing Problem Based Learning (PBL) or Learning by Doing based case studies in several practical workshop activities

c) by developing several materials sciences related courses which are all based on practical activities, such : bio-sourced (and/or artificial) polymers, sintering, metallurgy, thin films and coatings, composite materials, materials choice, materials identification and foundry.

The present communication will highlight the previously indicated aspects, related to the education strategy developed for the students following the Eco-Design of Innovative Products vocational degree at the Technical Institute of the Lille 1 University. Some examples of technological transfer in companies where the students performed their internships will equally be presented.

Poster 12

From research to teaching by means of composite lab experiences. Composite lab experiences for high performance composites

Jaime Juan Muñoz, Nuria Salán Ballestero, José Antonio Tornero García
School of Industrial and Aeronautic Engineering of Terrassa, Spain

Through the collaboration of ETSEIAT[1] (UPC-BarcelonaTECH[2]), INNOTEX Centre[3] and CMEM[4], COMPOLAB emerged four years ago as a research facility of advance composites manufacturing, Fibre Reinforced Polymers (FRP). One of the main purposes of COMPOLAB was to get students closer to present manufacturing techniques and new developments in this field.

This poster summarizes an actual educational experience, in which engineering and aeronautics students have participated. During the last two years, a typical practice of hand lay-up manufacturing of FRP laminates has been combined with a new activity focused on FRP laminates manufacturing by Vacuum Infusion Process (VIP).

VIPs are not newcomers, but in the last years they are becoming a promising alternative to traditional prepreg-autoclave manufacturing of high performance FRP parts. VIPs encompass a family of manufacturing processes which is gaining importance due to the potential to significantly reduce capital costs and environmental impact of prepreg-autoclave fabrication. They have been used in the past for manufacturing parts in which the potential advantages of FRP (very high specific mechanical properties) were not fully released due to the uncertainty over performance. To overcome this uncertainty, further investigation is needed for a better understanding of the process to achieve similar to prepreg-autoclave parts levels of quality and reliability.

The mentioned VIP practice starts with a materials research activity by means of CES-EduPack; in order to show students what kind of materials, specific matrix and reinforcements, VIP is addressed to. The whole practice experience lets students, not only comparing the traditional hand lay-up with a more sophisticated manufacturing technique, but keeping up-to-date; since the practice content is continuously updated with feedback of research activities and projects (Bachelor, Master and PhD theses). Continuous development is considered a key point of the educational experience.

Furthermore, COMPOLAB staff has assisted students in the manufacturing of some components for different engineering competitions, as Formula Student and Air Cargo Challenge. All the lab material and equipment is also available for this kind of activities.

1ETSEIAT: School of Industrial and Aeronautic Engineerig of Terrassa, 2 UPC-BarcelonaTECH: Universitat Politècnica de Catalunya, 3 INNOTEX Center, 4 CMEM: Materials Science and Metallurgical Engineering Department

Poster 13

Characterization of Electrically Conductive Surface Materials

Jian Song
Ostwestfalen-Lippe University of Applied Sciences, Germany

Electrically conductive surface materials are widely used in electrical and electronic components and devices. The basic function of electrically conductive surfaces materials is electrical conduction. One of the key characteristics for the electrically conductive surface materials is the contact resistance as function of the contact force. The electrical conduction of the surface materials can be strongly affected by corrosion, fretting corrosion and wear.

Two experiments are designed for the characterization of electrically conductive surface materials and used in the education program for mechatronics students. In the first experiment the contact resistance is measured with different contact forces and results can be illustrated in a contact resistance – contact force – curve whereby this curve is then compared with the calculated values. In the second experiment the relative motion with defined amplitude and frequency between the contacts is provided by a piezoelectric actuator. The contact resistance and the wear of electrical contact surface are measured simultaneously. The fretting corrosion resistance of different surface materials can be compared by observing the number of cycles to the rapid increase of the contact resistance due to fretting corrosion. The correlation between the fretting corrosion and the wear of the surface materials can also be studied using these experiments.

Poster 14

Introducing materials selection through a physical materials library

Liliana Pires, Martinho Oliveira, R. Torcato
University of Aveiro, Portugal

This work presents a pedagogical method implemented in a materials science introductory course of *Technology and Product Design* offered by the University of Aveiro. The degree program main goal is to prepare professionals with skills necessary for products and processes innovation, able to participate from the initial conceptual stage to the final prototyping/implementation stage. In order to accomplish this goal the curriculum is based on three principal fields of knowledge: Industrial Design, Engineering and Management/Innovation.

In the field of engineering, students are familiarized with the importance of materials in product development process, materials selection, mechanics of materials and processing technologies. Materials selection skills are particularly important for a product development professional. This subject is presented to the students in the course *Materials: Principles and Applications*, and is then practiced in the four subsequent project courses.

It was proposed to the students to construct a materials library. Each student worked two materials from the CES EduPack level 2 database. They received a data sheet template to fill and discuss, namely, the material history, properties, applications, design guidelines and a product incorporating that material. Finally, the students proposed up to 4 alternative materials for that particular application. Whenever it was possible, attached to the report the students delivered a physical example of the materials and the products.

This method proved to be suited to the course and to the program learning outcomes, for the following reasons: i) the students adhered and were more motivated because they "touch" the CES EduPack database; ii) the library is an excellent toll for the materials selection task that the students have to carry out in the subsequent project courses, facilitating the progression to more sophisticated selection tolls. With this approach the students developed the ability to select alternative materials and the perception of the importance of material properties for product performance.

