Materials in the Creative Industries

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Science and Technology Working Group

Materials and Creativity

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Background

It is a central tenet of materials science that a particular structure; microstructure, nanostructure, or an electronic structure, develops a particular set of properties, such as strength, band-width, etc. This provides a framework for the development of new materials such as aluminium alloys, semiconductors and biomaterials. The situation is very different for materials whose performance is not based solely on physical parameters, but also on sensual, tactile, aesthetic, and cultural properties.

These properties are particularly important for structures such as buildings, interiors, urban spaces and clothing – in other words, structures in which human comfort, inspiration, and sensual satisfaction are important. These structures tend to be designed by members of the creative industries, such as architects, designers, jewellers and clothes designers because of their level of expertise in understanding the needs of people.

However, there exists no systematic methodology for the development of materials with such senso-aesthetic properties. Until recently there has been almost no relationship between materials scientists and creative industry professionals. There is no coherent body of research linking structure to senso-aesthetic properties of materials.

The status quo is not ideal for many reasons. Firstly, the creative industries are economically very important in the UK. These industries employ 1.3 million people, generate £112.5 billion and account for 9.1% of the GDP. However they are not playing their full role in determining the focus of publicly funded materials research.

Secondly, the cultural sector has a long history of posing interesting problems which push science forward, for example the need for materials that transform their properties in response to digital stimuli for virtual touch. Such new materials would impact heavily on architecture, jewellery, clothing and product design.

Thirdly, materials have an immense cultural significance, and as such, the introduction of new materials by an isolated materials-science community holds the prospect of a further deepening of the rift between scientists and society.

Fourthly, the environmental impact and sustainability of materials manufacturing is dependant very much on the social use of the technology, which itself is related to the look, feel and smell (senso-aesthetic properties) of such materials.

2.
Current Trends

In architecture, glass, brick, steel and concrete remain pre-eminent as building materials, although both the interior and exterior of the buildings are changing, driven by social, cultural, economic and environmental drivers. Self-cleaning exterior coatings, such as titanium oxide coated concrete and glass are increasing in importance, combining aesthetic, practical and economic benefits. Thermochromic glass coatings in the infra-red range have been developed for insulation of glass clad buildings. Electroluminescent glass and polymers are also been incorporated. Integrating solar cells into the fabric of buildings, and thus manufacturing and connecting them on an industrial scale either on-site or off-site remains one of the primary aims of many architects.

Many manufacturers also claim to be developing building materials that convert sunlight into electricity, and also have interesting senso-aesthetic properties, but none has yet been demonstrated. Passive heating and cooling of buildings is also becoming increasingly popular, as it gives the building eco-credentials and the technology is established.

However, the actual effectiveness of such schemes is often poor, since to do it well requires modelling and development time, and the actual results are generally not experienced by the building's owners but by the tenants (through their energy bills). In addition the building trade is notoriously conservative and so charge a premium for incorporating new technologies into their buildings. Textiles with improved functionality, incorporating biosenors and electronics are being developed by companies such as Phillips for wearable technology applications and also by healthcare companies for therapeutic clothing. In the healthcare arena, wound dressing is an important application for new materials, since they affect the rate of healing, protect from infection and encapsulate odours. It has been shown that the senso-aesthetic properties of dressed wounds affect the outcome of the treatment – these products have an enormous impact on the mobility and recovery time of patients, especially for the elderly.

Clothes that administer doses of medication and monitor wound healing are also in demand, enabling patients to be discharged from hospital earlier. Anti-bacterial and anti-microbial materials and bedding are also in demand, especially in UK hospitals where battles against superbugs such as MRSA are strong. The integration of electronics into clothing providing mobile computing and energy generation are also of growing importance to the fashion and sports industries.

3D fabricators and rapid prototyping machines are making a growing impact in the areas of design, architecture and jewellery. The primary and most immediate impact is on the design process itself. The technology allows the design cycle from sketch to physical prototype to happen in a matter of hours, allowing a much greater range of designs to be sampled. The move from rapid prototyping to rapid manufacturing is occurring first in high-end design, but also has the potential to make an impact into mass markets. This has already happened in the jewellery industry where much of the high street UK jewellery is produced through rapid prototyping. The impact of 3D printing in healthcare (for implants) is already in place. Its use in association with 3D MRI to produce bespoke implants for hips and other bone replacements, as well as for dental implants is receiving significant interest. The use of rapid prototyping for bespoke hearing aids and other acoustic devices such as bluetooth head-sets is also ongoing.

