

ESF Exploratory Workshop on

Materiality of Light
*Energy-active and materially-smart design for a
resilient future*

Copenhagen (Denmark), Sept 19-21, 2012

Convened by:
Mette Ramsgard Thomsen and Carole Collet

SCIENTIFIC REPORT

1. Executive summary

The workshop “THE MATERIALITY OF LIGHT: energy-active and materially-smart design for a resilient future” was held at The Danish Art Workshops on Sept 19-20 2012. The workshop invited 16 researchers from a wide cross disciplinary field to discuss the role of emerging material practices for resilient design. Researchers ranged from senior researchers and programme leaders to young researcher at the start of their career. The researchers came from 5 different countries comprising the UK, the Netherlands, France, Sweden and Denmark.

Scientific objectives

The aim for the workshop was to examine the possibility of establishing a new network of scientists and designers involved in material design. By inviting researchers from the fields of architecture, design, biology, robotics, engineering, polymer science and energy, we wanted to question the drivers of these new material practices as well as identify their possible overlaps, synergies and discrepancies. Asking researchers to present their current practice as well as the emerging research questions that are shaping their fields, we wanted to understand the potential of establishing a common network for research exchange. We asked: what are the guiding questions such a network should bring together, what can we learn from each other and how can a better understanding of our mutual practices and methodologies as well as core skills and tools that shape knowledge production lead to new exchanges?

A second goal for the workshop was to situate these emerging material practices in a perspective of sustainability. By bringing in the particular context of *resilience* we asked researchers to question their work in respect to the *ecologies of production* that surround their practice. This kind of system thinking introduced an inter-scalar thinking bringing forth new connections between enquiries at the micro-scale; the scale of material production - to that of the meso-scale; that of the product, artefact, building or city – and finally to the macro-scale; that of the environment as a whole.

Workshop format and methodology

The workshop took place over two days each arranged in distinctly themed sessions. Day 1 focussed on research presentations allowing researchers to get to know each other's practices, while day 2 focussed on hands-on group work and discussion allowing researchers to interact and exchange experiences. The underlying goal for both days was to create lasting relationships and real appreciation of mutual research agendas.

Day 1: the presentations

Day 1 was structured around 3 presentation sessions. Session 1, Responsive Design and Materials, presenting practical and speculative examples of working for and with responsive design from both science and design. Here researchers showcased their work into the making of spaces, artefacts and materials that respond to changes in their containing environment. In Session 2, Energy and Design researchers working with energy active materials presented their research goals and outputs situating energy harvesting and environmental interaction as a particular concern. Finally in Session 3, Biology and Biomimicry as Models and Material for Design presented biology as both a model for replication as well as technology of manufacture. The session ended with the positioning of the field of resilience as a way of framing the ambitions of our joint practices in a holistic and ecological perspective.

The presentations were kept deliberately brief focussing instead on discussion and exchange. Each session was followed by longer discussion in which themes were debated and perspectives shared. During the session participants were asked to write keywords on to post it notes. After each talk the post it notes were assembled on a large table becoming a shared aide-memoire and basis for the opening knowledge mapping session on day 2. The post it notes were placed in no particular hierarchy and themes, comments, ideas, questions, methods, technologies were brought together with no system or structure.

Day 2: Sharing and Exchange

The second day aimed to find the potential synergies and overlaps between the represented fields. On the day both session 1 and 2 were redesigned to allow for a better synergy with the discussions of day 1.

The day was also structured around three sessions beginning with a mapping session. Taking point of departure in the shared discussions from day 1 five key themes were identified: Design Principles, Failure and Uncertainties, Wishes and Demands, System Thinking and Resilience and Technology and/or Nature. Working with the post it notes, 5 groups of 3 or 4 mixing scientists and designers were formed and each group was asked to find key words that could describe and discuss their particular theme. The groups were given 15 min to develop the theme and after this present their thinking in plenum. The presentations and following discussion allowed a summarising of the

In the second session: Sharing Skills, Tools and Methods researchers were asked to reform into new groups of 2 seeking to map the particular skillsets that make their practice. Again groups were given 15 min for individual discussion and 5 min for plenum presentations. What emerged from the presentations was a strong focus on methodology. Rather than discussing the particularities of their tools and techniques, researchers focussed on the methods by which their knowledge is developed, questioned and evaluated. The groups of two were asked to present each other's practice creating the basis for knowledge sharing and discussion. The methodologies were then discussed in plenum and similarities and differences between our practices of knowledge production were discussed.