Poster 15

New Granta's Teaching Resources Website 2.0

Magda Figuerola, Hannah Melia
Granta Design, UK

Today the number of resources that circulate over the internet is huge. It is important to select resources that are **high quality** with **trustworthy data**. Working closely with many respected Universities puts us in a good position to monitor **innovations** and **research** in the Materials Education field.

Our **Teaching Resources** compile powerful data and present it in an easy and accessible way across **different specialist fields.**

We manage **250+ teaching resources** for Materials Educators in **different languages, formats and specialities.** All the resources have been improved over the last year and put into a completely **new platform.**

In the new Teaching Resources Website it is easier to:

- Find resources
- Favorite resources
- Create your own memorable password
- Log in once and download everything
- Find out what the Teaching Resources team are up to
- Get inspiration from Granta's blog
- Communicate with other educators about materials education topics.

Granta's Teaching Resources Website also **supports academics** in **Teaching** and **works as a link** between the different communities and special interests via the **Forum** and the **Blog.**

This poster will showcase some of the improvements and request your feedback on ideas for future development.

Do not hesitate to visit us at **http://teachingresources.grantadesign.com/**

Poster 16

Capillarity Effect of Openness and WEB2.0 on Educational Innovation

Maria Kocsis Baán,
University of Miskolc, Hungary

The urgent need for in-depth reforms and paradigm shift in higher education has been recognised for more than a decade, however in the majority of HEIs, time seems to be freezing.

Some of the frontrunner universities have adopted new educational technology and launched their programs using advanced methodological solutions – their top-management recognised the importance of offering more flexible and versatile programs for the "digital-students" and non-traditional learners. In some other HEIs, reforms as e.g. introduction of Bologna system were far beyond their openness and tolerance for changes. However, sharing open education resources and courses, launching MOOCs (massive on-line open courses) have gradually changed the situation: in contrast with the „top-down" approach of strategic planning, individual scale of innovation in education has become feasible, due to the easy-access and user-friend WEB2.0 tools. Lecturers may create and share their content upon their own decision, using open tools and platforms, in a no-cost model. Paradigm shift is being implemented in a "bottom-up" approach.

Partners of a recently completed Lifelong Learning project – Open Educational Innovation and Incubation (**www.eadtu.eu/oeii**) – analyzed the current drivers behind open and online education including employability, accessibility and business models, moreover formulated recommendations to seek solutions to optimise the (open) educational innovation and incubation process, and identify any organisational structures and opportunities that can be taken advantage of.

Moreover, the European Commission launched a gateway portal – **www.openeducationeuropa.eu** - for distributing information on available open educational content and information. Although some useful OER are well-known in our specific subject – e.g. steeluniversity.org, MATTER, DOITPOMS, CORE-Materials – this new gateway portal may even more intensify sharing valuable resources and widening our jointly developed knowledge pool in materials education. Capillarity effect of individual scale innovation may result in a more dynamic reform of Higher Education, with specific focus on educational methodology.

Poster 17

Facilitating Product Development Teaching

Mats Eriksson[1], Claes Fredriksson[2]
[1]University West, Sweden, [2]Granta Design, UK

The Product Development Process, as applied in industry, consists of many different steps to bring a new or re-designed product to the market. These need to be covered by teaching and range from mechanical design to the life-cycle perspective on a product.

Our poster describes a teaching approach suitable for the product development process. The pedagogic context of the approach is project based learning (PBL) in small student groups with short regular meetings with a teacher for supervision. Among the educational resources that are used, EduPack plays an important role with its combination of a materials and manufacturing process databases, Eco performance indicators, as well as computer based selection and visualization tools.

The methodology has been tested in a class of third year undergraduate students of Mechanical Engineering taking a course in Product Development. A student group of four people was followed during the development of a combined liquid container and construction element for use in developing countries or in disaster areas. Details of the teaching approach, including the use of EduPack as a project tool, are described.

It was found that EduPack could be used in a relatively generic manner to aid in the learning related to specification of (i) product function and requirements, (ii) selection of concepts, (iii) optimization of properties for the final design, (iv) manufacturing selection and costing as well as (v) evaluation of properties of the final product. The technical aspects of the method are described in a separate poster.

Poster 18

Supporting Callister-based materials science courses with CES EduPack

Mattias Calmunger, Mikael Segersäll
Linköping University, Sweden

The background of this study is to highlight the task for a university teacher to maintain a high academic standard with an increased number of students and the fact that students have a different pre-knowledge. In our case, this is having both mechanical engineering students and engineering design students in a 4th year university material selection course. Generally, those two groups tend to approach a material selection problem in different ways. To use this diversity as a strength, we try to integrate the different student groups with each other in order to make a material selection with different inputs. In addition, if the students can see their learning as a function of their activity during the course this can also motivate the students to learn from each other. Hence, our task as teachers is therefore to supply teaching/learning activities that are active and stimulating for the students.

Due to a large number of students, home assignments interconnected to the course objectives are to be solved in small groups. By working in small groups, the work is peer-controlled and therefore also increases the student influence of the learning process. A peer-controlled project at the end of the course is also introduced where the students are able to use their pre-knowledge from bachelor studies as well as the knowledge gained from the course. The aim is to maintain a high academic standard by having a student centred learning throughout the course as well as using the diversity as something positive.