More generally, rapid manufacture based on user defined parameters and measurements is on the increase, there are furniture manufacturers working with CAD systems that allow furniture and lamps to be made to order with user defined sizes for the same cost as IKEA furniture. It is only a matter of time before many other household goods follow suit, such as cutlery and tableware.

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3.

Market Drivers

The market drivers include interactivity, individualisation, and sustainability. In the case of Architecture there is a huge desire to deliver buildings with greater interactivity. This takes the form of both technology push, with the architects keen to use innovative new materials, and technology pull, where clients desire more versatile living and work spaces while also requiring them to be more energy efficient.

Global competition for signature buildings, where significant cash is available to fund avant guard design is another driver, especially in the Far East and Middle East. The development of such buildings can drive economies of scale for new materials that then allow more economic and widespread use. Most new materials are used currently for either their visual and textual aesthetic or on the grounds of energy conservation. Very little has been done in terms of using materials to control the smell and sound of buildings, despite the great desire by architects to have more control of such properties, especially in hospital and restaurant design. With Design the major driving force is the desire for sustainability of the product consumption model.

There has been a recognition that this form of consumption does not lead to greater wealth if it comes at the cost of environmental degredation and the depletion of natural resources (e.g. Cradle to Cradle approach). Sustainability is an ill defined concept, and most manufacturing claims can be thought of as dubious at best. This is because it is not clear either what they are trying to sustain, or how it might be measured – the question of whether a paper bag is more sustainable than a plastic bag is still an open one.

Since materials are core to the question of sustainability – in terms of resources (recycling) and energy (processing) – it is clear that a major driver for materials research is product lifecycle and product energy densities. Biodegradable or recyclable electronics and display technologies are in high demand, but only as long as their performance is not impaired.

Individualised manufacturing is also becoming important (the birth of so called pro-sumerism). Footwear is one such application, now that 3D scanning technologies are prodiving the ability to measure feet and design footwear specifically for an individual. 3D rapid prototyped football boots have already been produced for professional footballers. The widespread familiarity with computers, 3D models and virtual worlds, makes this type of technology more desirable to the digital generation. The trend to use computer software to specify and design not just shoes but also clothes and furniture is in essence the 21st century equivalent of the craft based society that was largely abolished by mass production in the 20th century. The difference in this case is that the manufacturing will be done by programmable machines and the skills for designing such garments and furniture will be digital, not manual.

4.
Barriers

The UK is a global hub for the creative industries. It is also a global hub for materials science. Yet the two communities rarely talk. While the IOM3 has done a good job at getting creative industry professionals interested in materials science through the Materials KTN, and the UK Building Centre has tried to do the same with architects, it has not always been easy to get top materials scientists to emerge from their labs to engage with any of the creative industry professionals. This is partly because of the lack of funding in the area, and also the perception that the study of senso-aesthetic properties of materials is not thought to lead to high profile publications in top journals.