The final session Future Funding discussed the possibility of a new network. We discussed first the opportunities of such a network and what a prolonged exchange and knowledge sharing would enable. Carole Collet presented a map of the knowledge fields assembled in the workshop and questioned what disciplines were missing in the network. We discussed fields and persons as two different ways of questioning the composition of the network. Following this Mette Ramsgard Thomsen presented network methods. By presenting examples of former research networks we discussed the means of collaboration and networking a network could embody. She presented the Digital Crafting network which was based on structured hands-on workshops- seminars as a means of sharing knowledge through sharing of technology and tools and not only through presentation. As Richard Bonser, Reader in Biomimicry and Design from Brunel University put it – “we don't need another network where we meet every 6 months to see another 20 min presentation – we need real exchange”. The meeting concluded in a general agreement that the network would be productive for all the fields and could lead to real innovation in our work. The role of the network would be to enable new collaborations between network partners. It was agreed that the network should be dynamic and continually grow during its research span. A practice based approach to knowledge sharing was also generally agreed upon. Finally, it was

agreed that the network should last 5 years to have the real potential of creating new perspectives in our research and enable new collaborations.

As the ESF representative Salim Belouettar was unable to come at last minute we were not able to refer to the funding opportunities that he would have presented. Instead workshop convenors Carole Collet and Mette Ramsgard Thomsen had asked their research administrations to prepare a presentation of possible funding opportunities. Both KADK and CSM, UAL, reported that the best funding opportunities for a cross European network would be in the EU programmes but that because the 7th framework is at its end and the new Horizon programme has not started it is difficult to know the specifics of the funding opportunities at present. We concluded that we would assemble a funding committee in the group that would continue to search for further funding opportunities for the network.

Workshop atmosphere

The workshop atmosphere supported informal meetings and sub-group conversations allowing participants to get to know each other and to form further exchanges within the network. Much emphasis was put on time keeping allowing for the planned breaks for coffee, lunch and dinner to be uncompromised. The importance of informal meeting across coffee or lunch are essential for both the reflection on the discussions and broader framework of the workshop as well as for the creation of lasting relationships.

The format of the sessions was designed to support exchange and discussion. The many group work sessions in day 2 with continuously changing groups meant that all participants had the opportunity to speak directly to the other in the group while the plenum session ensured that all findings were shared.

The workshop had a very comfortable environment further supported by the Danish Art Workshops rooms. On day one we also had a showing of the workshops facilities and the general art work produced in the house – giving further possibility for discussion and exchange.

2. Scientific Content of the Event

Below are short summaries of each participant's presentation.

SESSION 1: RESPONSIVE DESIGN AND MATERIALS

Mette Ramsgaard Thomsen: "Material Designs"

Mette is an architect and Professor at the Royal Danish Academy of Fine Arts, School of Architecture and is the Director of CITA (Centre for IT and architecture). Her work focuses on practice based research to foster new approaches to embed interactive technologies in architectural proposals. In her talk she discussed material design as an architectural design task and how digital tools can bring us closer to understanding material behaviour. She outlined how in the field of architecture the creation of descriptions are central tools for design and innovation and how new material practices necessitate the invention of new description.

Marco Federighi: “Light and Shadows”

Marco is an electronic engineer and Vice Dean for Education at University College London (UCL) in the Faculty of Engineering Science. In his talk he presented his interest in resilience from an engineering perspective. He highlighted several of his current research interests: the use of silicon as infra red light; the integration of photonic/electronic into materials and the senso-aesthetic properties of materials. Marco stressed the importance of interdisciplinary collaborations to foster innovative design. He is currently working on bridging the gaps between seven research areas at UCL: “Infrared light in glass and Si”, Tony Kenyon, “The Institute of Making”, Mark Miodownik, “Digital Humanities”, Tim Weyrich, “Textures of materials”, Stuart Robson, “Urban Sustainability”, Marek Ziebart, “Energy demand reduction”, Tadj Oreszczyn, “Sustainable development”, Nick Tyler.