Poster 19

The ECO PEM and ACV BAT projects. Materials science and Life Cycle Assessment methodology used in engineering and products design

Mircea Voda[1], Ion Cosmin Gruescu[2]
[1]University of Lille 1, France, [2]"Politehnica" University of Timisoara, Romania

Numerous products are designed and promoted on markets by only considering the selling price and lower production costs. The design and the production processes are sometimes based on programmed obsolescence. On the other side, eco design is a very useful alternative in engineering, it permits to design new products, environmentally friendly, with longer lifetime.

The ECO PEM project, developed in the framework of the UVED virtual university (the Numerical University of the Environment and Sustainability of the French Ministry of Education) addresses the question of the evolution of pedagogical contents in the the technical sector in the Bachelor's and Master's degrees. The ECO PEM project is a pursuit of a previous one, entitled ACV Bat, an exclusive course dealing with the LCA methodology. In both projects the materials are always in the core, the interest of such projects is to propose choice tools allowing to the designer performing a material choice by evaluating the environmental footprint of a product.

The general idea of these courses is to give free elements to teachers and trainers, who can directly re-use them in their presentations or teachings supports. The courses can also be appropriated by self-learning. The ACV BAT project was realized by integrating a practical case study with materials from the building sector, it is also possible to apply the methodology to other industrial sectors without any difficulty. The ECO PEM project is actually in development, it deals with energy greedy products currently such the most common household appliances.

The first numerical resource (ACV Bat) has been used with success in a few courses, especially in the "eco-design innovative products" vocational licence at the Lille 1 University and at the high school of engineering ENSIAME, Valenciennes University. The second resource (the ECO PEM project) is developed by integrating case studies realized with students from the same universities and from the Politehnica University of Timisoara (Roumania).

The present communication is dedicated to the presentation of the obtained results in both ACV Bat and ECOPEM projects. Since the ACV Bat is already finished the lecturer can already take a look here

http://stockage.univ-valenciennes.fr/slide/files/orioai/MenetACVBAT20120704/acvbat/accueil/co/acvbat_010_accueil.html

Poster 20

A new website about "Choice of Materials and forming processes"

Philippe Revel
University of Technology of Compiègne, France

A French website was developed to help students, which are in their second cycle or in engineering schools, to acquire knowledges on the choice of material and their processes of manufacturing. This site starts off with three chapters of course, and more than 10 case-studies are proposed. The approach chosen in this site is based on the experience of teachers and industrials, but also on the approach for choosing materials, which was formalized by Pr. Ashby of Cambridge University. This website was the result of cooperation between the 3 French Technology Universities: University of Technology of Compiègne, of Belfort-Montbéliard and of Troyes (UTC, UTBM and UTT) and the French Centre of Mechanical Industries (CETIM). UNIT, the French Numerical University for Technology and Engineering, financed it.

For 3 years, an English version of this website has been developed and I wish to present it. Only the 3 first chapters and the case study on the engine of plane have been translated into English. I wish that it be able to be used in universities of countries of English language and also its development be able to be continued in co-operation.

Poster 21

You Say You Want A Revolution . . .

Richard J. Lombard
Virginia Commonwealth University in Qatar, Qatar

In 2013, Virginia Commonwealth University Qatar conducted its biannual design conference – Tasmeem – with a theme of "Hybrid Making". An RFP was issued for workshops that would explore the concept in a local context.

Along with colleagues from our US campus and members of Designtex, a US-based textile company, we constructed a workshop that would explore – in five short days – the creation of a sustainable, locally inspired "product" that could be manufactured with distribution in the Middle East.

In assessing our acuities and resources, we settled on wool felt as a core element: there is a history with its manufacture and use locally, it is a versatile and timeless material, and it represents a sustainable option in both its raw materials and its manufacture.

In addition to exploring local sourcing challenges (it turned out to be too cold in the Middle East to shear the sheep), the group experimented with both wet and dry felting methods, structural and design limitations of the material, and a variety of possible product designs. In the end, a viable design direction was identified; but it was hardly the most important outcome.

Perhaps the most striking outcome of the project was the emotional meshing of the group as we worked to mesh the fibers into felt. There was an intensely human-scale aspect to the project, though the outcome was by no means "craft-like". We had full knowledge of every aspect of our supply chain, from sheep to shelf, and became well acquainted with the potential hazards of each of those aspects. Additionally, the essential malleability of the material was experienced and internalized by many who had never considered the possibilities of felt for their work.

The presentation will include video of the process, samples of the outcomes, as well as a graphic presentation of the project.

Poster 22

Enhancing student experience through online collaboration: Materials research project

Simon Andrews
Falmouth University, UK

The project focused on an assessed team element of a level 4 module called 'Materials Technology'. Student teams researched an assigned material to demonstrate its properties, applications, environmental impacts, etc through the analysis of manufacturing processes of a chosen product. The research was traditionally presented using PowerPoint and the project progress tracked through group tutorials. However, the rationale for this project was to explore the potential of online collaboration (through the VLE, Mahara) to improve student engagement, improve understanding of material properties and applications, and improve the student experience and satisfaction with the module.

Each team collaborated and presented their research using a Mahara page. All materials research was collated and discussed through the software in addition to team meetings in the studio. Group tutorials were conducted around an interactive whiteboard so the Mahara page could receive live annotations and updates in response to tutor feedback. The online collaboration provided flexibility (time/location) in the way students contributed to the team project.

The process facilitated a collaborated outcome rather than a collection of individual contributions. A focus group gathered significantly more positive comments, than negative, in relation to student experience and satisfaction. When compared with the control project (team research presented through PowerPoint) a higher proportion of students felt that they had developed a good understanding of material properties and applications, and the overall module experience had considerably improved.