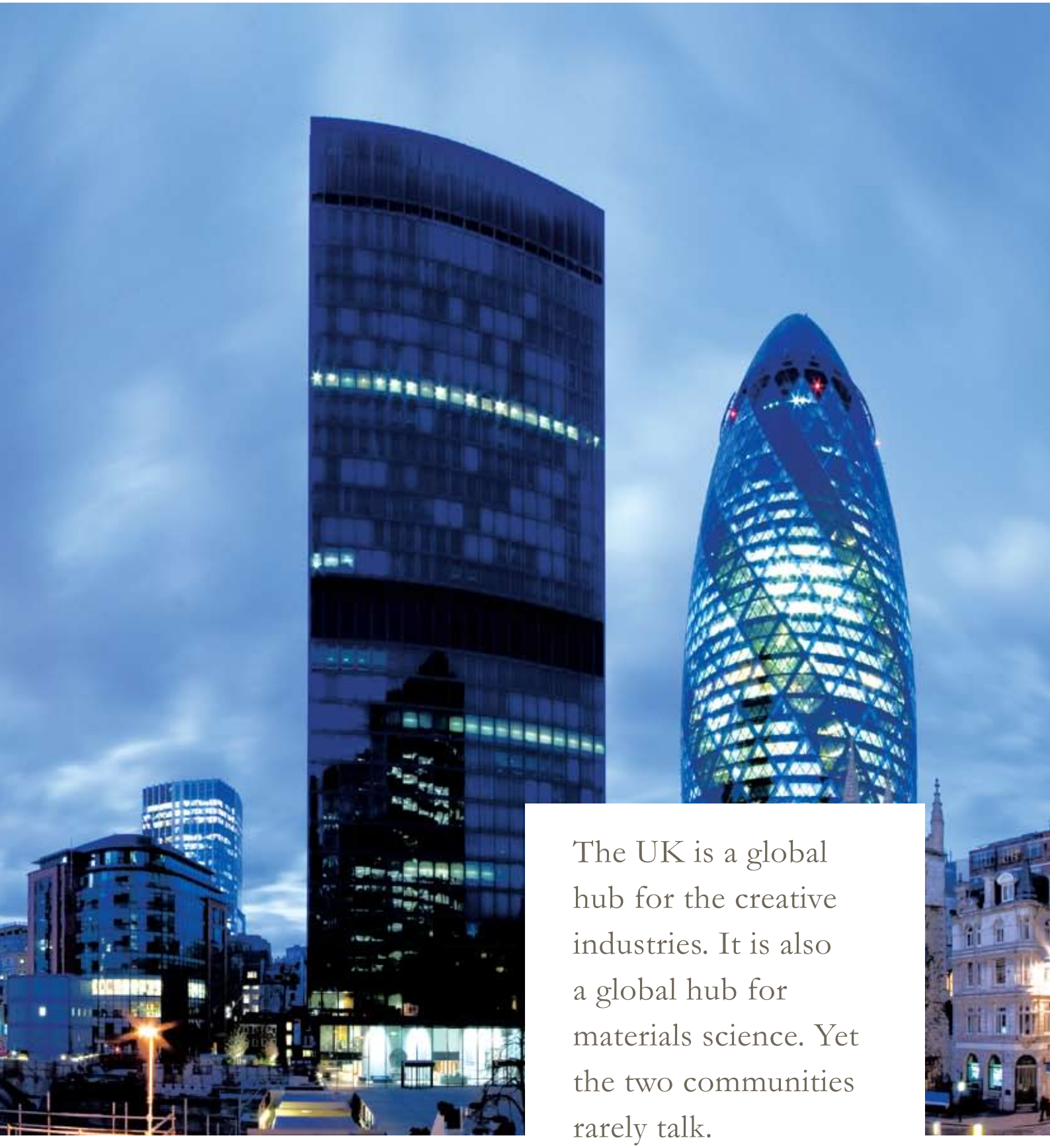
You only have to look at the research portfolio of the materials scientists in the UK to see the picture. This lack of dialogue and cross-fertilisation is the first major barrier – it is part of the classic arts-science divide which is widespread in the UK culture.

Architects do very little materials research. In fact they tend to refer to materials as products, specifying them as one might specify the pieces of a Lego set. The set of materials open to an architect is determined both by those available from the manufacturers of materials products, and also by engineers and building contractors who will charge higher fees to work with new materials. A further complication is that buildings insurers impose stringent requirements in terms of the certified longevity of the building materials and structures. Government regulations on buildings, although designed to make them more energy efficient, safer and healthier, are a barrier to innovation, since they require that a huge amount of development and testing needs to be done before new materials can be used in buildings.

This is also of course true in the aerospace industry. The difference is that aircraft manufacturers often have their research subsidised through government programmes. Also, the companies involved are usually much larger and so able to maintain R&D departments as well as commissioning university research. Thus it is that the building materials and processes are somewhat less sophisticated than in other industries – and there is little perceived inventive for materials scientists to work in the area, either in terms of strategic alliances with architects or engineers (The building consortia themselves are fragmentary in nature).

In Design there is not as much regulation but the situation is very similar with a low level of research and innovation in terms of new materials. Design businesses are usually quite small, and as such, innovation is often related to the chance finding of materials used in other industries and repurposing them.

Even large design companies do little research, since their margins are small. Using materials selection as a research tool requires skilled personnel but also an ability to modify the materials to suit new uses. Design companies like Apple do this by working with the materials manufacturers. This means that finding out about materials becomes a major issue for innovative companies. As the number of materials and manufacturers becomes greater and the range more complex, this task becomes harder and harder. It requires personnel that can speak both the language of design and the language of science – these people are very few in number. If such tasks are left to marketing personnel the results are not good.



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5.

Competitiveness

The UK Position

London is a world-class creative hub. It has an international reputation for art and design colleges, such as the Royal College of Art, Goldsmiths College, Central Saint Martin's, and the London College of Fashion. The final shows of these colleges attract talent scouts of the major companies from all over the world. Jonathan Ives, the designer of the iMac, the iPod, and the iPhone is a graduate of the Royal College of Art.

Architecture is also very strong in London with at least six of the top architects based in the city, as well as a huge number of smaller practices. London is also home to many top materials science and engineering programmes including Imperial College, UCL, King's, Queen Mary and many others.