Dirk Jan Broer: “Switching Plastics: “Hierarchy in Molecular Design Modulating Shapes, Surfaces, Optics”

Dirk is a chemical engineer and Professor at the Department of Chemical Engineering and Chemistry, Group Functional Organic Materials and Devices at Eindhoven University of Technology. In his talk he presented his work with smart polymers and how to build in responsive material behaviour at molecular level. He showed examples of smart polymers that move in response to heat, touch, moisture, or pH levels. He highlighted his interest in how to develop applications for polymer actuators to create dynamic topologies in an architectural context. As an example on this he discussed his work with Aurelie Mosse and their experiments to develop “Photo-kinetic Textiles”. The audience questioned the technology in relation to reversibility, durability, recyclability and life-span.

Ruairi Glynn: “Animating Matter”

Ruairi Glynn is an architect and installation artist. He teaches on Masters programme at the Bartlett School of Architecture, UCL and Central Saint Martins, UAL. In his talk he presented his work with interactive installations and human responsive robots. He is interested in studying the emotional response triggered by animated robots. He discussed the perception of biological motion and how to manipulate robots to self learn and develop adaptive behaviours.

Kasper Stoy – “Energy-Active and Materially Smart Design in Robotics”

Kasper Stoy is a robotist, Associate professor and head of USD modular Robotic Research Lab at the University of Southern Denmark, SDU. He presented his research into the design and construction of robots based on the study of material behaviour and mechanical systems. As an example he presented a robot that uses gravity to ‘walk’. He stressed the importance of intuition and empirical research in his working method and advocates for ‘better design, not better engineering’.

DISCUSSION for session 1

Session 1 was followed by group discussion and focused on:

- When working with smart responsive materials, how do we navigate between the ability to steer and control material behaviour, and the possibility to not be fully in control? When does the material take charge?
- How can we use adaptive and responsive smart polymers to develop resilient system in architecture?
- Can we optimize these materials according to time and scale?
- Can energy-active materials contribute to reducing the overall use of energy in an architectural system?

SESSION 2: ENERGY AND DESIGN

Adriaan Beukers: “Lightweight Composite Structures for the future”

Adriaan Beukers is an aerospace engineer. He is a full time Professor at the Faculty of Aerospace Engineering at the Delft University of Technology and part time Professor at the Materials Department at the Catholic Leuven University. Adrian presented his research into ‘frozen textile structures’ to achieve ultra light structures. He presented several projects, from automotive textile prototypes to aircraft proposals as well as the development of specific machinery to engineer lightweight structures.

Guillaume Foissac: “Nothing is simple, there are only simplified things”

Guillaume Foissac is an engineer and designer who works in the R&D department at EDF (Electricity of France). His research is focused on developing new industrial design solutions that foster energy efficiency and innovation in the field of renewable energies. He presented his methodology and his approach to design with an engineering perspective and argued that it is the task of a designer to simplify complex problems. He presented the project ‘Herbier Energetique’, a series of design prototypes which combined two or more technologies such as a heat pump combined with a solar harvesting system. He outlined the importance of interdisciplinary collaborations to sustain design innovation.

Aurélie Mosse: “Material Tales for Self-Actuated Textiles”

Aurélie Mossé is a textile designer and PhD student in Tectonic Textiles in the double context of the Centre for It and Architecture (CITA), Copenhagen, and Textile Futures Research Centre (TFRC), London. Her work is practice-based and design-led. In her presentation, she asked how the design of self-actuated textiles can contribute to a domestic culture of interconnectivity in a 21st century disconnected interior. She discussed the following by introducing three examples in her practice: 1) “Photovoltaic Mashrabyia” a textile membrane exploring the aesthetic potential of flexible thin photovoltaic films 2) “Reef” the design of a self-actuated ceiling based on electro-active polymers changing with the wind and developed in collaboration with: Guggi Kofod from Potsdam University, David Gauthier from CIID and with support from Danish Technological University (DTU) 3) “Photo-kinetic Textiles” a material probe into shape-changing textiles induced by light in collaboration with Professor Dick Broer and Ele de Boer from Technical University of Eindhoven with support from Danish Technical University, DTU.

Anne Ladegaard Skov: “Material design and processing – hard competition or great synergy?”

Anne Ladegaard Skov is a chemical engineer, and Associate Professor at the Department of Chemical and Biochemical Engineering (DPC) at the Danish Technological University (DTU). She presented her research into dielectric electro active polymers (DEAP) and introduced the audience to the preparation process required to use DEAP. In her presentation she highlighted the challenge of upscale both the functionality, the carrier (matrix) and the manufacturing of DEAP for future applications.