The approach demonstrated a higher level of student engagement through the flexibility of online collaboration and greater overall student satisfaction. The teaching model fostered wider participation and encouraged shared peer learning of material properties and applications. The research led to further investigation into the potential for online design studios to encourage greater peer interaction through collaboration, and sharing and enhancing ideas, skills and processes.

Poster 23

Thermoelectric wood stove student project: from the classroom in Bordeaux to the rural communities in India

Stéphane Gorsse
ICMCB-CNRS, France

This poster presents an example of project based learning implemented in first and second year in engineering school of chemistry with the aim at stimulating students by confronting them to practical problem related to materials, sustainability and humanitarian purposes.

Around the world, three billion people use biomass for heating and cooking, which generate indoor air pollution responsible for more than 1.5 million deaths, especially in rural areas of developing countries. These areas usually do not have an electricity supply, and if they do, the supply is very limited.

The strategy followed by the group of students in charge of this project was to design and fabricate cheap wood stoves with enhanced combustion efficiency based on an active ventilation system that do not rely on any external source of electrical power neither batteries. The space industry gives the solution with the thermoelectric generators (TEGs). For the past 40 years, TEGs have provided a reliable and autarkic source of electrical power to space probes such as Voyager and planetary rovers such as Curiosity.

In this project, during 2 years, students have put their competences into context, applied and developed their knowledge to find solutions and worked together as a group in order to design, fabricate and distribute to rural communities in India cheap and smokeless thermoelectric woodstoves.

The project involved conducting a two-folded process:

- The design of the stove that includes the selection of the materials using the CES Edupack and the implementation of the TEG. The design requirements were translated into constraints and objectives (price and sustainability). After screening, the materials were ranked using performance indexes.
- The fabrication of the stoves that were given for free to 20 Indian families to verify that the product suits well their needs. This stage of the project was performed in India after a successful fundraising to cover the cost of making the stoves and the search of local craftpersons and material providers.

Poster 24

A new paradigm in educating building/construction professionals in materials

Steven W.F. Tsang[1], Louisa L.H. Tsang[2], Joshua M.H. Tsang[3]
[1]Hong Kong Polytechnic University, Hong Kong [2]Nanyang Technological University, Singapore, [3]Imperial College London, UK

Most building/construction professionals in Hong Kong are engineers, surveyors, property managers and certainly no material scientists. At the Hong Kong Polytechnic University, where one of the authors works, a typical year will take over 200 students studying the subject of construction materials. To be able to cater for students coming from such a wide diversity of backgrounds, the shear large number of students as well as the limitation in time to do the teaching requires a new paradigm in the teaching and delivery of the subject.

The method adopted is actually the realization of the idiom: "Seeing is believing". Demonstrations or sometimes hands-on experience as well as personal participation in playing with models were given as much as possible, certainly in small tutorial classes and even during large lecture sessions. The approach has also made full use of modern instrumentation/equipment to showcase live to the students the manifestation of the important properties of materials. For example, equipment capable of heat sensing, emission, reception and imaging of waves of various kinds are used in teaching/demonstration. This approach has found to be able to inspire the students' interest in the first instance and their drives to do more self- or peer-learning after classes and during work on a mini-research style assignment.

The assignment requires students to work in small groups (about 5 to 6 in a group). The allocation of topics for each group is given in a matrix which spans the full width and depth of the syllabus and expected learning outcomes of the subject. This will also ensure less duplication and wider coverage of the syllabus. In brief, each group is asked to compare and contrast two different building materials, two out of the range of material properties and one major degrading agent which has a profound negative effect on the two chosen materials' intended performance over the life-time of the materials in service.

Students are requested to submit the assignment in a written report format as well as a self-recorded video in a free format as evidence of achieving the learning objectives. By marking the submitted assignments, watching their video presentation and more importantly the individual reflective journals, I can gain individual reflection of and insight into their process of learning (i.e. the aspects they like/appreciate and the aspects they don't). In all, it is overwhelmingly clear that most students like the approach adopted in the delivery of this subject.

I believe, many universities around the world are increasing stretched to teach more large groups of students with less resources. Materials education is no exception. I believe the paradigm advocated in this poster will help to cope with this challenge in educating students or future professionals from a wide variety of disciplines (from material scientists, earth scientists to building/construction professionals) to learn materials more effectively, with enthusiasm and satisfaction.

Poster 25

Achieving CDIO Learning Outcomes using CES EduPack

Tatiana Vakhitova, Claes Fredriksson
Granta Design, UK

Quality assurance is an essential aspect of educational systems around the world. Learning outcomes are the main indicators of educational quality. Engineering programmes and courses have well-established accreditation systems with evaluation criteria, such as ABET and CDIO Syllabus. This poster demonstrates how CES EduPack could be used by Universities to achieve learning outcomes that contributes towards the CDIO Syllabus. In particular, the areas of Design and Sustainability outcomes are found to be well supported by CES EduPack and related teaching resources. This tool helps educators to ensure that future engineers are prepared to solve global challenges.

Poster 26

Pre-university materials education: Supporting science and engineering courses

Victor Arnoux, Rebecca de Rafael
Granta Design, UK

In France, engineers count among the top 10 most sought-after profiles on the job market according to the French employment service "Pole Emploi". Meanwhile, the Society of French Engineering Schools' Directors (CDEFI) predicts a shortage of engineering students in the near future.

To tackle this challenge, French educational authorities have launched several initiatives to raise students' awareness and interest about science and engineering curricula, at different levels of study. A recent reform in technical high schools (16-18 year-old students) aims to modernise lectures and reinforce materials knowledge as well as introduce concepts of sustainability into courses.