Other major creative hubs such as Milan, Paris, New York and Tokyo do not have such a rich combination of educational and research establishments. What they do have which London lacks, is a strong manufacturing base – a set of SME's that have working relationships not just with their own designers and fashion companies but with scientists and engineers.

Paris and Milan in particular have developed very strong links between their cosmetic and fashion manufacturers, designers, and scientists. Conferences such as the recent workshop on psycho-physical materials in France (Sept 08) and the upcoming Pangborn conference in Italy (July 09) are important indicators of this interdisciplinary culture, and include not just materials research from cosmetics and fashion labs, but also from car manufacturers and architects. These hubs also all have access to materials libraries as resources and spaces for creative industry professionals to find out about new materials technologies.

London has a number of smaller materials libraries but these are not integrated to serve the complete range of creative industry needs. Thus London is rich in ideas and talent but poor in manufacturing and networked materials infrastructure.

Birmingham is an internationally recognised jewellery hub – it has excellent colleges, a strong manufacturing base as well as a healthy pool of skilled talent. In the face of strong competition it has managed to maintain its vibrancy by maintaining its reputation for high quality design and by innovation. The link with the Jewellery Industry Innovation Centre provides a way in which new technology is introduced into this manufacturing sector.

Much of the success is undoubtedly due to the history and social structure of the Birmingham district, it has a jewellery making culture which allows skills and talent to be valued and developed without reducing them solely to their monetary value. The sustainability of this culture is threatened by the transformation of parts of the area by the growth of housing schemes and recreation facilites, as well as an alternative approach to sustainability based on consumption rather than production. There are however very few links with the materials science departments.

Globally there is a tremendous appetite for materials knowledge. This is partly because almost all creative industry research starts with getting a 'feel' for a material – the senso-aesthetic properties come first.

Whether it be architecture, design, jewellery or fashion, the need to interact with and 'feel' material samples is paramount. Hence there are now materials libraries in New York, Paris, Amsterdam and Milan, as well as many other minor ones. Many design and architecture companies find materials libraries so important that they have in-house facilities, such as Heatherwick Studios, IDEO, Foster and Partners. However all these materials libraries have severe limitations – they serve very specific design communities, their materials collections are extremely limited, they only deal with commercial materials, but most importantly, they are almost completely dissociated from the materials-science community.

London is an exception in that it is served by a few materials libraries that do try to connect the materials science community to the creative industry professionals, such as the IOM3 Materials Library and the King's Materials Library, however they are relatively small in size.

6.
The Key Issues

Although the creative industries as a whole are very large, they are mostly made up of small companies, and these SME's are too small to commission materials research.

Companies such as Fosters and Partners, as world class architects claim they could develop more business if they could bring more materials innovation into new buildings. Architects do search for new materials solutions but they rarely initiate them. Even the more daring of architects find it too difficult to engage in this sort of activity. Therefore, if the UK wants architects to innovate more from a materials perspective, one of the issues that must be addressed is how to support materials research that benefits British architecture as a whole, or British designers, or British lighting or interior designers.

