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Materials Development: An Alternative Career Pathway for Design Graduates

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ABSTRACT

Prescribing materials for manufacturing a designed object has always been part of the industrial designer's palette of skills and knowledge areas. While the typical approach would be for designers to specify commercially available materials during the product development process, the development of novel raw materials, particularly "sustainable" ones, has become another avenue of activity for industrial design graduates in recent decades.

The strong link in materials innovation that exists between industrial design practitioners and materials development technologists is confirmed by the emergence of various organizations and resource centers dedicated to this pursuit, such as the Materials and Design Exchange and Material ConneXion. Many "designerly" books and magazines have also recently surfaced to inform and inspire product creators on material-intensive manufacturing innovations. A couple of international competitions have also been organized to challenge design professionals and students to creatively fashion consumer goods from innovative or sustainable materials.

This paper catalogues various educational activities in some universities around the world, where industrial design students have been actively engaged in the exploration of new material resources that could be considered for product development. Cases include undergraduate design projects on prototyping experimental materials and product proposals from those materials; a highly successful partnership of design graduates who invented an organic binding and insulation material while working in a university incubation centre; and an interdisciplinary master's degree in design and engineering with a materials specialization.

Furthermore, the material development work done by industrial design practitioners in design workshops and research laboratories are also reported on, and this supports the proposition that working on new sustainable materials can provide an alternative career path for graduates of industrial design degree programs.

INTRODUCTION

"Materials are the stuff of design", writes Ashby & Johnson (2002). Indeed novel materials have a highly significant role in innovative product design and development, and thus courses in materials and manufacturing are core standards in every industrial design curriculum.

Industrial designers work with material technologists in various ways. Typically in response to a conventional product development brief designers would refer to a material selection handbook, or seek assistance from technologists in prescribing the most appropriate material or process. Sometimes a new material has been developed or commercialized and the industrial designer is called in to ideate product applications. Nowadays, it would not be uncommon to see that industrial designers themselves are the ones deeply involved in innovative material origination and experimentation, building up a working knowledge and understanding of the aesthetic, behavioral, emotional and sensory properties of materials (Williams, 2007). This last strategic role is the focus of this paper.

I. RESOURCES FOR INSPIRING MATERIALS IN DESIGN

Recent decades has seen an accelerated growth in the number of knowledge centers that are forging connections and communications between the materials and design communities, and that are inspiring designers to create even more fascinating innovations. Material ConneXion is the world's largest global resource of new materials; its physical libraries in New York, Cologne, Bangkok, Daegu and Milan have 4,500 samples of innovative and sustainable materials and processes, accessible to member designers and corporations. This resource allows designers to fully understand a material's potentials and limitations for their specific creative applications (Beylerian *et al*, 2005). Figure 1 shows other online resources and information platforms that help industrial designers find the right materials and processes for their projects.



Figure 1. Online resources for materials and design.

There are two large professional societies which promote the materials and design junction: MADE and ASM/Mtrl. MADE is the Materials and Design Exchange, which publishes a free magazine thrice a year for the design and materials communities. A program of the Materials Knowledge Transfer Network (KTN), MADE is a partnership between the UK Design Council, the Institute of Materials, Minerals and Mining (IOM3), the Institution of Engineering Designers, and the Royal College of Art. MADE has a material resource centre in London, and delivers free workshops on material innovations for the design community (Williams, 2007). On the other hand ASM/Mtrl is the Materials Information Society, providing industrial design professionals with authoritative databases, expert perspectives, and workshops and updates on materials innovation. Formerly the American Society of Metals, the organization expanded its geographic and material scope when it rebranded itself to ASM International.

Aside from resource centers and websites, another avenue which could excite designers to participate in materials development are “designerly” competitions which award creative material and process innovations. One of these is “Composites on Tour” (www.compositesontour.be) a travelling exhibition and international design competition series funded by the European Commission to raise public awareness about composite materials and their applications. The competition ran in 2002 and 2007 and was open to both design students and professionals, and called for technologically and artistically innovative consumer goods which use fiber-reinforced polymers in an intelligent and highly effective manner. Another competition is the €15,000 Doen Materiaals Prijs 2009 (www.doen-materiaalprijs.nl) which invited Dutch fine artists and designers to come up with sustainable designs that combine innovative materials with style, beauty and functionality. Among the entries are a chair from sugar-beet waste, “wood” made out of newspapers, and a bird house of fallen autumn leaves.

The constant stream of new designerly references on emergent materials will no doubt inspire designers to consider materials innovation as an interesting area to contribute their creative talents to. In the last decade the following have been published: Transmaterial in 3 volumes (Brownell, 2010), the multi-volume handbook series on manufacturing and Materials for Inspirational Design (Lefteri, 2006; 2007), the Materiology manual (Kula & Ternaux, 2009), the Materials and Design selection guide (Ashby & Johnson, 2002), and the encyclopedia-like Manufacturing Processes for Design Professionals (Thompson, 2007).