To support this reform, Granta Design adapted its teaching resources CES EduPack in collaboration with teachers and French educational authorities ("Académies"). New teaching resources such as courses, design projects and exercises have been created and translated to support teaching in the fields of Materials, Processes and Eco-Design.

In the light of this experience, teachers showed interest to go even further and to adapt Granta's resources to the secondary school level. The next step is to motivate 11-15 year-old pupils with interactive resources, to introduce them to the world of materials and to support secondary school teachers in this endeavour. Since 2012, Granta's Teaching Resources Team has been collaborating with motivated teachers. In this poster, we will present the progress made on this latter project.

Poster 27

Preparing Chinese Engineering Students for the World

Xinxin Li, Zhiyi Zhao
University of Science and Technology, Beijing

China owns the biggest group of enrolled engineering students and graduates. However, the qualified Chinese engineering graduates who meet the global requirements are less than those of countries like the United States, Japan and India. The problem lies in the lack of knowledge and ability about international vision, experience and international standards of how to be a qualified engineer. Preparing Chinese engineering students for the world should be a final goal for all the Chinese educators and university education policies. In this paper, we will introduce the methods USTB utilizes to educate engineering students majored in materials so as to equip them with the ability of professional knowledge, leadership, team work, international vision and entrepreneurship spirit. The methods include revising curriculum according to the industry requirements, internationalized e-learning experience by inviting international engineers as the instructors, team-work training through special courses and project task assignments to be finished under dual tutorship of university and industry instructors. All the methods are combined together during the study and help the students to be prepared not only with useful professional knowledge, but also with the experience of working and studying with instructors from the industry at home and abroad. Feedback from the industry shows that this kind of graduates is better prepared for the internationalized industries.

Keywords: Leadership, Entrepreneurship, Internationalized e-Learning, Engineering students

Section 5:

Contact Details &

Venue Information

Important Local Contact Information

Venue contact details

Further details, directions, and maps are provided on the following pages.

Cambridge University Engineering Department—venue for Short Courses

Department of Engineering,
Trumpington Street,
Cambridge, CB2 1PZ
01223 332600

Clare College—venue for accommodation, Symposium, and Symposium Dinner

Clare College,
Queens Road,
Cambridge, CB3 9AJ
01223 333261

Magdalene College—venue for the Presenters' Dinner

Magdalene College,
Cambridge, CB3 0AG
01223 332 100

Granta Design contact details

Please feel free to contact Granta if you have any problems or questions during your stay in Cambridge.
Address: 300 Rustat House, 62 Clifton Road, Cambridge, CB1 7EG
Phone: 01223 518895