Gilles Rougon: “The lighter, the smarter...”

Gilles Rougon is a Design Manager, within the Research and Development Department at EDF. He presented research data that forecast a 4 Tbit/s shortage of energy for 2050. One of the aims of his department is to propose new design solutions for energy efficient products

as well as to foster a change in people's behaviour towards consumption of energy. As an example, he presented "WINDSKIN", a design project and finalist of the EDF Sustainable Design Challenge 2011. He concluded that collaborations on energy efficiency in the following areas are vital to develop innovative design solutions: hybridisation, osmosis, bio-indication, energy production, living architectures, eco-design and resilient design.

Kate Goldsworthy: "Designing Material Journeys"

Kate Goldsworthy is a textile designer, PhD and Senior Research Fellow at the Textile Future Research Centre (TFRC) at the University of Arts London (UAL). In her talk she presented concepts for designing 'recyclability' into materials as a strategy for continuous resource use. Comparing technical and biological systems and designing appropriately for 'material journeys' within each, she presented five key Cradle to Cradle design approaches: ultra biodegradable, mono-materials, designed disassembly, up-cycling and closed-loop systems. In closing she presented a vision for a future 'material economy' in which all resources can be cycled indefinitely.

DISCUSSION for session 2

Session 2 was followed by group discussion and focused on:

- Can we use bottom up principles to develop new energy active materials?
- Nanotechnology vs biotechnology: how can we control material behaviour when *aligned* at molecular level (chemical engineering/nanotechnology) Vs. when *programmed* at molecular level (biologically programmed/synthetic biology). It was noted that research into biological fabrication has evidenced that we do not understand yet the behaviour of living molecules enough to control them fully.
- The relationship between textiles and architecture: Discussion around the etymological differences and terminology.
- The use of intuition and serendipity in research methodology. This was also noted by speakers in the first session and again highlighted in session 2.

SESSION 3: BIOLOGY AND BIOMIMICRY AS MODELS AND MATERIAL FOR DESIGN

Carole Collet: "Designing with Living Technology Horizon 2050"

Carole Collet is a Reader in Textile Futures and Deputy Director of the Textile Future Centre (TFRC) at Central Saint Martins College of Arts and Design, University of The Arts London. Carole's research focus is to explore new directions for sustainable design and to investigate emerging and disruptive technologies that can lead to a more resilient future. Carole discussed the need to move away from the current model of manufacturing based on chemical transformation and energy hungry systems to manufacturing devices based on biology. Growing products instead of manufacturing them. She presented her recent project Biolace, which explores the potential of synthetic biology to reprogram plants so that they could produce fruits and vegetables as well as textiles with their root systems.

Birger Lindberg Møller: "Plant Power: The ultimate way to go green"

Birger Lindberg Møller is a plant biochemist, Director of the Centre for Synthetic Biology and Professor at the Department for Plant and Environmental Science at the University of Copenhagen. Birger presented his research into the design of new plant systems or biologically active microbial factories to produce substances such as biofuel, medicine or food flavouring. He highlighted several successful examples: algae programmed to turn sunlight into biofuels; yeast reprogrammed to produce Toxon, a cancer treating substance

and yeast producing vanilla. Birger discussed the potential sustainable advantage of synthetic biology and the need to develop innovative ways to integrate algae solar harnessing systems into buildings.

Richard Bonser: “Biomimetics - Designing Smart and Multifunctional Structures”

Richard Bonser is Reader in Biomimetics and Design in the School of Engineering and Design, Brunel University, United Kingdom. Richard presented his research on how nature operates and how we can abstract models and principles inspired by nature. Nature has perfected systems through evolution for billions year and is often a step ahead of us when it comes to problem solving. As an example, he presented “The Octopus” a European project which aims at using biomimicry to develop soft-bodied, multifunctional robots.

Annette Schumer: “Biomimicry, The Circular Economy, Materials & Innovation”

Annette Schumer is a business economist and co-founder of BiomimicryNL. Annette presented her roadmap of knowledge on biomimicry for a new circular economy. She aims to encourage more designers to use biomimicry principles and tools to develop more sustainable products. She argues that our current technological and manufacturing models rely on key raw materials that are overexploited and will soon not be available anymore; whereas nature relies on elements which are plentiful, such as carbon, hydrogen and oxygen. The Circular Economy model and the biomimicry approach offer 'a way out'.