Finally, industry expositions, conferences and workshops provide regular avenues for creative professionals to showcase their works as well as get inspired by the latest material discoveries. The MaterialXperience yearly trade shows in various cities in the Netherlands is a free “inspirational event where contact, atmosphere and experience by stimulating all the senses is the central focus” (www.materialexperience.com). Aside from being a meeting place for designers and manufacturers it is also a lecture venue for speakers worldwide to share their work on materials.

II. UNIVERSITY & INDUSTRY PROGRAMS IN MATERIALS & DESIGN

As previously stated, the study of materials and processes is standard in the curricula of all industrial design degrees. We were interested to find out if there are specialist degrees on “materials and design” for people who want to make a career out of this area. We came across some interesting educational approaches in covering this subject.

A. Politecnico di Milano

The design, mechanical engineering and materials engineering departments of the Politecnico di Milano in Italy joined forces to offer a two-year Interdisciplinary MSc (*Laurea Magistrale*) in Design & Engineering. “Materials” is one of the specializations of this combined degree; in this stream professional designers are trained with specific competencies in materials and surfaces, thus integrating the “technical-engineering” culture with the design culture. The course entails manipulating all perceptive and sensorial aspects of materials and understanding the interaction between materials and the environment.

B. Rensselaer Polytechnic Institute

A dual undergraduate major in Product Design and Innovation (PDI) is offered by the Schools of Engineering, Architecture, and Humanities, Arts, and Social Sciences at the Rensselaer Polytechnic Institute in Troy, New York. The program allows students to combine a BSc degree in Design, Innovation, and Society with a BSc in a technical field such as mechanical engineering, computer science, or management. The PDI degree includes a class called the “Inventor’s Studio”, which offers students hands-on experiences with the process of developing a commercially viable product and patenting it. Two of the most successful students of this course are Eben Bayer and Gavin McIntyre, who developed a material known as Greensulate™. This material is a renewable, compostable, biodegradable and organic thermal insulator and packaging medium grown from seed husks and mushroom roots. The university also operates the Rensselaer Technology Park, a business incubator for technology ventures focused on the interface between industry and education. Bayer and McIntyre began their start-up company in this incubator (Ecovative Design www.ecovativedesign.com) and has since won many international prizes, accolades and research grants for Greensulate.

C. Innventia

Formed by the merger of STFI (Swedish Test Fiber Institute) and Packforsk (Swedish Packaging Research Institute), Innventia AB (www.innventia.com) is now a world leader in the research and development of biomaterials. One of the ongoing projects of this academic research institute is exploring renewable material design, using a hierarchic design approach where the design perspective influences the entire materials development process. Innventia’s ability to develop innovative, fiber-based products and materials is enhanced by its collaborations with the Konstfack University

College of Arts Crafts and Design, the KTH Royal Institute of Technology, the Luleå University of Technology, and the École Polytechnique Fédérale de Lausanne. Two of the results of this industry-academe collaboration is the Kofesen, a solid composite of molded cellulose fiber pulp and polylactide; and a mechano-active paper capable of moving and altering its shape in response to stimuli (Innventia, 2009). Other collaborative results between Konstfack students and Innventia were shown in the “Out of the Woods” exhibition in the 2007 Milan Furniture Fair.

The Kofesen material was expanded by Joakim Nygren, a KTH MSc Engineering student for his thesis, which investigated the communication and collaboration facilitation between designers and engineers. Nygren collaborated with the Swedish design consultancy Claesson Kovisto Rune, Södra Pulp Labs and Innventia to come up with Parupu, a child’s chair made from DuraPulp + biodegradable plastic.

D. Universidad del Bío-Bío

The Composites Material Laboratory at the University of Bío-Bío in Chile works on the analysis, testing and technology development for the production of panel boards and adhesives. Several undergraduate industrial design students have been using this facility for their thesis projects. These include interior panels made from particle boards from underutilized South American bamboos; and modular playground equipment from extruded and pressed composites of pine wood flour and polypropylene (Wechsler, 2004). After these experiences the laboratory continued working with industrial designers, including a research project on developing door and window frames from wood plastic composites.

In spite of our best efforts, our search for a current university program that produces graduates with a combined specialization in both materials technology and product design has not been successful. What we found were an interdisciplinary postgraduate degree that offered a materials stream and mostly undergraduate design projects that involved intensive collaboration with technical research laboratories in university engineering departments or industrial technology research institutes. The cooperation between designers and engineers in these interdisciplinary endeavors has often been reported as being productive, horizon-broadening, and valuable. The unavailability of a combined degree in industrial design and materials, and the apparent demand for such as specialism or research area, presents an opportunity that creative and technical education institutions can tap into.

III. DESIGNER EFFORTS IN MATERIAL INNOVATION

There is a growing body of work among designers who are eager to contribute to new material development. Typical approaches include the creation of new composite materials for their product development; novel applications of existing materials; and modifying materials to obtain desired properties.