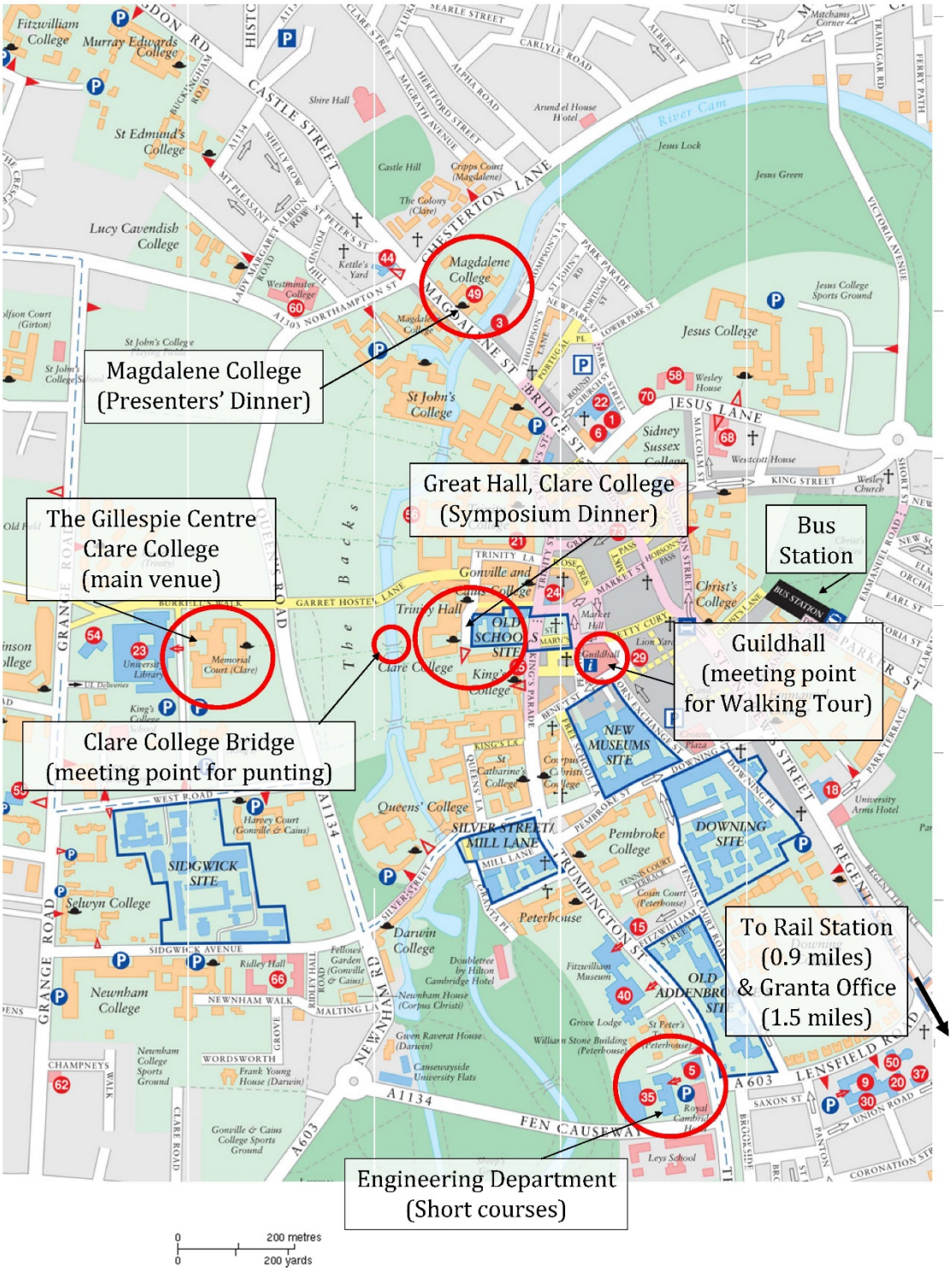
Out-of-hours emergencies

If staying at Clare College, please ask the Porters Lodge for assistance. They will have emergency contact information for Granta should that be required.

Other useful contact information

Addenbrookes Hospital	Hills Road	01223 245 151
Taxi service (Camcab)	**www.camcab.co.uk**	01223 704 704
Tourist Information	The Old Library, Wheeler Street	0871 226 8006
Trains	**www.nationalrail.co.uk**	0845 748 4950
Emergency services (police, fire, ambulance)		112

Map of Venues



Cambridge University
Engineering Department (CUED)

www.eng.cam.ac.uk/visitors/
01223 332600

Access by public transport or on foot

The Department is the venue for the **short courses**. It is on the corner of Trumpington Street and Fen Causeway, a five minute walk from the city centre via Trumpington Street, or Silver Street via a footpath along the river. The central drop-off point for bus services is at the city bus station on Drummer Street.

Please report to Reception on arrival at the Department.

From the rail station:

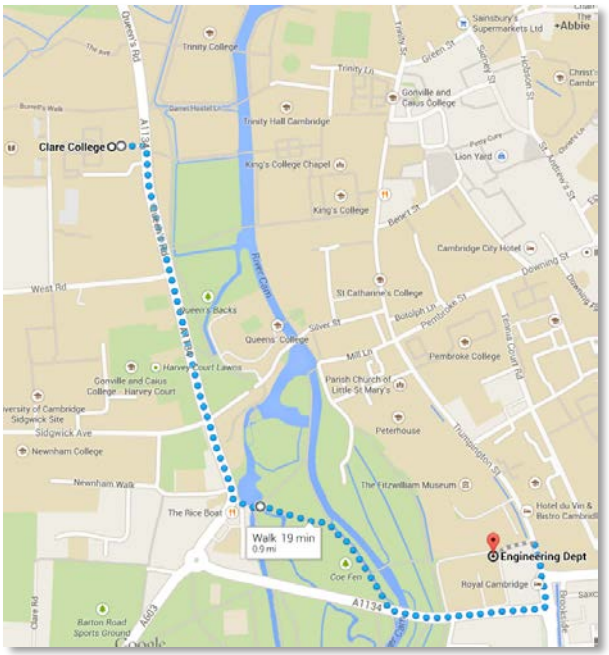
- On foot: a twenty minute walk (up Hills Road, along Lensfield Road, and into Trumpington Street).
- Taxi: a five - ten minute taxi-ride (although it may take longer at peak periods).
- Bus: a fifteen minute journey time, combining bus and foot. The bus take you as far as the corner of Hills Road and Lensfield Road. Walk along Lensfield Road and onto Trumpington Street to find the Department.

From the bus station (Drummer Street):

- On foot: a fifteen minute walk. Walk along Emmanuel Street, cross to Downing Street (which becomes Pembrook Street), then turn left and walk down Trumpington Street to the Department.
- Taxi: a five minute taxi ride.
- Bus: a five minute bus ride. Take the citi 4 to Trumpington Street.

From Clare College:

- On foot: a twenty minute walk (pictured right).
- Taxi: a five minute taxi ride (in clear traffic)



Further maps and directions can be found on the ***Engineering Department website****.*

NB. Parking is not available at CUED: the Department have advised us that cars parked on site without prior permission will be wheel-clamped. Those staying at Clare College should walk (20 minutes) or take a taxi (5 minutes) from the college.

A brief history

The Department was founded in 1875 by James Stuart, Professor of Mechanism and Applied Mechanics (1875-1890). Today, it is the largest department in the University of Cambridge, representing approximately 10% of the University's activities by the majority of common metrics, and is one of Europe's largest integrated engineering departments.