Louise Hard Segerstad: “From Guilt to Grace: Resilience and Planetary Boundaries”

Louise Hard a Segerstad works as a Science Communicator at “Albaeco”. Resilience, Ecosystems and Planetary boundaries are key aspects of her research. Louise stressed the importance of working ‘out of grace’ instead of ‘out of guilt’ because it is a more inspiring incentive for people. She presented two research projects: 1) “Naturescape” with Anna Maria Orru. 2) “Q-book”, with Stockholm Resilience Center, KTH and KIT and discussed models to develop an implement methodologies for resilience in urban planning.

DISCUSSION for session 3

Session 3 was followed by group discussion and focused on:

- The definition and complexity of resilient thinking.
- The need to converge skills and work at both micro levels (nano tech, robotics, and bio tech) and macro levels (design, engineering, ecologist, economist) to achieve more resilient systems
- How can we develop materiality-smart architecture and design that can optimise our potential to change and adapt.
- What kind of tools and languages do we need to develop energy active and materially smart materials for a resilient architecture?

3. Assessment of the results, contribution to the future direction of the field, outcome

What was learnt from the workshop and new objectives:

Learning how to engage with different scientific languages:

The key learning from the workshop arose from the diversity of scientific and design fields represented and allowed participants to present and discuss their individual research fields outside of their usual comfort zone. This cross-disciplinary intersection allowed us to discover each others languages, methodologies and to assess where and how we could

benefit from working together. There was a general consensus that mutual partnerships would enable each of us to enrich and challenge our respective research, be it from a very practical hands-on exchange of tools and expertise, to a more conceptual and theoretical set of framework models.

Mapping the Gaps and Steering Research Questions:

In the second day of the workshop, we identified that the 'space between' our disciplines were often leading to the most interesting conversations and highlighted the need to bridge our practices so as to pose new original research questions. Often our funding streams are dictated by our respective disciplines and few funding opportunities allow for bridging different fields, yet it is this very intersection, or 'new ways of seeing' that can lead to original contribution to knowledge. One of the sessions led us to spend time learning from each other to steer our existing research questions, or frame new ones.

New and Confirmed Objectives:

- We confirmed that we would all benefit from establishing a "Materiality of Light" network. The objective would be to create a sandbox environment for innovative ideation where scientists and designers can work together on the specification of highly engineered and energy smart materials for resilient design and architecture.
- This 'Supra' disciplinary research group that would allow us to work from the micro to the meso and macro levels and combine expertise in polymer science, synthetic biology, biomimicry, energy, robotics, chemical engineering, ecology, resilience, design and architecture.
- The network should focus on a series of practice-led workshops where we can address specific briefs identified through our respective research projects but needing expertise outside of our own fields.
- The network would also provide a range of satellite experts who could 'inject' expertise and provide new insights.

Next Steps and Action Plan:

The following next steps have been agreed at the end of the workshop:

- Develop a website reference points as a platform to grow a Materiality of Light network (see www.materialityoflight.org) (TFRC and CITA)
- Identify suitable network funding calls as part of the new European Horizon 2020 and apply for a 5 year network funding wherever possible. (TFRC and CITA to lead on this.)
- Maintaining informal connections between our respective research centres whilst waiting for a fully funded network to be established. (All)
- Start drawing a list of potential additional partners that would benefit the network, in particular from the field of material science. (All)

4. Final programme

Tuesday 18th September 2012

Afternoon *Arrival*

20.00 - *Informal meeting and drinks*
Hotel Bar, CITY HOTEL, Peder Skrams Gade 24, 1054 København

Workshop Day 1: Wednesday 19th September 2012

Danish Art Workshops Strandgade 27 B, 1401 København K

09.00 **Welcome by Convenor**
Mette Ramsgaard Thomsen, CITA, Royal Danish Academy of Fine Arts, Schools of Architecture, Design and Conservation, School of Architecture DK and **Carole Collet**, TFRC, Textiles Future Research Centre, CSM, Central Saint Martins, University of the Arts

Presentation of the European Science Foundation (ESF)
Dr Salim Belouettar (Standing Committee for Physical and Engineering Sciences - PESC). *Cancelled.*