A. Philippe Starck

Probably the best known designer in the New Design style, Philippe Starck (www.starck.com) is an interior and product design graduate of the École Nissim de Camondo in Paris. His streamlined and organically styled products and furnishings are often produced with unusual combinations of materials, such as glass and stone, plush fabric and chrome. One of his material explorations resulted in the external housing of his 1994 Jim Nature Portable Television, manufactured by Thompson Consumer Electronics for Saba France. Molded from wood powder impregnated with formalin-free glues, the design proves that it is possible for a inferior and traditionally discarded materials to have a strong aesthetic appeal (Starck & Philippi, 2000).

B. Marc Harrison

Australian product designer Marc Harrison developed the material “Husque” (www.husque.com) from scrapped macadamia nut shells (Australia is the world’s biggest macadamia producer). After the nut kernels are removed, he mills the shells into fine particles, melds them with a polymer to form a Bakelite-like composite that is molded into bowls and trays. Each Husque item is hand finished by mirror polishing the colored glaze and hand rubbing with macadamia oil to a satin finish (Cochrane, 2007). Husque has been featured in many industrial design books, magazines and exhibitions around the world, and is sold in gift shops internationally.

C. Nick Rawcliffe

Armed with an MA in Industrial Design Engineering from the Royal College of Art, Nick Rawcliffe founded Raw Studio (www.rawstudio.co.uk) and started experimenting with artificial and natural resins, fibers and fillers for furniture. He created a coffee table from recycled coffee grounds cast with resin. This work has been featured in many design magazines.

D. Alberto Lievore

In 1993 Argentine architect Alberto Lievore designed a chair molded out of “Maderón” (www.maderon.com), a composite manufactured by the Spanish company Indartu from waste almond shells and natural resins. The material is wood-like yet plastic-like, waterproof, heat-resistant, and – as Spain is the second largest producer of almonds in the world – a logical and sustainable development.

E. Marcel Wanders

A product design graduate of the ArtEZ Institute of the Arts in Arnhem, Marcel Wanders (www.marcelwanders.com) is celebrated for fusing cutting-edge technology with his conceptual visions for quirky and witty products. An example of this is his 1996 Knotted Chair, which he produced for Droog Design, the influential Dutch design collective. This iconic chair is made of resin-stiffened carbon-fiber ropes executed in macramé; limited copies are now displayed in art museum collections around the world. This technique was replicated in the 2002 Crochet Table and the 2006 Crochet Chair, both made of hand crocheted cotton

flowers stitched together, formed over a mould and resin-hardened (Wanders *et al*, 2009).

F. Hella Jongerius

Having studied industrial design at the Design Academy Eindhoven, Hella Jongerius (www.jongeriuslab.com) has since combined elements of that discipline with those of traditional craftsmanship in products, textiles and ceramics. Many of her early designs were manufactured by Droog, such as her 1994 Soft Urn and 1996 Soft Washbowl. By using silicone and polyurethane in her vases and bathroom sinks, Jongerius has transformed objects that are traditionally hard and rigid into soft and pliable ones, thereby creating form from formlessness by simply exploiting the full potential of the material (Ramakers, 2004).

G. Emiliano Godoy

Based in Mexico City, Emiliano Godoy (www.godoylab.com) studied industrial design and furniture design at the Universidad Iberoamericana, Pratt Institute and Danish Design School. His furniture conveys the simultaneous sensitivity to material and acumen of craft. His 2004 Knit Chair and 2005 Piasa Room Divider blend FSC-certified aircraft plywood, cotton rope, and wax; there are no nails and the whole products can biodegrade at their end-of-life (Proctor, 2009).

H. Fernando + & Humberto Campana

The Campana Brothers (www.campanas.com.br) are perhaps Brazil's most renowned product designers. Fernando completed an architectural degree while Humberto originally studied law but began to design furniture later. Materials take center stage in the Campana Brothers' works: they playfully transform trivial items into decadent and opulent pieces. Their 2003 Sushi sofas and 2004 Harumaki chairs unpredictably transform strips of brightly colored felt, textiles and synthetics into concentric ring rolls and upholstered on a basic frame (Byars, 2006).

IV. CONCLUSIONS

Our research shows that there is an emerging cross-over between the worlds of industrial design and materials science. Indeed there is some evidence of interest from both camps showing a greater desire to collaborate with each other in new discoveries. More designers are becoming involved in material innovations and material technologists are seeing the value of working with the creative professions. Industry expositions, conferences, workshops and references also help in bridging the worlds of the creative with the technical.

It would be advantageous for us in industrial design education to acknowledge this crossover. While all industrial design degree programs already teach basic courses in material technologies, the increasing interest and engagement among practitioners in materials advancement can be hinting that this could be a potential area for specialization of our graduates. To cater for this trend it may be possible for

design education programs to either: offer laboratory-based electives on material experimentation and exploration; encourage design students to cross-enroll in courses in materials engineering departments; or support them in pursuing new material development in their final year thesis projects.

This paper is part of a larger interfaculty research undertaking at the University of New South Wales, where the thesis project of a PhD Industrial Design student is being jointly supervised by professors and lecturers in the School of Material Science and Engineering and in the Faculty of the Built Environment.

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