Clare College

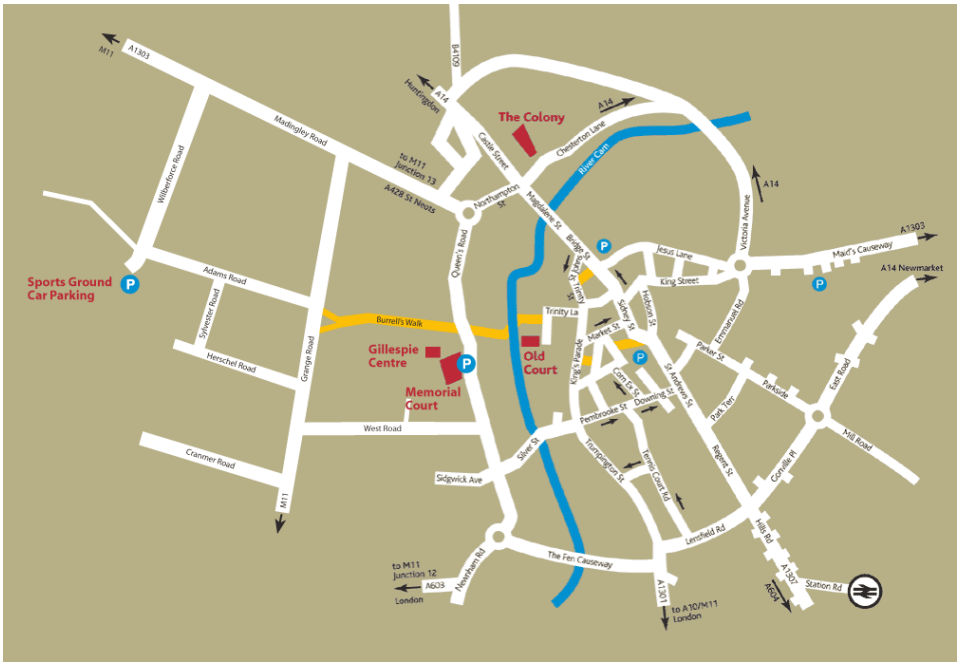
www.clare.cam.ac.uk/Home/
01223 333203

Clare College is the venue for the main Symposium (in the **Gillespie Centre**) and for accommodation booked via Granta Design.

The main entrance to Clare College is located on Queens Road, which is just off Madingley Road, a 10 minute walk from Cambridge City Centre.

- From the M11, take junction 13 onto the A1303 towards the City Centre.
- From the A14, take junction 31 onto the A1307 towards the City Centre.

www.clareconferencing.com/contact/findus.html



Directions & Parking

If driving, access to the car park is off Wilberforce Road. Parking at Clare College must be pre-booked via Granta Design, or by calling the College directly (01223 333261). Parking is charged at £4.50 per car, per day.

- Enter the Sports Ground car park (located on map) from Wilberforce Road
- Walk down Adams Road, onto Burrell's Walk until you reach the Gillespie Centre at Clare College

You may use the car park overnight if you are staying in the college. Please note, the car park is private and relatively secure, but parking is at your own risk.

Access by public transport or on foot from the City Centre

From the rail station: Cambridge rail station is about 1.5 miles from the College—a 10 minute taxi-ride, although it may take longer at peak periods (ask for "Memorial Court, Clare College"). For bus connections, take a bus to the city centre.

From the bus station: Cambridge bus station is about a 15 minute walk, or 5 minute taxi-ride (ask for "Memorial Court, Clare College") in clear traffic from Clare College.

A brief history

Clare College is the second oldest of Cambridge's thirty-one colleges. It was founded in 1326, and endowed a few years later by Lady Elizabeth de Clare (Lady de Burgh), a granddaughter of King Edward I (1272-1307). It became known as Clare Hall as early as 1339 (the present simplified title, 'Clare', dates from 1856). In 1359, a set of statutes were defined by which the new college was to be governed. The remarkably enlightened attitude to learning and university education in these statutes has guided the college for nearly seven centuries: 'the knowledge of letters ... when it hath been found, it sendeth forth its students, who have tasted of its sweetness, fit and proper members in God's Church and the State, to rise to diverse heights, according to the claim of their deserts.'

The present college buildings which surround the 'Old Court' were built over a period of seventy-seven years, from the mid-seventeenth-century to the early eighteenth (1638-1715). There is no record of the architect who designed these beautiful buildings, the prospect of which, looking across King's College lawns, is one of the most famous in England. (Clare tradition has it that the architect was the great Inigo Jones; but this tradition cannot be verified.)

Memorial Court (the location for our meeting and accommodation) was built just across the river from Old Court during the 1920s to a design of Giles Gilbert Scott and dedicated in 1926.

Magdalene College

Magdalene College, Cambridge, CB3 0AG , **www.magd.cam.ac.uk**

The Presenters' Dinner on Wednesday evening will be held in Magdalene College (customarily pronounced *MAWD-lin*). The college is located in the centre of Cambridge, beside the Magdalene Bridge on the River Cam. In 1428, King Henry VI approved the establishment of a hostel on the site for Benedictine monks coming from their abbey monasteries in the Fenland to study Canon Law at the University. Today, the College has some 320 undergraduates, nearly 180 graduate students and around 60 Fellows and other teaching officers.

Magdalene College is located on Castle Street. It is a short walk from Clare College. Either head north along the Backs (Queen's Road), turn right onto Northampton Street, and right at the cross roads onto Castle Street. Magdalene College is just on the left just before the bridge. Alternatively, walk through Clare College and through the centre of town. When you arrive at the Porters' Lodge at the main entrance on Magdalene Street, you will be directed to the drinks reception. Dinner will be held in the beautiful 16th century dining room (pictured, below), originally the monastic refectory, where we will dine by candlelight below the stunning stained glass windows and the Heraldic arms of Queen Anne.

Note: *Presenters who have signed up to arrive by punt should be ready to leave from Clare College Bridge at 6:30pm.*

Cambridge: Local Information

While you are in Cambridge, why not take the time to explore some of the beauty of this ancient university town? Local websites provide many walks and guided tours, or just head out and start exploring.