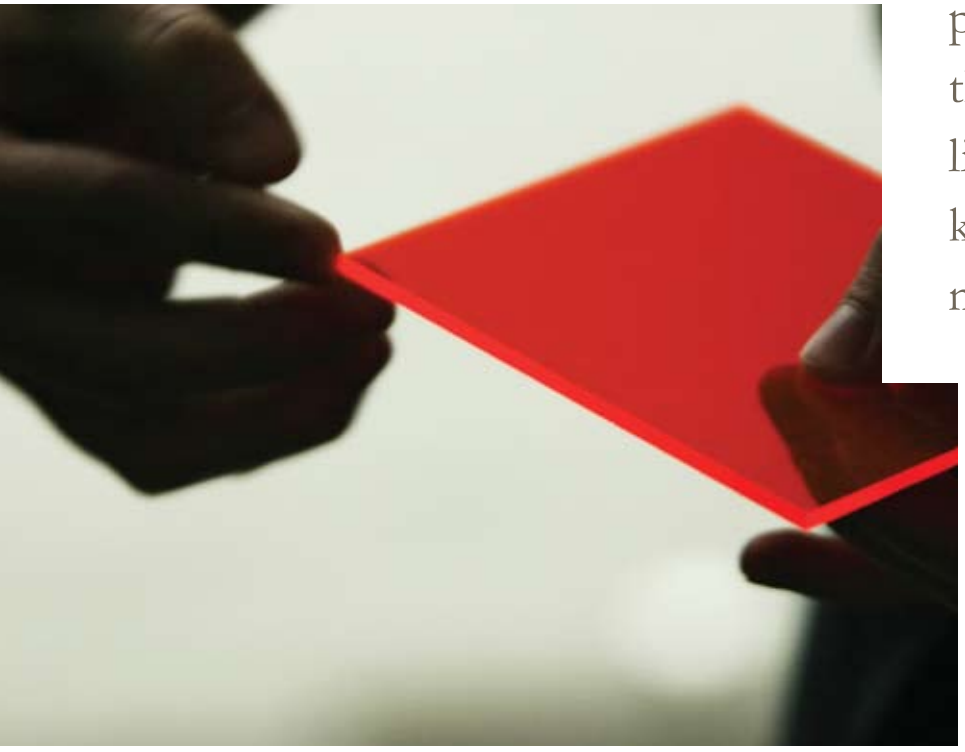
Globalisation has benefited the UK creative industries by allowing them to access much larger markets. On the other hand it has smeared out the distinctive traits of national styles, whether it be in clothes fashion, design, architecture, the 'brand' is no longer associated with nation states. If materials research money is to flow into the creative industries it needs to do so with a specific agenda. If the only requirement is economic gain, then enhancing the abilities of some international brands to further dominate the market place is the most likely outcome of an undifferentiated call for proposals. It would be to miss the potential of the creative industries to enhance public life, and address the question of real sustainability and improve healthcare. A key issue here is what values the UK wishes to establish in good design, health and architecture. Thus any funding must be accompanied by creative leadership.

Although the UK has some of the best materials science and engineering academic departments in the world, none of them interact with the creative industries to any significant extent and none of them have professorial Chairs associated with the creative industries. This contrasts with other innovative sectors such as aerospace materials, or nanomaterials materials, which are uniquely represented in the UK materials science and engineering departments – such as Rolls Royce or Corus/Tata professorships. This sends a strong message that materials science and engineering is relevant only to a small proportion of the manufacturing community, and indeed the syllabi clearly reinforce this impression. The materials science community needs to be alerted to the fact that the creative industries are as important as aerospace and as worthy of investigation.

Sustainability is a key issue, but remains poorly defined. Unless more clarity is established about the meaning of this term and its relevance to the materials industries, the public will start to ignore it. Little research on such issues is actually done in materials science and engineering departments. By contrast the creative industries is engaged in a whole host of initiatives and design-related methodologies to understand sustainability from a human and community perspective.

Clearly sustainability is a 'systems' property since it relates to both manufacture and usage – as such it is the perfect subject to unite the arts and sciences, since they both are part of the materials system.

All creative professionals agree that materials libraries are the best knowledge transfer mechanisms.



7. Recommendations

To encourage a culture of research and development for the benefit of the creative industries a grand challenge competition should be set up to design and manufacture new materials for the creative industries. There should be several categories, e.g. Architecture, Design, Fashion, and Jewellery. Consortia of industry professionals, materials scientists and professionals should be encouraged to apply. The criteria must be that it will enhance the creative industries as a whole not just narrow economic needs.

To encourage leadership in the materials sciences, a professorial Chair in Materials Science for the Creative Industries should be established. The aim of this initiative must be to establish research excellence in materials science for the creative industries. The effectiveness of this post should be evaluated on research excellence, creative industry impact and interaction, curriculum change within the degree course, and should be self-sufficient in funding after 10 years. This chair should have associated with it, certain admin support to enable the holder of this chair to deal with the huge number of enquiries from members of the creative industries that will necessarily ensue.

All creative industry professionals agree that materials libraries are the best knowledge transfer mechanisms for new materials technologies – they need to feel, smell, see the materials. A national programme of resources and an effective network of libraries should be made available.

Knowledge transfer should be central to the library network enabling materials manufacturers to display their samples. The library network should provide an interface for materials scientists and engineers with the creative industries.

To encourage an educational shift in both the arts and the sciences, a series of fellowships should be created. These would allow materials scientists to spend one year in a design, architecture or other materials-arts departments. During their fellowship they would be expected to teach basic materials science to the arts students in innovative and approachable ways. Through this immersion they will also appreciate the types of senso-aesthetic research that can make an impact in the creative industries. Additional fellowships should be allocated for materials-arts professionals to spend a year in materials science departments teaching courses such as 'Materials for Architecture'.

Likewise the outcome of these fellowships would be designed to initiate culture change within the institution. These fellowships should be aimed at mid-career professionals who are already established experts in their fields.

8.
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