10.15 Morning Session 1: Responsive design and materials

Mette Ramsgaard Thomsen, "Material Designs"
Professor and Head of CITA Centre for IT and Architecture, Denmark

Marco Federighi, "Light and Shadows"
Vice Dean of Engineering Sciences, UCL, United Kingdom

Dick Broer, "Switching Plastics: "Hierarchy in Molecular Design Modulating Shapes, Surfaces, Optics"
Professor and Head of Group Functional Organic Materials & Devices (SFD), Eindhoven University of Technology, Dept. Chemical Engineering & Chemistry, The Netherlands

Ruairi Glynn, Animating Matter"
Lecturer in Architecture & Interactive Design, UCL Bartlett, United Kingdom

Kasper Stoy, "Energy-Active and Materially Smart Design in Robotics"
Associate Professor and Head of Modular Robotics Lab, The Maersk Mc-Kinney Moller Institute, University of Southern Denmark, Denmark

Session 1: Q&A and Group Discussion

11.45 Tour of Danish Art Workshops

12:00 Lunch

13:00 Afternoon Session 2: Energy and Design

Adriaan Beukers, "Lightweight Composite Structures for the future"
Professor and Chair of "Design and Production of Composite Structures" and of Centre for Lightweight Structures, TU Delft, The Netherlands

Guillaume Foissac, "Nothing is Simple, There are Only Simplified Things"
Engineer researcher, EDF R&D, France

Aurelie Mosse, " Material Tales for Self Actuated Textiles"
PhD Candidate, CITA Centre for IT and Architecture, Denmark

Anne Ladegaard Skov, "Material Design and Processign-hard competition or great synergy?"

Associate Professor, DTU Chemical Engineering, Department of Chemical and Biochemical Engineering, DTU, Denmark

Gilles Rougon, " The Lighter, The Smarter..."

Engineer research, EDF R&D, France

Kate Goldsworthy, "Designing Material Journeys"

Senior Research Fellow, TFRC, University of the Arts London, United Kingdom

Session 2: Q&A and Group Discussion

14.45 Coffee/Tea Break

15.15 Afternoon Session 3: Biology as model and material for design

Carole Collet, " Designing with Living Technology Horizon 2050"

Reader in Textile Futures Central Saint Martins College of Art and Design, University

of the Arts London, United Kingdom

Birger Lind Moller, "Plant Power: The Ultimate Way to Go Green"

Professor and Head of Department of Plant Biology and Biotechnology, Univeristy of

Copenhagen, Denmark

Richard Bonser, "Biomimimetics-designing Smart and Multifunstional Structures"

Reader in Biomimicry and Design, Brunel University, United Kingdom

Annette Schumer, "Biomimicry, the Circular Economy, Materials and Innovation"

Co-founders of biomimicryNL, The Netherlands

Louise Hard Segerstad, "Resilience and Ecological Modelling"

Albaeco/Stockholm Resilience Centre, Sweden

Session 3: Q&A and Group Discussion

17:00 Group Discussion and introduction to Day 2 programme.

19:00 Drinks followed by Dinner

Workshop Day 2: Thursday 20th September 2012

Danish Art Workshops Strandgade 27 B, 1401 København K

9:00 Welcome & Coffee

9:30 Morning Session: What do we have in common-emergent knowledge territories and their intersections

Hands On Knowledge Mapping workshop led by Mette Tamsgard Thomsen

10:30 ToolBox: Sharing research tools and methodologies emerging from our respective research fields, discussion.

12:00 **Lunch**

13:00 **Afternoon Session: Where do we go from there? Future perspectives and the need for dialogue.**

Future-Scoping workshop exploring energy active and materially smart design concepts for a resilient future led by Carole Collet.

15:00 **Coffee / Tea Break**

15:30 **Discussion on follow-up activities, networking and collaborations. Exploring possibilities for future funding.**

16:30 **End of Workshop Program**

18:00 **Drinks and Dinner.**

5. Final list of participants

Convenors:

Mette Ramsgaard Thomsen

Professor and Head of CITA, Royal Academy of Fine Arts, Copenhagen, Denmark

Carole Collet

Reader in Textile Futures, Deputy Director TFRC

Central Saint Martins College of Art and Design, University of the Arts, London, United Kingdom

Participants:

Adriaan Beukers

Professor, Faculty of Aerospace Engineering, Delft University of Technology and in the Materials Department, Catholic Leuven University, The Netherlands.