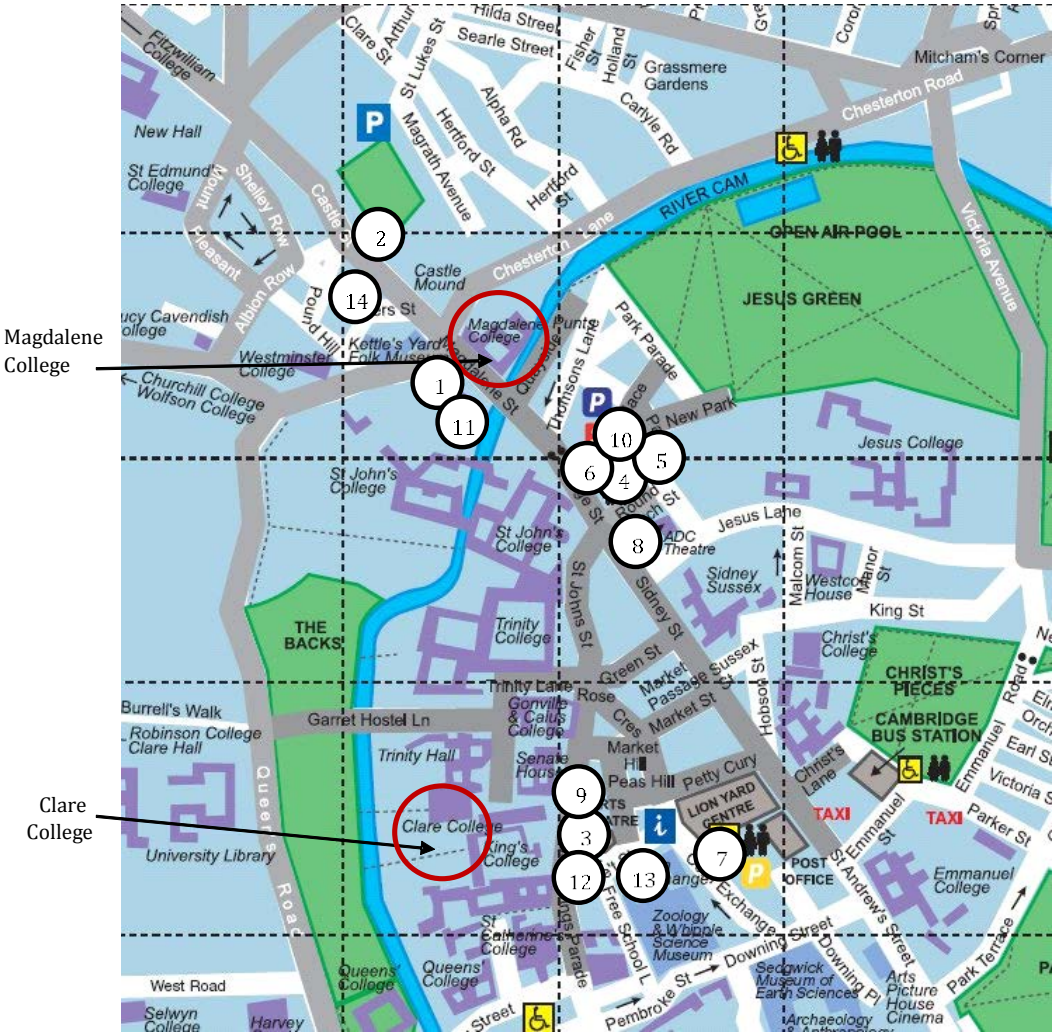
Useful links:

- Cambridge University's tourist information page
  www.cam.ac.uk/local/tourist.html
- Cambridge City Tourist Information
  www.visitcambridge.org/
- Cambridge Weather
  www.bbc.co.uk/weather/2653941






Restaurants and Pubs within the City Centre



Nearby Pubs

1	The Pickerel Inn	Magdalene Street	01223 355068
2	The Castle Inn	Castle Street	01223 353194
3	The Eagle	Bene't Street	01223 505020
4	The Baron of Beef	Bridge Street	01223 505022
5	The Mitre Tavern	Bridge Street	01223 358403

Nearby Restaurants

There are plenty of restaurants in the Bridge Street/Quayside area, a short walk from the college.
Here are just a few in that area and further into the city centre:

6	Ask	Pizza/pasta	Bridge Street	01223 364917
7	Carluccio's	Italian	1 Fisher Square	01223 307046
8	Pizza Express	Italian – Pizza	Jesus Lane	01223 324033
9	Rainbow Vegetarian Café	Vegetarian	9a King's Parade	01223 321551
10	Curry King	Indian	5 Jordans Yard	01223 324351
11	Thanh Binh	Vietanamese	17 Magdalene Street	01223 362456
12	Cambridge Chop House	British	1 Kings Parade	01223 359506
13	Jamie's Italian	Italian	The Old Library,Wheeler Street	01223 654094
14	Maharaja	Indian	9 Castle Street	01223 358399

Section 6:

Symposium Organization

Organization

The International and North American Materials Education Symposia are coordinated by Granta Design with support from the advisory committee and the following organizations:

- **American Society for Engineering Education (ASEE), Materials Division**
- **ASM International**
- **Department of Materials Science and Metallurgy, University of Cambridge**
- **Department of Engineering, University of Cambridge**
- **European Society for Engineering Education (SEFI)**
- **Granta Design**
- **The Federation of European Materials Societies (FEMS)**
- **University of Illinois at Urbana Champaign**

The program for these events was guided by the following Advisory Committee:

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