Richard Bonser

Reader in Biomimicry and Design, Brunel University, UK

Dick Broer

Professor, Eindhoven University of Technology, Dept. Chemical Engineering & Chemistry Group Functional Organic Materials & Devices (SFD), The Netherlands

Marco Federighi

Vice-Dean of Engineering Sciences, University Central London UCL, United Kingdom

Guillaume Foissac

Engineer Researcher and Senior Lecturer, EDF – R&D, France

Ruairi Glynn

Lecturer in Architecture & Interactive Design, UCL, Bartlett, Faculty of the Built Environment, United Kingdom

Kate Goldsworthy

Senior Research Fellow, TFRC, University of the Arts London

Anne Ladegaard Skov

Associate Professor, DTU Chemical Engineering

Department of Chemical and Biochemical Engineering, DPC, Technical University of Denmark

Aurelie Mosse

PhD Candidate, Royal Academy of Fine Arts, CITA, Denmark

Gilles Rougon

Design Manager, EDF - R&D, ENERBAT, France

Annette Schumer

Business economist, co-founder BiomimicryNL, The Netherlands

Kasper Stoy

Associate Professor, Modular Robotics Lab , The Maersk Mc-Kinney Moller Institute University of Southern Denmark

Louise Hård af Segerstad

Stockholm Resilience Centre and Albaeco, Stockholm University, Sweden

Birger Lind Moller

Professor and Director of the Synthetic Biology Research Centre, University of Copenhagen, Denmark

6. Statistical information on participants

Of the 16 participants (including convenors) 7 were women.

Of the 16 participants (including convenors) 1 was under 35, 4 under 40, 6 under 45, 2 under 50, 1 under 55, 1 under 60 and 1 under 65.

PERSON	AGE	COUNTRY	M/F	SCIENTIFIC SPECIALITY
Convenor:				
Mette Ramsgaard Thomsen, CITA, Royal Academy of Fine Arts, Schools of Architecture, Design and Conservation, School of Architecture	40-45	DK	F	ARCHITECTURE
Co-Convenor:				
Carole Collet, Textile Futures, Central Saint Martins College of Art and Design, University of the Arts London, TFRC/ Research Department	40-45	UK	F	DESIGN
Participants:				
1. Richard Bonser, Brunel University	45-50	UK	M	BIO-MIMICRY
2. Dick Broer, Eindhoven University of Technology, Dept. Chemical Engineering & Chemistry Group Functional Organic Materials & Devices (SFD)	50-55	NL	M	POLYMER ENGINEERING
3. Marco Federighi, Engineering Sciences, UCL	50-55	UK	M	ENGINEERING
4. Guillaume Foissac, EDF – R&D	35-40	F	M	DESIGN
5. Ruairi Glynn, UCL Bartlett , Faculty of the Built	35-40	UK	M	INTERACTION/

	Environment				ARCHITECTURE
6.	Kate Goldsworthy, University of the Arts London, TFRC/ Research Department	35-40	UK	F	TEXTILE DESIGN
7.	Anne Ladegaard Skov, DTU Chemical Engineering, Department of Chemical and Biochemical Engineering, DPC, Technical University of Denmark	40-45	DK	F	POLYMER ENGINEERING
8.	Aurelie Mosse, Royal Academy of Fine Arts, CITA, School of Architecture	30-35	DK	F	TEXTILE DESIGN
9.	Gilles Rougon, EDF - R&D, ENERBAT	40-45	F	M	DESIGN
10.	Kasper Stoy, Modular Robotics Lab The Maersk Mc-Kinney Moller Institute, University of Southern Denmark	40-45	DK	M	ROBOTICS
11.	Birger Lind Moller, Synthetic Biology Research Centre, University of Copenhagen, Faculty of Life Sciences	55-60	DK	M	SYNTHETIC BIOLOGY
12.	Louise Hård af Segerstad, Stockholm Resilience Centre	35-40	SE	F	ECOLOGY/RESILIENCE SCIENCE
13.	Adriaan Beukers , TU Delft, Faculty of Aerospace Engineering	60-65	NL	M	AEROSPACE ENGINEERING
14.	Annette Schumer, Biomimicry NL	40-45	NL	F	BIOMIMICRY